World Sustainability Series

Walter Leal Filho ·
Amanda Lange Salvia · Eric Pallant ·
Beth Choate · Kelly Pearce *Editors*

Educating the Sustainability Leaders of the Future

Springer

World Sustainability Series

Series Editor

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Due to its scope and nature, sustainable development is a matter which is very interdisciplinary, and draws from knowledge and inputs from the social sciences and environmental sciences on the one hand, but also from physical sciences and arts on the other. As such, there is a perceived need to foster integrative approaches, whereby the combination of inputs from various fields may contribute to a better understanding of what sustainability is, and means to people. But despite the need for and the relevance of integrative approaches towards sustainable development, there is a paucity of literature which address matters related to sustainability in an integrated way.

Notes on the quality assurance and peer review of this publication

Prior to publication, the works published in this book are initially assessed and reviewed by an in-house editor. If suitable for publication, manuscripts are sent for further review, which includes a combined effort by the editorial board and appointed subject experts, who provide independent peer-review. The feedback obtained in this way was communicated to authors, and with manuscripts checked upon return before finally accepted. The peer-reviewed nature of the books in the "World Sustainability Series" means that contributions to them have, over many years, been officially accepted for tenure and promotion purposes.

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Preface

If we want to achieve the goal of "Educating the Sustainability Leaders of the Future", we need to start now. This statement is the departing point of this book.

It contains a set of papers presented at the World Symposium on Sustainability in Higher Education (WSSD-U-2022) and has additional inputs which showcase some of the means via which educational opportunities may be created and capitalised upon, with a view to catering for a greater understanding about matters related to sustainable development, which may be used to the advantage of the future leaders: university students.

This book meets a perceived need for a publication on students' engagement on sustainability on the one hand, complemented by examples of initiatives, on the other, which may provide a basis for further works. The book also demonstrates various means via which sustainability messages may be communicated across universities and their audiences. It has the following features:

(a) It outlines some of the methods used in education for sustainability, both using conventional means and distance and online learning, as tools towards educating sustainability experts and leaders of the future.
(b) It describes some of the means which may be used to connect learners and stakeholders through classroom-based discussions about local sustainability concerns.
(c) It illustrates examples of how to use ESD experiences—both in classrooms and outside—to better relate with students.
(d) It showcases tested methods which may be deployed in order to cater for greater involvement of students on sustainability matters.

This book is structured into two parts.

The Part one (*Students' Learning Opportunities and Innovative Teaching Strategies*) presents a set of chapters that explore the connections between innovation and learning, with a strong focus on students' perspectives.

The Part two (*Leadership Through Operations, Engagement and Partnerships*) focuses on examples of the usefulness of leadership in connection with practical operations, also showing the key role played by partnerships.

We thank all authors for sharing their knowledge and their experience by means of their chapters and those colleagues who have contributed to it by assisting with the reviews.

Thanks to its design and the contributions by experts from various areas, this publication provides a welcome contribution to the literature on sustainability in higher education and may hopefully inspire further works in this field.

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Students' Learning Opportunities and Innovative Teaching Strategies

Health at the Margins: Exploration of an Academic Studio Approach to Design for Physical and Mental Resilience in a Sustainable Context

Robert Fryer

1 Introduction

1.1 Background

There are several dynamics underway that are converging to challenge how the US will care for its seniors. It is clear from evidence from existing care facilities and demographics that past approaches are not sustainable and do not work. Among the driving forces are an exploding senior population, the outsourcing of senior care, the high cost associated with this care, the poor conditions of care facilities, and the recent, rapid spread of the SARS-CoV-2 virus that disproportionately impacts senior populations.

Reports show that one-third of all pandemic deaths are either seniors in care facilities or their care providers (Yourish et al. 2020). Grabowski from Harvard states that the leading causes of transmission are the size of the facilities and the number of infected people in the broader neighborhood (Mendoza 2020; Abrams et al. 2020; Hearings before the United States Senate Special Committee on Aging, 116th Congress 2020). The researchers believe that transmission is first occurring from pre- or asymptomatic caregiver and/or visitor to senior.

The opportunity to socialize is a critical component of mental health, which diminishes with age through a lack of mobility and how those with age-related needs are separated from social networks. Furthermore, it is particularly nefarious how SARS-Cov-2 transmission renders socialization dangerous and potentially fatal. Urgent solutions are needed to protect against social isolation while protecting against a disease transmitted through face-to-face interaction.

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What was learned over the past decades could mitigate the spread of diseases like Covid-19 if it was applied in practice. Evidence has been mounting for characteristics and quality of care from room size and configuration, density, building forms, daylighting, to connections to nature both indoors and out. The conventional design developed in the 1970s focused too much on the efficient deployment of institutional care. Studies show that results improve when design simultaneously considers the individual as a whole person, and the care professionals' performance and health.

Sustainable education, research, and design approaches are presenting positive alternatives. However, these findings do not seem to be widely deployed and adopted in either new construction nor the renovation of existing buildings. This article reports on design research and education into these issues, and presents alternative designs. Perhaps more interesting are the areas of overlap between what is beneficial for senior care design and others areas of urgent design needs, specifically open spaces, a connection with nature, urban resilience, and sustainability. The process and work presented here are generated in multiple studios in a graduate program. The process and insight gained can impact the education and success of students as they graduate to be the leaders of tomorrow.

1.2 Social Dynamics

According to a multi-institutional report, "For the first time in history, and probably for the rest of human history, people age 65 and over will outnumber children under age 5" (National Institute on Aging, National Institutes of Health, US Department of Health and Human Services, & US Department of State 2007, p. 6), and the senior population will outnumber all children by 2035 for the first time in history (National Institute on Aging, National Institutes of Health, US Department of Health and Human Services, & US Department of State 2007; US Census Bureau 2018). As a result of such dynamics, the burden of cost for seniors will fall on fewer people while the costs are increasing. Seniors require care that is provided by and, for some, funded by younger demographics. This will require younger populations to pay more than previous generations to provide for others as they near the end of their life. Furthermore, the economic conditions for younger populations do not resemble previous generations' wage growth and living costs at their age as shown by higher levels of student debt, delayed marriage and starting of families, and lower rates of homeownership. It is uncertain if higher costs can be supported by a fewer number of already economically challenged citizens, despite the honorable social responsibility to do so.

Part of this can be explained by cultural shifts over the past century, where the family structure has shrunk over time, from extended, to nuclear, to single parent homes, and where women, the predominant caregivers at home, are choosing or are forced to enter the workforce. As a result, the skills required to care for older relatives are not learned as they once were, and more are, understandably, opting to outsource care. As more families seek care outside the home, access to social and

financial resources is required, which is influenced by socioeconomic forces. The middle class, unable to afford private care yet too wealthy to qualify for assistance, is severely impacted (Bookman and Kimbrel 2011).

As the number of primary caregivers declines, seniors will either find institutional care, or go without. Having no caregivers usually means social isolation. However, isolation can occur within institutional care, too. This creates a need for senior facilities that must be met rapidly.

2 Methodology

Student work was from multiple graduate-level studios, ranging from a 3 credit "mini-studio" with 3 weeks for the project, to thesis with two semesters. The design approach differs significantly differs from conventional studio education in three ways. First, this approach asks students to delay the impulse to start their design with concepts of making and form (a conventional approach) to instead start by undertaking research and follow the recommendations that result. Second, the research is analyzed through a systems thinking process, which can work across scales and conventional disciplinary boundaries to arrive at broader, systems-level analyses and conclusions. This often leads to unconventional solutions that challenge the traditional scope of the architectural domain. Finally, the design approach employs an adaptation of the integral framework in an effort to be more holistic by viewing the design analysis and proposal from multiple viewpoints.

2.1 Research

Students began by understanding the topic through extensive research. They compiled relevant sources and case studies to discover issues over time. Sources included government publications, scientific studies, industry periodicals, etc., and identified key drivers in demographics, published health studies, and evidence-based research regarding state-of-the-art design developments, such as technology and biophilia.

2.1.1 Demographics

Students investigated the relationship between age and size distributions of population classifications at a national scale. Seniors require care that is provided by and, for some, funded by younger demographics. In 1900, the number of people living beyond 85 years of age was approximately 100,000; by 2010 it was 5.5 million; by 2050 it is projected to be 19 million; and it is the fastest growing segment of the population (Institute of Aging 2016). Most senior care (approximately 65%) is

still provided inhouse by the younger members of the family, predominantly women (Institute of Aging 2016).

However, the decreasing rate of homecare has been projected to accelerate. Demographics showed an increase in the number of women in the workforce, and that the senior population will outnumber children by 2035 for the first time in history (National Institute on Aging 2016; US Census Bureau 2018). As a result, more families sought care outside the home, which required access to social and financial resources, which are influenced by socioeconomic forces. The middle class, unable to afford private care yet too wealthy to qualify for assistance, was severely impacted (Bookman and Kimbrel 2011).

According to AARP, 68% of Americans expect to rely on family to provide care (Redfoot et al. 2016). However, given population dynamics, this may not be possible. In fact, this "care gap" is growing. In 2010, there was a family caregiver to senior ratio of 7:1; by 2030, this is projected to be 4:1; by 2050, 3:1 (Redfoot et al. 2016). As the number of primary caregivers declines, seniors will either find institutional care, or go without. Having no caregivers usually means social isolation. However, isolation can occur within institutional care, too.

From this research, students learned about the complex system dynamics of socioeconomics, population change, and caregivers, which created the foundation of a learning scaffold. This information was initially compiled in a point-based outline, and later developed into text.

2.1.2 Understanding the Context of Health

The next layer to the learning scaffold was understanding the context of senior health and its key drivers. Students decided to work with three main research areas: isolation, dementia and biorhythms.

Isolation

Approximately 28% of the 65 + population lived alone in 2010, the majority of which were women (West et al. 2014). Living alone often leads to social isolation, which studies show have negative health consequences. The death of friends and spouses, retirement, moving, and lack of mobility, all contribute to diminished rates of social contact. Humans have evolved to be social, meaning-making creatures, therefore without social contact, mortality risks, obesity, type 2 diabetes, depression and dementia all increase (Cacioppo and Hawkley 2009). Isolation also increases vulnerability to abuse, physical and financial, and LGBT seniors are twice as likely to live alone due to a lack of community support and the tendency to have fewer children (SAGE 2018).

Dementia

The most common cause (60–80%) of dementia is Alzheimer's Disease, which includes memory loss and other cognitive decline (Alzheimer's Association n.d. a). Estimates state that in 2017 5.5 million Americans were living with it; by 2050,

that number is projected to increase to16 million (Alzheimer's Association n.d. b). Among the symptoms, Alzheimer's Disease presents itself as having more-than-age-appropriate difficulty with daily tasks, wayfinding, time and place confusion, difficulty with spatial relationships, and a withdrawal from social activity (Alzheimer's Association n.d. c). Supervision of those with dementia includes limiting their independence and mobility as a protection, however, this negatively impacts one's dignity, confidence, and quality of life, reinforcing the decline of cognitive and physical well-being.

Daylighting and Circadian Rhythms

Risk of dementia can be increased by poor lighting. Biorhythms required for mental and physical health, such as circadian rhythms, depend on being synced with the solar rhythm. When access to daylight is prevented, or artificial lighting does not simulate natural daylighting variability, sleep and mental cognition is impaired (Lighting Research Center at the Rensselaer Polytechnic Institute n.d.). Studies show ambient lighting levels of 2,500 lx during daylight hours in common spaces results in significant improvement in sleep (Calkins 2009), and improving lighting in dining rooms improves food intake (Brush and Calkins 2008).

The students began to connect the dots between these issues and the built environment. The architectural elements of spatial relationships, defining time and place, functional requirements of tasks and circulation, and social spaces were seen as operational in senior health issues. Students wondered how best to define beneficial spatial configurations, and if any research could propose antidotes to health concerns. They also posed the question: could design be re-envisioned to engender well-being, rather than respond to symptoms? This became another layer in their scaffold where they dug further into the built environment research to unearth past, present and future solutions.

2.1.3 Evidence-Based Research

Students found a strong and evolving body of evidence-based research investigating the therapeutic capacity of the built environment. They studied the context of research over time to find published recommendations. The findings were used as opportunities for critical discourse, analysis, and ultimately were applied to their projects. The findings presented in this paper relate to the issues outlined above (isolation, dementia, daylighting and biological impacts) and were explored through multiple scales: from neighborhood, to site (landscape and building relationship), to building (building form, unit size and configuration), and interiors (unit layout).

Senior care design has evolved over time. Students uncovered that originally facilities were designed to provide care based on the efficiency of caregiver performance. The nurse station was a dominant feature, and there were usually 60 "patient" units, within easy reach, organized along monotonous, double-sided corridors. The aesthetic was institutional. This began to change in the late 1970s with the Weiss Pavilion in Philadelphia, informed by the groundbreaking work of Dr. M. Powell

Lawton, who is regarded as a research pioneer into the built environment and dementia. He outlined 5 principles which came to be the foundation of therapeutic goals for such facilities: orientation, negotiability, personalization, social interaction, and safety (Calkins 2003). Their translation into design has since been advanced by further research in lighting and the impact of biophilia.

Students also investigated building forms, and found that, traditionally, they were H, L or T shaped to provide centralized, efficient care (Hiatt 1991). Since then, unconventional formal experiments confirmed simple forms, such as L and T (notably not H) work best for wayfinding. However, these forms can also lead to monotonous corridors that disorient residents. Other research suggests that these building forms, if used in conjunction with varied configurations such as clusters, open spaces and combinations of the two, lead to increased independence, confidence, and social interaction. Studies using the function social density metric (social space area per number of residents) show facilities with higher function social density correlate with increased social activity (Calkins 2009). Students discovered the development of such varied configurations create opportunities for outdoor views, which greatly enhance wayfinding and provide daylight and lighting variability, which have demonstrated mental and physical well-being benefits, and are among the 14 patterns of biophilic design (Browning et al. 2014).

Biophilic design and its effects have become more popular, stretching from traditional Japanese *shinrin-yoku* ("forest bathing") (Ohtsuka et al. 1998) to the development of therapeutic gardens. Health research confirmed there is a beneficial biological response to nature (Kellert et al. 2008; Browning et al. 2014) while surveys of senior care residents showed gardens are a desired feature that impacts psychology (Kearney and Winterbottom 2008). People want to be near nature because it is soothing, alive, meaningful, and helps them sleep better. Students realized that varied configurations, which mark a break from the traditional layout of monotonous corridors and easy to reach units, can actually improve caregiver performance, as wll, by introducing biophilic elements that are shown to improve productivity, and alleviate symptoms of stress and illness. Outdoor access, whether direct or not, became a central issue for students through their analyses. They confirmed that connections with nature are essential to successful senior living facilities.

Students also concluded, based on research, that private rooms should be offered as much as possible (acknowledging equity limits to this proposition), and should be customizable through furniture, art, plants, etc. A general theme that emerged from studies was the need to create home-like atmospheres. Students argued that senior facilities are obligated to be places of therapeutic value, respite, safety, and comfort, but that they are also places to reside, eat, have fun, and find meaning, including opportunities for activity and exploration. The students explored the notion of "home" across scales via a study of Hogeweyk (Dementia Village Associates n.d.; Niek Roozen BV Landscape n.d.), a dementia care village, which expanded the experiences of dignity, independence, freedom and mobility from the level of the room and applied them at the scale of a small village. Residents of Hogeweyk are able to walk outdoor corridors ("streets") lined with stores and cafes to grocery shop

and relax. However, there is only one entrance to the village that is secured, so no resident can wander offsite.

At this point, students concluded, in agreement with much of the research findings, that senior facilities as currently executed are not widely incorporating the latest research. They argued for architects and related professionals to do more.

2.2 Design Approach

2.2.1 Framework

The studio explored a new design framework informed by Integral Theory (Wilber 2005), but adapted to accommodate a more comprehensive design process. Although the components (site inventory, site analysis, design) were not new, the adaptation used the four quadrants of Integral Theory to attempt a more holistic process, an innovation compared to traditional studios. The quadrants are based on the psychological imperative of addressing the whole person for well-being, and were adapted by DeKay (2011) to design, and the studio further adapted them to facilitate a design process that addressed the whole project: subjective, personal experiences; subjective, collective culture; objective measurements of performance; and objective observations of nested systems that impact the project. This can be applied at all scales (individual to global), and cross-scalar drivers and relationships can be identified and addressed through design. The use of a more holistic process, i.e. seeing the project through four unique lenses at multiple scales, opens the possibility to include more dynamics and information, and thus miss or ignore fewer key drivers, approaching a more truly sustainable outcome by eliminating externalities. For example, students designed health-related policy in addition to the site/building design.

2.2.2 Site Research

Students identified potential sites, and the selections varied from adaptive reuse to brownfield sites. These sites were inventoried to capture experiences (beauty, views, feelings); performance (sun path, winds, climate and microclimate); culture (demographics, livability index, public art, etc.); and systems (transportation, stormwater, power, waste, etc.) (Fig. 1).

Students then created guiding principles to help make design recommendations, establish goals, and propose strategies. Example guiding principles are: A safe, comfortable, and healing built environment will enhance the quality of life for the residents (Experience); An energy efficient built environment promotes the well-being and performance of the staff (Performance); Seeing patients and caregivers as one community promotes inclusiveness, interaction, and support (Culture); Respecting planetary boundaries, biodiversity, and striving for zero emissions will add resilience

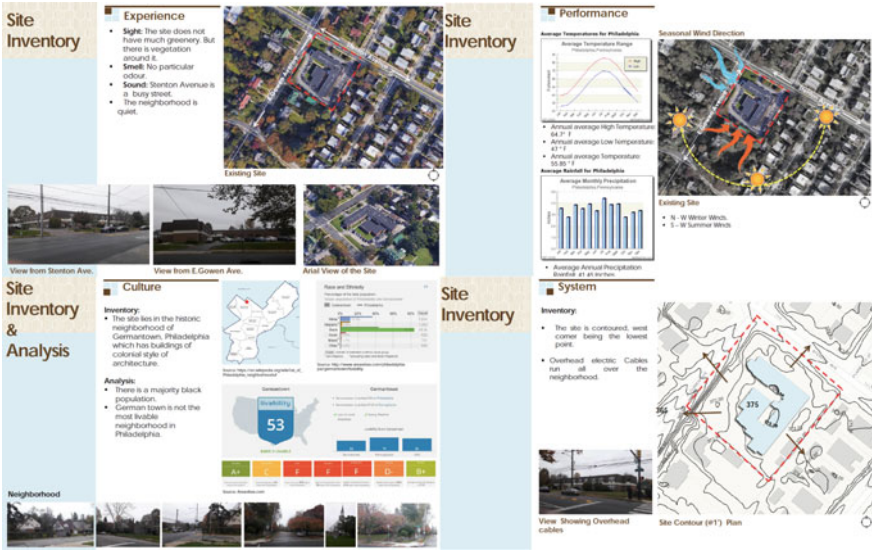

Fig. 1 Site inventory of a project with an existing building to be renovated and reused

(Systems). One student argued for more stakeholder equity in the design process, and held a charrette at a local senior facility to include the residents.

During site analysis, students reflect on their inventory to identify opportunities, challenges and recommendations consistent with their guiding principles. This began their goals and strategies development. Example are: Provide indoor and outdoor spaces that encourage physical and social activity by limiting corridor lengths; include multiple, smaller lounge spaces for interaction; design a walking route outdoors through a therapeutic garden (Experience). Perform better than the EnergyStar EUI for senior care communities benchmark by enhancing daylight, building envelope and natural ventilation (Performance); all social spaces must be 100% ADA accessible (Culture); meet LEED v4 water benchmarks via greywater reuse, low flow fixtures, and raingardens (Systems).

2.2.3 Design Development

Form and Aesthetics

In conducting the design research, opportunities were explored to accommodate the insights from the students' research regarding builing form. Such opportunities are limited, however, when working with renovations to existing buildings and zoning demands, such as FAR requirements and height restrictions. In one case (Fig. 2), however, there was an opportunity to enhance the existing L-shaped form of a building by removing a block (shown by dashed yellow lines) and relocating its program as a

Fig. 2 Site location of one of the study projects with an existing senior care facility. **a** After careful study, the area in the yellow-dashed box was relocated on top of the of the red-dashed L building form, thus following evidence-based recommendations for building forms of senior care facilities; **b** shows an aerial image from the southeast. Removing the block increased solar passive heating and daylighting for the building

third floor on top of the existing 2-story form (shown by dashed red lines). Detailed programming analysis (Fig. 3) led to a reconfiguration of spaces, and also created the opportunity to alter the aesthetics of the building to better fit with its surrounding neighborhood context, which is marked by traditional residential architecture, gabled roofs and dormers.

Although the aesthetics of the final design of the research study (Fig. 4) may not appear to be "innovative", this was not the goal of the research. Instead, the goal was to meet evidenced-based care needs while becoming a visual member of its surrounding community, and to resist the more ego-based formal and aesthetic expressions of designers, or as Roaf put it, "the architectural fantasy that [architects'] main professional contribution to society is in sculptural art" (Roaf 2020, para. 2). This also helped to reinforce the home-like feel, and replace the mid-century institutional aesthetic of the existing structure, both of which are shown to improve care outcomes.

The design study analyzed the floor plans to propose solutions to monotonous corridors by adding social spaces, such as lounges and game/activity areas on each floor. All have the potential to accommodate social distancing requirements to prevent the spread of SARS-CoV-2, when required (Fig. 5). By making the decision to remove the block and relocate the programming spaces to a new third floor, the newly created outdoor space provided the opportunity to increase the functional social density and

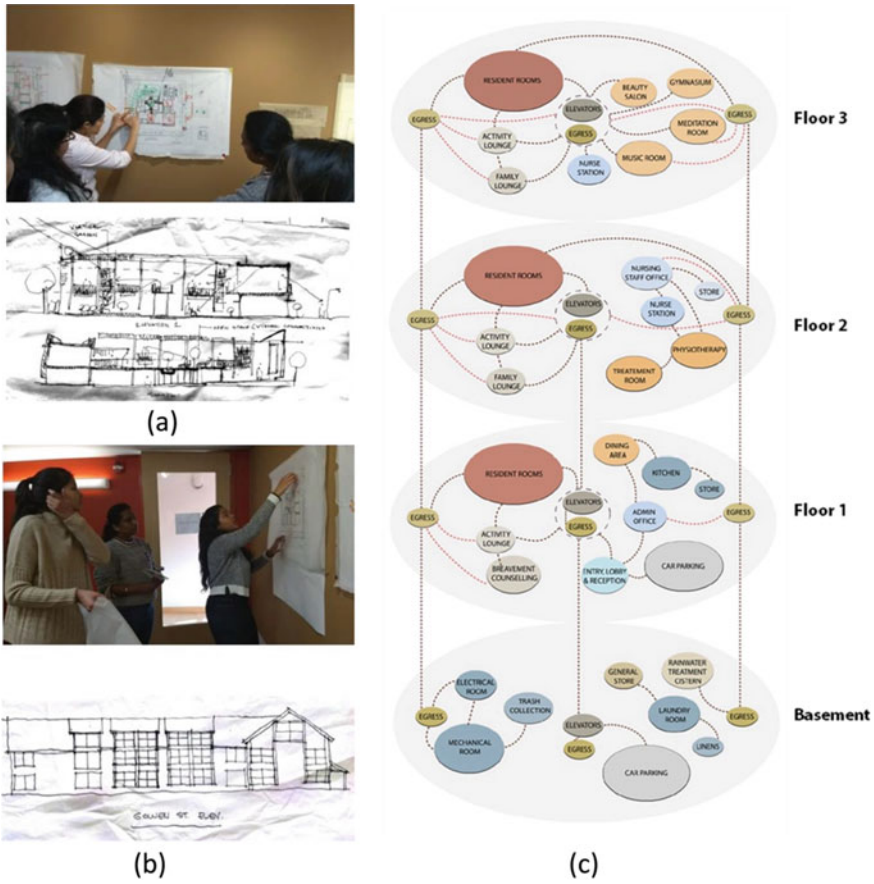

Fig. 3 Design renovation process of program, plan, and elevations. **a** Shows plan revision sketches; **b** shows the development of the elevations to match the local context; **c** shows the revised program by floor to relocate the existing programming formerly in the demolished box

achieve multiple biophilic design objectives, such as a visual connection to nature, presence of water, dynamic and diffuse light, complexity and order, prospect, and refuge.

Another essential element of the formal and programmatic revisions was to consider the residents' care and the care professional's performance and health simultaneously. The change in form and layout provides caregivers with direct access to and views of nature, sunlight, and gardens, which are shown to reduce their levels of anxiety and depression, while improving job satisfaction, productivity, and creativity (Browning et al. 2012). Furthermore, other amenities were added to support caregivers, such as bike racks and showers.

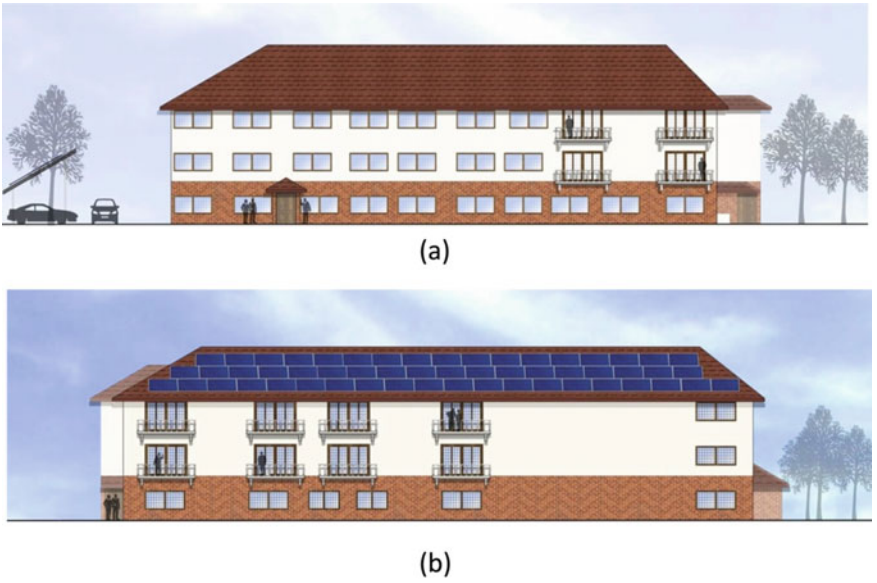

Fig. 4 Revised elevations to match local architectural style and to fit better with the neighborhood. **a** Shows hipped roofs, added balconies, new windows, and brick and stucco façade; **b** shows the southwest elevation with solar panels on the roof

Room Size and Density

The existing building of the design study offered mostly double occupancy rooms, and these did not meet the minimum rooms dimensions of the 2017 National Center for Assisted Living Guidelines (NCAL), nor did they meet minimum dimensions of the Americans with Disabilities Act (ADA). The NCAL requires a minimum of 300 ft^2 for doubles and 225 ft^2 for singles, and the existing rooms provided 192 ft^2 for the doubles, thus not even meeting the guidelines for single occupancy rooms. As a result, the rooms were reconfigured to provide mostly single occupancy rooms (ranging between 260–300 ft^2), with double occupancy rooms provided for couples (ranging between 405 and 562 ft^2), and all ADA requirements were met (Fig. 6). Private rooms and home-like atmospheres also support caregivers because these result in fewer roommate disputes, a very common and stressful dynamic.

All rooms were provided with multiple operable windows for several reasons. First, natural ventilation is essential for fresh air, and this is discussed more later. Second, they provide access to sun and the natural daylighting of spaces. Both of these also support reduced fuel consumption, greenhouse gas (GHG) emissions, and add resiliency to the design. Finally, they provide multiple biophilic design characteristics thus supporting health and well-being.

Senior facilities are to be places of therapeutic value, respite, safety, and comfort, but they are also places to reside, eat, have fun, and find meaning, including opportunities for activity and exploration. While private rooms are meant as places of respite

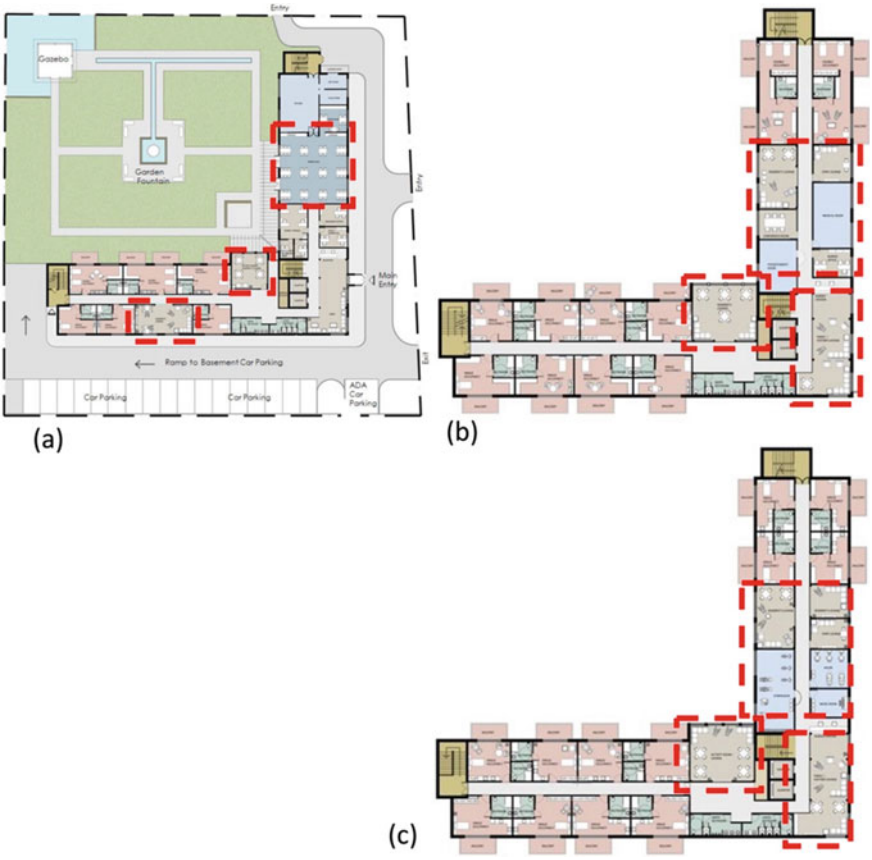

Fig. 5 Floor plans indicating new interior social spaces in red-dashed areas. These were designed as solutions to the existing monotonous corridors, and were replaced with added lounges, game/activity areas, and dining. Each of the spaces can accommodate social distancing requirements. **a** Ground floor; **b** second floor; **c** third floor

and relaxation, isolation is addressed through community gathering spaces. Because of Covid-19, gathering spaces need to be smaller, limiting the number of residents to prevent transmission, and the CDC and others recommended limiting the number of visitors (Centers for Disease Control and Prevention 2020). However, outdoor spaces can be activated as social spaces and can be used for visiting purposes, thus expanding the opportunity for increased social engagement. Outdoor spaces provide multiple benefits, such as promoting mobility, exercise, and a connection to nature and natural systems in spaces where the potential for transmission of SARS-Cov-2 is greatly reduced. This is discussed more later.

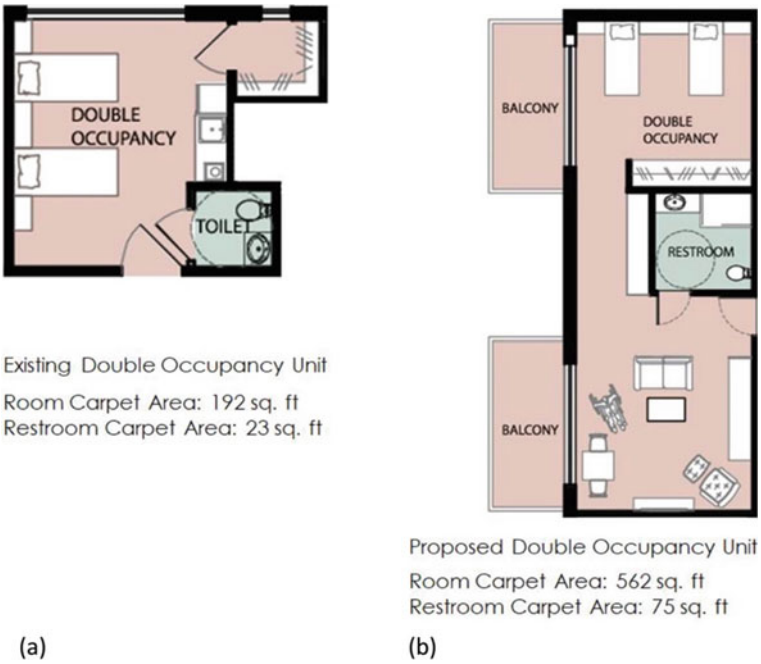

Fig. 6 Before and after redesigned room plans. **a** Existing plan and areas; **b** Revised to meet NCAL, ADA and Covid-19 requirements

Daylighting

To support biorhythms, it essential to provide abundant and appropriate levels of daylighting. Simulations were used to evaluate daylighting performance (IESVE version 2018; Radiance 1998) and energy consumption (Sefaira 2018). For daylighting, simulations were run multiple times per day of the solstices (Fig. 7). Results were compared against targets recommended by the Illuminating Engineering Society (IES) and in senior health studies (Calkins, 2009), and used to refine the design.

Design targets set for daylighting attempted to reach them without artificial lighting. These targets recommend 300–600 lx for private rooms, and up to 2,500 lx ambient lighting in common spaces. Limitations were the orientation and building forms of existing structures, and the need for multiple floors in buildings with deep plans, which must rely on roof access for daylight penetration near the center of the floor plans. Results showed that most rooms, if moved to the edges of floor plans, could meet the targets, and even require glare control for some period of the year. The targets for common spaces were more difficult to reach, and were highly dependent on number of floors and building form of existing buildings. If designing new buildings, building forms should include thinner floor plates to provide access to lighting

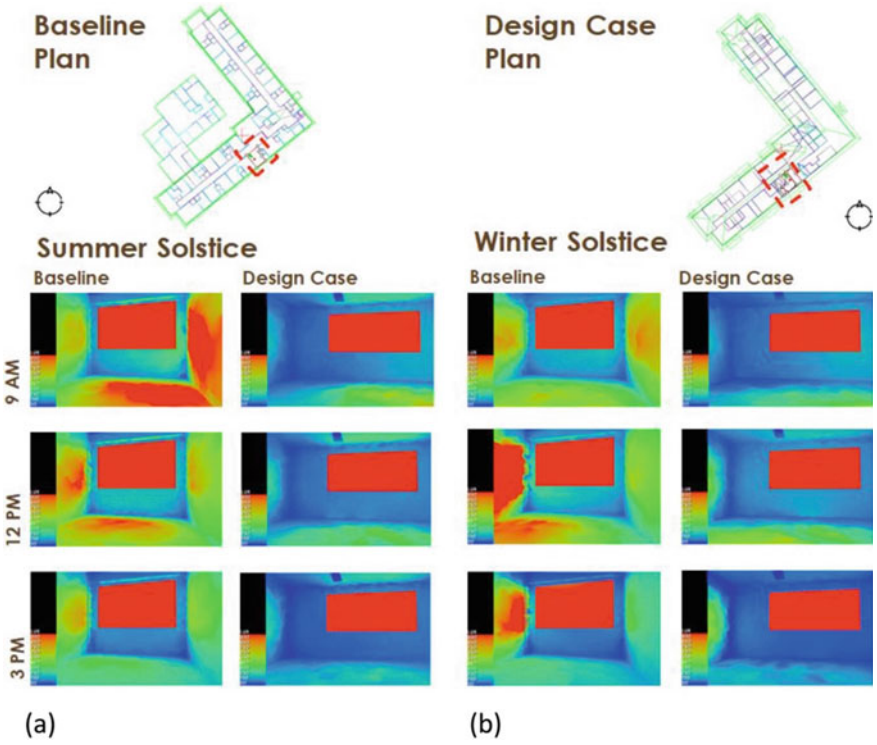

Fig. 7 Daylighting simulations comparing the existing and proposed room changes. **a** Summer solstice; **b** winter solstice

and natural ventilation through wall openings or incorporate daylight access through the roof near the center of deep floor plans.

HVAC Systems and Energy

Thermal comfort is a central concern for older populations as the body's metabolism slows with age. Furthermore, being an airborne virus, SARS-CoV-2 requires higher ventilation rates (use of a direct outdoor air supply (DOAS) system) with higher performance air filtration than standard recommendations (MERV-13 or higher) to help combat its ability to spread. Depending on the climate, thermal comfort and ventilation can be met passively through operable windows for a portion of the year, and operable windows and balcony doors were provided for this reason. Furthermore, the use of operable windows and doors is highly effective in reducing the spread of the coronavirus by reducing the density of any aerosolized viral load that may be present. However, when the climate is outside of the comfort zone, thermal comfort must be met by mechanical systems, which also drive energy consumption, and depending on the energy source used, could also increase CO_2 and other GHG emissions.

For energy consumption, the energy use intensity (EUI) was simulated to establish a baseline for a DOAS system (268 KBTU/sf/yr), then simulations were performed in series to isolate and evaluate specific alterations to the building, such as windows and insulation (Fig. 8), geoexchange (Fig. 9), and finally the use of solar panels. EUI results were compared against benchmarks, such as EnergyStar values for senior care centers, enabling designs to be situated among case studies.

Net zero energy is difficult to achieve. However, the use of energy efficiency methods, such as high R-value insulation in walls and roofs, carefully selected windows, geoexchange DOAS HVAC, and onsite energy can decrease offsite energy demand significantly (down to 55 KBTU/sf/yr for one project), and reduce energy consumption in some cases by half compared to EnergyStar benchmarks (125.5 KBTU/sf/yr) (Energy Star Portfolio Manager 2021).

Social Spaces: Interior and Exterior

As mentioned before, spaces with higher functional social density increase social activity. The architectural tools available to increase the functional social density are indoor and outdoor spaces that are made easier to create with specific formal adaptations to traditional T and L building forms, such as clusters and open spaces.

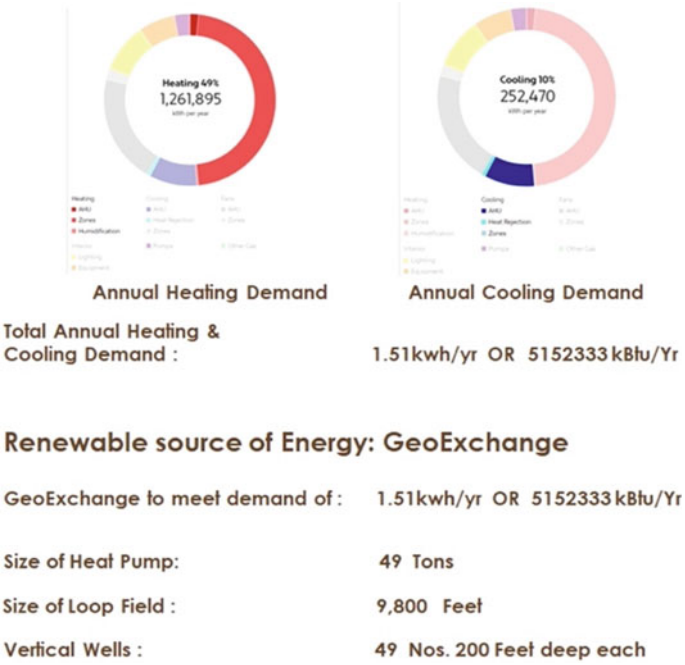

Fig. 8 EUI simulations showing impacts on DOAS system after changing R-values in the walls and roof. At this stage of design, the EUI was reduced from 268 to 196 KBTU/sf/yr. Additional changes (geoexchange and solar panels) and simulations eventually reduced the EUI for this project to 55 KBTU/sf/yr

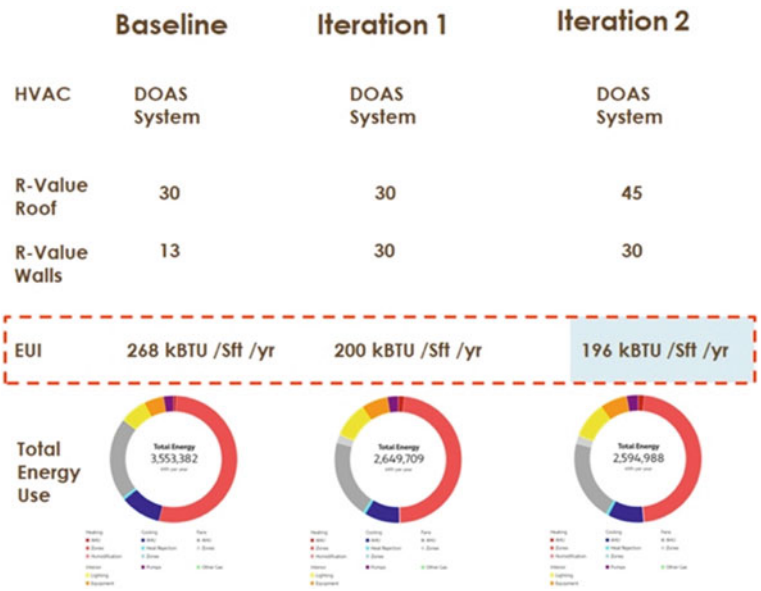

Fig. 9 Simulations showing the impact of a geoexchange system on energy consumption

Furthermore, limitations on the number of visitors are based on the number available spaces for gathering and the area of these spaces to meet social distancing requirements, in essence limiting the functional social density. However, outdoor spaces are permitted for visitation, and can thus be used to expand the number of allowable visitors. Furthermore, spending time outdoors is correlated with lower risk for spreading SARS-CoV-2 and an improved immune system response to Covid-19 because of Vitamin D3 activation, and there are additional wellness benefits to being in nature and gardening (McIntosh 2020).

Designs were developed with these approaches, referring to case studies for guidance. For example, to incorporate biophilic outdoors spaces with wayfinding view corridors from inside, naturalistic compositions were proposed that also promote healing, so garden designs of Gertrude Jekyll were explored and the American Horticultural Therapy Association's (AHTA) therapeutic garden characteristics were applied (Fig. 10) (Hazen 1995). Jekyll's famous garden designs featured a combination of rigid and organic elements that provided a hidden organization over time as the vegetal composition matured. Her designs were known for water features and the layering of vegetation that was carefully chosen for rich colors and textures and different flowering seasons so the gardens could be enjoyed throughout the year. The study's design used Jekyll's approach as inspiration, including a central water fountain, native species for different seasons, and varying paths to encourage activity for the residents and visitors, which supported the AHTA's recommendations. Garden benches are also provided under shade for relaxing. The gazebo also has seating where residents can enjoy the still water of the pond, which is strategically located

at the lowest elevation of the site where it can double as a stormwater collection element. Spaces, such as the pergola, are also provided for outdoor group activities like yoga or occupational therapy sessions.

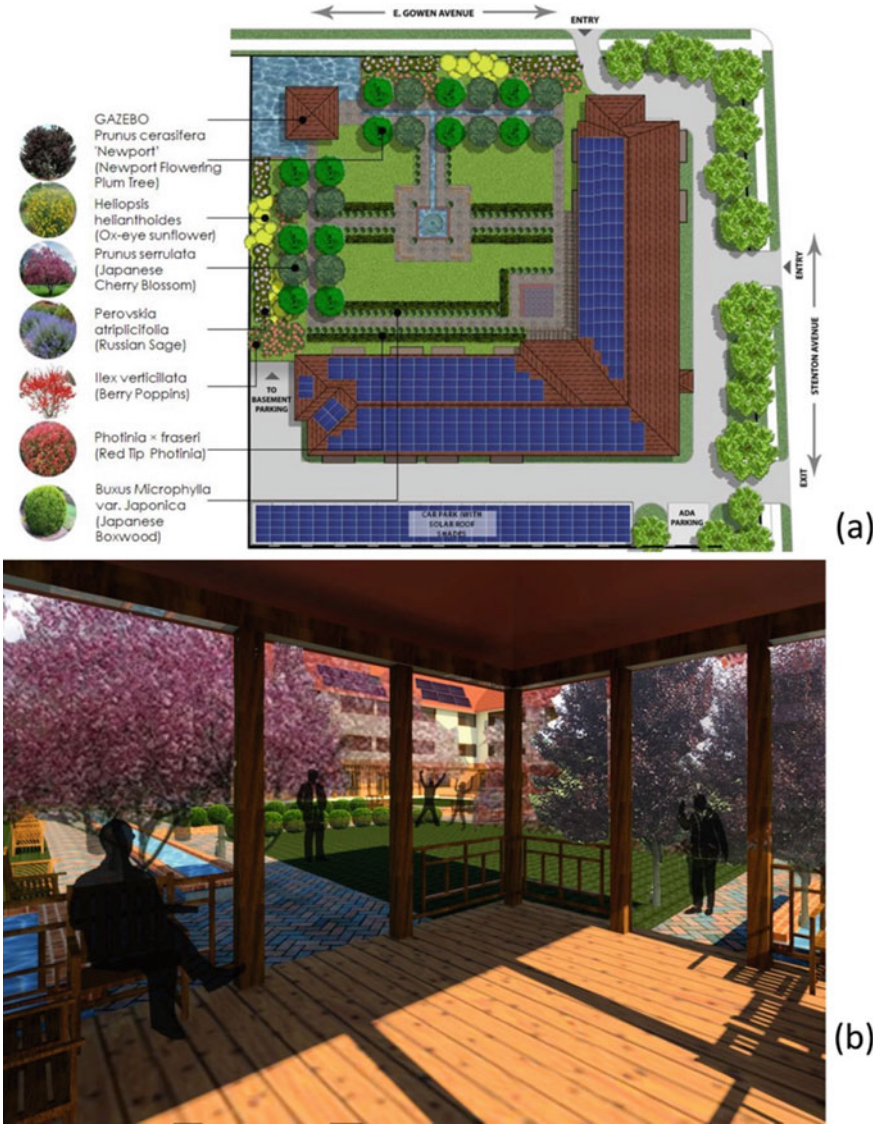

Fig. 10 The proposed site plan redesign, including the new outdoor social spaces and natural vegetation species. The design proposal was informed by the work of Gertrude Jekyll and the AHTA's therapeutic garden recommendations. **a** Shows the site plan and native species; **b** shows a perspective from the pavilion looking towards the building

These outdoor spaces not only help against the coronavirus and social isolation, but they also help provide the needed lux levels of natural daylight to support natural biorhythms. Furthermore, these spaces add needed ecosystems services by the provision of biodiversity to an urban setting which has multiple benefits: reduce the Urban Heat Island Effect, attract declining birds and bees, and remove some pollutants from the local air.

In addition to outdoor spaces, several research projects explored the development of indoor spaces as biophilic gathering rooms. These designs sought to bring the outdoors in by providing views to outside, but also by deploying facsimiles of nature. Among the 14 Patterns of Biophilic Design are Natural Analogues, such as biomorphic forms and patterns, material connection with nature, and complexity and order. These translated into features such as the use of wood, stone on floors and walls; the use of color pallets that are found in nature, including greens, blues, and browns; organic shapes of indoor gardens and the use of indoor vegetation; and lighting that uses organic forms and LED technology that can illuminate sky formations complete with changing light levels and sky colors that match what's happening outdoors throughout the day (Fig. 11).

3 Conclusion

The innovative design approach used in the studios led to more comprehensive design solutions, including proposals that lie beyond the scope of the traditional design education and profession. The students were able to connect dots for themselves through a process of conceptual scaffolding that encouraged them to connect dots between pieces of research, to discover insights that lead them to conclusions, and to ultimately argue for and propose alternatives to the norm based on informed research. They ultimately concluded that architects and professionals have an ethical obligation to do more for seniors and the environment. It is precisely this kind of approach that design education requires to develop leaders of tomorrow. The following conclusions are distilled from the student research.

3.1 Student Conclusions

The design investigations attempted to answer the stated research questions, and were able to define some spatial configurations that could alleviate senior health concerns, but they were also able to speak to the potential for design to engender well-being, and envision senior care centers as life-supporting homes, rather than institutions for the end of life. Below are potential generalized solutions to be adopted in academic studios that are supported from the investigations.

At the individual scale, the notion of resilience is personal as it relates to an individual's physical and psychological states. Supporting mental, physical and

Fig. 11 Multiple explorations into the biophilic design of health care spaces. **a** Shows a corridor using organic forms, natural daylighting, natural materials, vegetation of views to achieve many of the 14 patterns of biophilia; **b** shows a lobby of senior care center in a proposed biophilic renovation to a warehouse; **c** shows a greeting and waiting area with natural floor material in organically shaped patterns and matching light shades, and abundant natural daylight

social activity is essential and achieved through intentionally inducing mobility and autonomy via activities through the design of the building to include:

- Indoor activity spaces a short distance from resident rooms that are large enough to remain useful during times of required social distancing. Planning space sizes should consider 36 ft.^{2} (6 ft. $\times$ 6 ft.) distancing from early in the design or redesign process.
- Attractive and enticing outdoor spaces that are able to act as social visitation and exercise spaces. Of course, during the current pandemic, such spaces need to accommodate visitors at a distance and provide abundant access to sunlight and fresh air.

- Interior spaces need to be as full of life as the outdoors, so biophilic design principles are very useful to bring the outdoors in.
- It is essential to design the outdoor spaces with as much care and programming as the interior
- Consider making single occupancy rooms the norm, and allow or double occupancies for couples. This is beneficial for the residents, especially during pandemics, and also for the caregivers, as it reduces the number of altercations.
- Provide operable windows, and if possible, balconies for mental and physical well-being, including biorhythms
- Permit high levels of room customization, including colors, furniture, plants, etc.

Resilience also relates to the building/site scale, as it is intended that the care center and its grounds are able to withstand shocks in the form of extreme weather events and power fluctuations. In order to achieve this the building must be energy efficient and enable appropriate levels of daylighting and fresh air to support biorhythms and decrease the density of any aerosolized coronavirus that may be present.

- Use L or T building forms for new designs, and if possible, when renovating
- Design the building for a high level of visual and circulatory connection with the outdoors for health (biophilia) and building performance (daylighting, natural ventilation) for both the residents and the caregivers
- Include amenities for the caregivers whenever possible, especially those that are biophilic
- Incorporate biophilic design in the design of interiors, including artificial light techniques to reach the required high levels of lux required to support biorhythms, especially in common spaces
- Use high performance building envelopes
- Locate resident rooms at the periphery of the building with operable windows and doors to a balcony (if possible)
- Meet human comfort requirements as much as climate will allow through passive techniques, such as natural ventilation provided through the windows and doors
- Otherwise, use HVAC system with high performance filters and a DOAS system
- Decrease energy consumption using these techniques to add resilience and sustainability
- Become more resilient by maximizing renewable energy provided onsite (e.g. via solar arrays)
- Finally, add resilience via the landscape design to sustain biodiversity and stormwater surges from extreme weather events

3.2 Studio Reflections

Student work was from multiple graduate-level studios, ranging from a 3 credit "mini-studio" with 3 weeks for the project, to thesis with two semesters. This demonstrates that the topic and design approach can be outside of the traditional studio course.

However, students can find the approach difficult because it significantly differs from previous education. Students are initially driven by concepts of making and form, while this approach asks them to delay this impulse to first complete research and follow the recommendations that result. But, the design proposals are more comprehensive and holistic. Some students state the process and their proposals are more meaningful and satisfying.

Furthermore, the topics were self-proposed by the students, and not prescribed by the faculty. This is important because the work was completed by intrinsic motivation and personal concern for the topic, which increased the level of curiosity and motivation.

Students were in search of a more resilient built environment for seniors. The built environment was made more resilient by selecting sites near amenities, such as bus stops, and by attempting to have the buildings rely on onsite energy generation only. It's important to note that students learned the limits to what is typically a high-energy-demand program. Steps towards enhancing user resilience relied on providing social interaction, physical activity, proper lighting and views to nature and other biophilic design elements.

In planning for future senior care studios, more time should be devoted to design development. The research is essential to this topic, was well-consolidated and understood by students, and was engaging. But, the course suffered from research creep, where student drive and interest ultimately decreased the opportunity to design a solution to the question they posed, "could design be re-envisioned to engender well-being, rather than respond to symptoms?" The solutions and application require more time to sufficiently address the topic to find innovative solutions to this urgent societal need.

References

Abrams HR, Loomer L, Gandhi A, Grabowski DC (2020) Characteristics of U.S. nursing homes with COVID-19 cases. J Am Geriatrics Soc 68(8):1653–1656. https://doi.org/10.1111/jgs.16661

Alzheimer's Association (n.d.-a) What is Alzheimer's disease? https://www.alz.org/alzheimers-dementia/what-is-alzheimers

Alzheimer's Association (n.d. b) 10 early signs and symptoms of Alzheimer's. https://www.alz.org/alzheimers-dementia/10_signs

Alzheimer's Association (n.d. c) Facts and figures. https://www.alz.org/alzheimers-dementia/facts-figures

American Senior Communities (2016). Assisted living statistics and facts|ASC blog. https://www.asccare.com/assisted-living-statistics-a-deeper-dive-into-the-demographics/

Bookman A, Kimbrel D (2011) Families and elder care in the twenty-first century. Future Child 21(2):117–140. https://doi.org/10.1353/foc.2011.0018

Browning W, Kallianpurkaran N, Ryan C, Labruto L (2012) The economics of biophilia. Terrapin Bright Green. Retrieved from https://www.terrapinbrightgreen.com/report/economics-of-biophilia/

Browning W, Ryan C, Clancy J (2014) 14 patterns of biophilic design: improving health & well-being in the built environment. Terrapin Bright Green. https://www.terrapinbrightgreen.com/reports/14-patterns/

Brush JA, Calkins MP (2008) Enhancing mealtimes in group dining rooms. Environmental interventions and dementia. The ASHA Leader 13(8):24–25. https://doi.org/10.1044/leader.ftr4.13082008.24
Cacioppo JT, Hawkley LC (2009) Perceived social isolation and cognition. Trends Cogn Sci 13(10):447–454. https://doi.org/10.1016/j.tics.2009.06.005
Calkins MP (2003) Powell Lawton's contributions to long-term care settings. J Hous Elder 17(1–2):67–84. https://doi.org/10.1300/j081v17n01_06
Calkins MP (2009) Evidence-based long term care design. Neuro Rehabilitation 25(3):145–154. https://doi.org/10.3233/nre-2009-0512
Centers for disease control and prevention. (2020). Considerations for preventing spread of COVID-19 in assisted living facilities. https://www.cdc.gov/coronavirus/2019-ncov/hcp/assisted-living.html
DeKay M (2011) Integral sustainable design: transformative perspectives. In: Bennet S (ed) 1st edn. Routledge, New York, New York
Dementia Village Associates. (n.d.) The Hogeweyk Dementia Village—care concept. The Hogeweyk Dementia Village. https://hogeweyk.dementiavillage.com
Energy Star Portfolio Manager (2021) U.S. energy use intensity by property type. Portfoliomanager.Energystar.Gov. https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf
Hazen T (1995) Therapeutic garden characteristics. Quart Publ Am Horticult Therapy Assoc 41(2):3. https://www.ahta.org/assets/docs/therapeuticgardencharacteristics_ahtareprintpermission.pdf
Hearings before the United States Senate Special Committee on Aging, 116th Congress (Testimony of R. Tamara Konetzka) (2020) Caring for seniors amid the Covid-19 crisis
Hiatt L (1991) Nursing home renovation: designed for reform. Butterworth-Heinemann, Burlington, Massachusetts
IESVE (2018) Version 2018. https://www.iesve.com
Institute of Aging (2016) Read how IOA views aging in America. https://www.ioaging.org/aging-in-america
Kearney AR, Winterbottom D (2008) Nearby nature and long-term care facility residents. J Hous Elder 19(3–4):7–28. https://doi.org/10.1300/j081v19n03_02
Kellert SR, Heerwagen J, Mador M (2008) Biophilic design: the theory, science and practice of bringing buildings to life, 1st edn. Wiley, Hoboken, New Jersey
Lighting Research Center at the Rensselaer Polytechnic Institute (n.d.) Light and health. Retrieved from https://www.lrc.rpi.edu/programs/lightHealth/index.asp
McIntosh R (2020) Why quarantining can be bad for older adults health. Forbes. Retrieved from https://www.forbes.com
Mendoza A (2020) Facility location determines COVID outbreaks, researchers say. Provider Magazine. Retrieved from https://www.providermagazine.com
National Institute on Aging, National Institutes of Health, US Department of Health and Human Services, & US Department of State (2007) Why population aging matters: a global perspective. US Department of State. Retrieved from https://www.nia.nih.gov/sites/default/files/2017-06/WPAM.pdf
Niek Roozen BV Landscape (ND) http://www.niekroozen.com
Ohtsuka Y, Yabunaka N, Takayama S (1998) Shinrin-yoku (forest-air bathing and walking) effectively decreases blood glucose levels in diabetic patients. Int J Biometeorol 41(3):125–127. https://doi.org/10.1007/s004840050064
Radiance. Lawrence Berkley Laboratory (2018) https://www.radiance-online.org
Redfoot D, Feinberg L, Houser A (2016) The aging of the baby boom and the growing care gap: a look at future declines in the availability of family caregivers. Retrieved from https://www.aarp.org/home-family/caregiving/info-08-2013/the-aging-of-the-baby-boom-and-the-growing-care-gap-AARP-ppi-ltc.html
Roaf S (2020) A disturbing reason so few buildings have windows that open. Fast Company. Retrieved from https://www.fastcompany.com

SAGE (2018) Social isolation. Retrieved from https://www.sageusa.org/your-rights-resources/social-isolation/

Sefaira (2018) Trimble. https://www.sketchup.com/products/sefaira

US Census Bureau (2018) Older people projected to outnumber children for first time in U.S. history. Census.Gov. https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html

West LA, Cole S, Goodkind D, He W (2014) 65+ in the United States: 2010. Retrieved from https://www.census.gov/library/publications/2014/demo/p23-212.html

Wilber K (2005) Introduction to the integral approach. Ken Wilber. Retrieved from http://www.kenwilber.com/Writings/PDF/IntroductiontotheIntegralApproach_GENERAL_2005_NN.pdf

Yourish K, Lai RKK, Ivory D, Smith M (2020) One-third of all U.S. coronavirus deaths are nursing home residents or workers. The New York Times. Retrieved from https://www.nytimes.com

Mapping Migration in the SDGs: A Pedagogical Tool of Sustainability Learning for Students of Migration

Douglas de Toledo Piza

1 Introduction

Students of migration are often surprised to learn that migration is not directly mentioned in any of the 17 Sustainable Development Goals (SDGs) of the United Nations (UN). Given how comprehensive the UN 2030 Agenda for Sustainable Development is, that absence is indeed remarkable. Yet, migration does play a role in achieving the SDGs. Migration is mentioned in a few SDG targets, and it features in several indicators. Moreover, there are multiple indirect linkages between migration and sustainable development.

This paper aims to describe the development of a pedagogical tool and an assignment that were designed to support higher education learning about the interrelations between migration and SDGs. The assignment's two learning outcomes are: identifying the SDG targets and indicators that explicitly state migration-related issues; and understanding the cross-cutting connections between migration and the SDGs. By describing the practical steps of the assignment, the paper offers insightful guidance for instructors to adapt it for their courses.

The paper contributes to sustainability education in three ways. First, it emphasizes the practicalities of designing and implementing an in-class activity as a blueprint for replication in other educational settings. While a growing body of literature focuses on the theoretical or empirical aspects of sustainability education and the role of higher education institutions (Leal Filho et al. 2018; Žalėnienėa and Pereira 2021), less attention has been paid to exchanging practical steps of assignment design and implementation that can support sustainability-related learning outcomes (Brundiers and Wiek 2017; Pepper and Wildy 2008). Recognizing that sustainability education shares with social justice pedagogy the goal of meaningful and durable

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change through learning (Scarff Seatter and Celeumans 2017), the paper draws on the literature that suggests that the lack in publications focused on "doing" social justice pedagogy limits good practice exchanges and the replicability of practical toolkits proven effective to achieving transformative learning outcomes that have a broader and long-lasting impact (Taylor et al. 2019). Similarly, the UN's Education for Sustainable Development: Towards Achieving the SDGs framework (ESD 2030)—drawing on the Decade of Education for Sustainable Development (2005–2014) and the Global Action Programme on Education for Sustainable Development (post-2014)—calls for greater exchange of ideas for classroom activities that can help students develop knowledge, skills, values, attitudes, and behaviors that promote education for sustainable development.

Second, the paper showcases an assignment that can foster emergent sustainability leadership by making students—who will take on various professional, civic, and social roles—engage with the SDGs. The mindset transformation potential of higher education can make a significant impact in the advancement of sustainable development through developing future professionals as change enablers (Scarff Seatter and Celeumans 2017:48). While "higher education institutions have a great responsibility to form future sustainability leaders and support the ambitious SDGs targets implementation" (Žalėnienėa and Pereira 2021:105), sustainability education implies "a need to enact change and develop leadership" (Savage et al. 2015:695). Pepper and Wildy (2008) emphasize that leadership for sustainability implies ways of knowing, thinking, relating, and doing that ultimately means combining deep knowledge of sustainability, the ability to imagine a different future, the interpersonal skills to build strong relationships, and the capability of acting to achieve the imagined different future. According to the authors, leadership in the context of sustainability is both a matter of influence and a skill—the latter is an ability that can be learned or cultivated in educational settings, and the former is transformational and inspirational in nature. By exposing students to the opportunities and challenges practitioners face when linking migration and SDGs, the assignment familiarizes them with the application of content knowledge to policy. This is a crucial first step towards the acquisition of professional skills that are key to successful careers in sustainability (Brundiers and Wiek 2017). It empowers students to seize opportunities for sustainability-sensitive personal, academic, civic, and professional growth. Furthermore, by exposing students to an intricate web of interlinkages between a complex social issue like migration and a comprehensive sustainable development roadmap like the SDGs, the assignment helps prepare future leadership that is attentive to a definition of sustainability that has moved past a focus on environmental issues to include economic and social issues from a holistic perspective.

Lastly, the paper offers a tool for educators to adopt an interactive, experiential learning activity that exposes students to digital interactive platforms created by global leading practitioners of migration and sustainable development. The International Organization for Migration (IOM) aims to make the SDGs a tangible reality for ordinary people who can take civic and sustainability action (IOM 2018). By using the OIM's digital platforms together with its guide for practitioners, the assignment facilitates learning about the potentialities and gaps in the kinds of work

students might be doing (or challenging) in their future professional roles in fields as different as policymaking, implementation, monitoring and evaluation, or scholarly and applied research. Commenting on the sustainability curriculum's role in transforming students' thinking and actions, Scarff Seatter and Celeumans (2017) call for a pedagogy that focuses on student-activating teaching methods like experiential learning and practical assignments to elevate the potential for critical thinking and transformative learning in sustainability education. Similarly, Leal et al. (2018) point out that critical thinking, problem-based learning, and participatory pedagogies that promote transformational learning are paramount for achieving sustainable development.

The remainder of the paper is divided into four parts. First, a review of the multiple ways in which migration is connected to the SDGs, targets, and indicators. Second, a description of the methodology of the paper as a descriptive and observation-based case study. Third, an explanation of the assignment and the tool. Lastly, the lessons learned about the application of the tool.

2 Migration and the Sustainable Development Goals

The SDGs are the UN's universal call for action to end poverty, protect the planet, and improve the lives and prospects of people under the core principle "leave no one behind." The 17 SDGs (see Table 1) were adopted by the UN member states at the UN Sustainable Development Summit in New York in September 2015, as part of the 2030 Agenda for Sustainable Development,[1] which provides a shared blueprint and sets out a 15-year plan to achieve the goals. The SDGs build on decades of work dating to the 1992 Earth Summit in Rio de Janeiro when 178 countries adopted the Agenda 21—a comprehensive plan of action to build a global partnership for sustainable development.

UN bodies and agencies understand that addressing migration issues contributes to the achievement of the SDGs. UN migration stakeholders emphasize that the range of sustainable development issues covered by the SDGs—such as poverty, hunger, health, education, gender equality, climate change, and others—cannot be overcome without due consideration of migration (Naujoks 2018). For instance, IOM, the UN Department of Economic and Social Affairs (UN DESA), and the Organisation for Economic Co-operation and Development (OECD) highlight that "migration is an integral part of the 2030 Agenda" and that "meeting the targets related to migration can contribute positively to the achievement of other Goals and targets of the 2030 Agenda" (UN DESA, IOM, and OECD 2019:1).

[1] Officially presented as Transforming Our World: The 2030 Agenda for Sustainable Development, it was adopted in Resolution A/RES/70/1 by the United Nations General Assembly on 25 September 2015.

Table 1 The sustainable development goals

SDG #	SDG name
1	End poverty in all its forms everywhere
2	End hunger, achieve food security, and improved nutrition and promote sustainable agriculture
3	Ensure healthy lives and promote well-being for all at all ages
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5	Achieve gender equality and empower all women and girls
6	Ensure availability and sustainable management of water and sanitation for all
7	Ensure access to affordable, reliable, sustainable and modern energy for all
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10	Reduce inequality within and among countries
11	Make cities and human settlements inclusive, safe, resilient and sustainable
12	Ensure sustainable consumption and production patterns
13	Take urgent action to combat climate change and its impacts
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Source UN (2015)

2.1 Targets

Although no single SDG is specifically focused on migration, migration is connected to the SDGs and the targets of the 2030 Agenda in two major ways: direct connections where migration-related issues are explicitly stated in the targets, and cross-cutting connections where the topic may affect or be affected by migration (IOM 2018:21).

Of the 169 targets, at least nine include migration-related issues (see Table 2). The target that most explicitly connects to international migration is the SDG target 10.7, which calls on countries to "facilitate orderly, safe, regular, and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies." Other migration-related targets include providing scholarships for study abroad (target 4.b), respecting the labor rights of migrant workers (target 8.8), reducing the costs of transferring remittances (target 10.c),

Table 2 SDG targets related to international migration or migrants

Target #	Target name
4.B	By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries
5.2	Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation
8.7	Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms
8.8	Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment
10.7	Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies
10.C	By 2030, reduce to less than 3% the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5%
16.2	End abuse, exploitation, trafficking and all forms of violence against and torture of children
16.9	By 2030, provide legal identity for all, including birth registration
17.18	By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts

Sources UN (2015) and UN DESA (2020:1)

ending human trafficking (targets 5.2, 8.7, and 16.2), and providing universal legal identity (target 16.9). Additionally, SDG target 17.18 calls for disaggregating data by various characteristics, including migratory status. The focus of SDG 17 on enhancing the availability of reliable data for evidence-based policy making reflects a growing understanding that disaggregation of data is key to ensuring inclusiveness and preventing discrimination against sub-groups like migrants. Rather than focusing explicitly on migration-specific issues, SDG target 17.18 focuses on gaining better data on migrants' situations across themes to understand their living conditions, and to understand how migration impacts on health, income, education, and other areas. According to IOM, disaggregation is necessary in order to integrate migration as a cross-cutting theme across other sectors (IOM GMDAC 2018:10).

However, the lack of a specific goal related to migration presents challenges. Most noticeably, there is no migration-related target under SDGs 13 (Climate Action)—despite both the recognition in the 2010 Cancun Adaptation Framework that human

mobility is an adaptation strategy to climate change and the greater acceptance that climate and environmental issues are either a primary driver of migration or an additional stressor that compounds to other drivers. Furthermore, migrants, displaced people, members of the diaspora, and returnees are all affected by factors dispersed across a range of goals that have no migration-specific targets, such as SDGs 3 (Good Health and Well-being), 9 (Industry, Innovation, and Infrastructure), and 11 (Sustainable Cities and Communities), or dispense insufficient attention to migration issues, like SDGs 4 (Quality Education), 5 (Gender Equality), and 8 (Decent Work and Economic Growth). Additionally, migration drivers may be related to goals such as SDGs 1 (No Poverty), 2 (Zero Hunger), 6 (Clean Water and Sanitation), 14 (Life below Water), 15 (Life on Land), and 16 (Peace Justice and Strong Institutions) (JMDI 2017).

The recognition of those challenges motivated IOM to include detailed information and instructions in its 2018 Guide for Practitioners on how "migration and migrants can be integrated into the implementation of other targets of the Sustainable Development Goals" (IOM 2018:32). The guide emphasizes that "it is possible to link migration to every Goal in the 2030 Agenda" and provides practitioners with the SDG Target and Migration Correlation toolkit that includes 61 targets that can enhance positive migration outcomes in ten areas[2] (IOM 2018:32).

The IOM's desire to be more intentional about integrating migration with sustainable development is long standing. In 2013, the international community was moving beyond the Millennium Development Goals and towards the formulation of the United Nations post-2015 development agenda that eventually became the 2030 Agenda. In preparation for the second United Nations High-level Dialogue on International Migration and Development held in New York in October 2013, IOM launched the book Migration and the UN Post-2015 Development Agenda to focus attention on making migration work for poverty reduction and sustainable development. According to the book editors, "There were references to migration in the 2000 Millennium Declaration [which established the framework of the Millennium Development Goals or MDG], such as the need to combat human trafficking and protect the rights of migrants, but specific goals, targets and indicators for migration were not included in the MDG framework" (Laczko and Lönnback 2013:7).[3] The book includes a comprehensive list of recommendations of migration-related targets and indicators that served as the basis for the 2030 Agenda (Rosengärtner and Lönnback 2013).

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[2] Themes and corresponding targets include Poverty and Growth (1.1, 1.2, 1.4, 1.5, 1.A, 1B, 8.1, 8.2, 8.3, 10.1); Social Protection (1.3, 5.4, 10.4); Health (3.1, 3.2, 3.3, 3.4, 3.7, 3.8, 3.B, 3.C 3.D, 5.6, 8.7, 8.8, 10.7, 10.C); Education (4.1, 4.2, 4.3, 4.4, 4.5, 10.7, 10.C); Gender (5.2, 5.3, 5.4, 5.A, 5.C); Children (1.2, 4.2, 4.5, 4.A, 5.1, 5.2, 8.7, 10.7, 16.2, 16.3); Cities (11.1, 11.3, 11.B, 11.C); Climate Change (1.5, 10.7, 11.5, 13.1, 13.3); Citizenship, Rule of Law, and Inclusion (10.2, 16.3, 16.4, 16.7, 16.9, 16.B); Diaspora and Partnerships for Investment (8.9, 9.2, 12.B, 17.3, 17.5, 17.13, 17.16, 17.17, 17.18).

[3] For an account of how migration was not included in the MDG framework, see Appave and Sinha 2017:ix–x.

2.2 Indicators

While the goals and targets are constitutive elements of the 2030 Agenda since its adoption in 2015, the evidence base and methodological tools for assessing progress towards achieving the SGDs were nonexistent at that time. The Global Indicator Framework for Sustainable Development Goals was set to be developed by the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) and was eventually adopted in 2017, consisting of 232 individual global indicators. Each indicator has a custodian agency that is responsible for collecting data, supervising reporting, and reviewing methodology.

There are two major ways in which migration connects with SDG indicators (see Table 3). First, a few indicators measure migration-specific targets. Second, several indicators can be disaggregated by migratory status.

Table 3 List of selected migration-related global indicators and their custodian agencies

Indicator	Indicator name	Custodian agency
3.c.1	Health worker density and distribution	WHO
4.b.1	Volume of official development assistance flows for scholarships by sector and type of study (quantifying the public effort that donors provide to developing countries for scholarships)	OECD
8.7.1	Proportion and number of children aged 5–17 years engaged in child labour, by sex and age	ILO and UNICEF
8.8.1	Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status	ILO
8.8.2	Level of national compliance with labour rights (freedom of association and collective bargaining) based on International Labour Organization (ILO) textual sources and national legislation, by sex and migrant status	ILO
10.7.1	Recruitment cost borne by employees as proportion of yearly income earned in country of destination	World Bank and ILO
10.7.2	Number of countries that have implemented well-managed migration policies	UN DESA and IOM
10.c.1	Remittance costs as proportion of the amount remitted	World Bank
16.2.2	Number of victims of human trafficking per 100,000 population, sex, age, and form of exploitation	UNODC
17.3.2	Volume of remittance (in United States dollars) as a proportion of total GDP	World Bank
17.18.1	Proportion of sustainable development indicators produced at the national level with full disaggregation when relevant to the target, in accordance with the Fundamental Principles of Official Statistics	

Source IOM (2018: 32–33; 42; 96)

The IOM Global Migration Data Analysis Centre (GMDAC) has played a key role in the collection, analysis, and use of migration data towards international frameworks and processes, including the SDGs. In addition to the SDGs, GMADC has played a crucial role in data collection and analysis for the Global Compact for Safe, Orderly and Regular Migration[4] (GCM). The GCM is the first-ever UN global agreement on a common approach to international migration in all its dimensions in a holistic and comprehensive manner. It is a non-binding document consisting of 23 objectives that was adopted in 2018 as the result of the 2016 New York Declaration for Refugees and Migrants, which recognizes verbatim the need to address the call of SDG target 10.7 "to facilitate orderly, safe, and responsible migration and mobility of people." Thus, the GCM is rooted in the 2030 Agenda and framed consistently with SDG target 10.7.

Through GMADC, IOM launched in 2018 the Global Migration Indicators report to provide a baseline for both the SDGs and the GCM processes. The report is based on data taken from IOM's Global Migration Data Portal. Launched in 2017, the portal is a one-stop shop for timely, comprehensive migration statistics and reliable information about migration data globally. According to the report, the portal "is designed to help policymakers, national statistics officers, journalists and the general public interested in the field of migration to navigate the increasingly complex landscape of international migration data, currently scattered across different organizations and agencies" (IOM GMDAC 2018: 10–11). As discussed below, the portal features an interactive platform in which the user can explore the interconnections between migration and SDGs.

3 Methodology

The paper describes the design of a higher education assignment and the development and application of a pedagogical tool. The methodology is descriptive case study based on observation. According to Bishop-Clark and Dietz-Uhler (2012: 48–51), case study, which is a descriptive project focused on a sample of one, is a powerful methodological choice in the scholarship of teaching and learning because a basic premise is not to cause major effects on the natural situation of the learning environment. Case study is nicely complemented by observation, which is useful for gathering firsthand information on an educational technique, recording the implementation of activities, and reflecting on lessons learned. According to the authors, description is useful for giving a detailed account of how innovative teaching addresses learning needs, with the description being based on the instructor's assessment of circumstances that may affect learning and observation of class participation.

Descriptions of creative teaching techniques are useful for the exchange of practices that can be adapted and replicated in other educational settings. As Bishop-Clark

[4] The Global Compact for Safe, Orderly and Regular Migration was adopted by the UN Resolution A/RES/73/195 on January 11, 2019.

and Dietz-Uhler say, "by describing our innovative teaching and student reactions to that teaching in a systematic and careful way, we help ensure that such techniques are applied beyond our own classroom" (2012:49). Descriptions provide greater details of the process of developing, documenting, reflecting on, and sharing new teaching techniques (Bishop-Clark 2006) and are particularly useful in early phases of scholarship of teaching and learning projects where they can function as hypothesis generators and baseline knowledge assessments (Bishop-Clark and Dietz-Uhler 2012:19).

Furthermore, there is a need for best practice exchange that increases the dissemination of tips, strategies, and tools educators can use to advance their teaching. Taylor et. al (2019) call for descriptive publications that can fill the gap in examples of concrete pedagogy strategies that can be implemented in classroom settings, including tools that facilitate the development of assignments focused on learning that fosters transformative change.

The assignment design and tool development include teaching methods informed by pedagogical approaches like participatory pedagogies and transformative learning for sustainability (discussed in the introduction) and backward design of instruction and Transparency in Learning and Teaching (discussed in the next session). Those approaches value student-activating teaching methods utilized in the assignment design and tool development like experiential and problem-based learning, interactive activities, and practical assignments.

The assignment is an interactive, group activity designed for the course "Migration, Cities, Climate," offered in Spring 2020 and Spring 2021 at The New School. It was given to three course sections with a total of 63 undergraduate students.

All course sections met weekly for 75 min and students worked on this project over two weeks, totaling 150 min of class time and an estimated additional 180 min per week to complete the readings assigned. The reading for the first week of the assignment includes UN (2018) or UN (2019) (in Spring 2019 and Spring 2020, respectively) and the readings for the second week include IOM GMDAC (2018) and IOM (2018) (Section II, pp. 17–52).

3.1 Limitations

As a descriptive case study, this paper cannot test predictions, generalize hypotheses, or imply causal relationships. Future research is needed to make scientific arguments about the way students benefit from these innovative teaching techniques. Another limitation is that the lessons learned reflect the instructor's observation of class activities and comments made by students after the assignment and in the course evaluations—they do not include surveys, focus groups, or interviews that could systematically capture student feedback. A third limitation is that the assignment was implemented in a remote learning environment due to the coronavirus pandemic circumstances, although no major negative impact is expected for the implementation of the assignment in person.

4 The Assignment Design

The assignment design followed the backward design of instruction approach proposed by McTighe and Wiggins (2004), which is an instructional framework focused on student learning and understanding. Rather than designing lessons with the activities or instruction in mind, the framework calls for first determining what the final outcomes are and then aligning learning goals, course activities, and assessments accordingly. According to the Center for the Integration of Teaching, Learning, and Scholarship at Lafayette College, "backward design is an iterative and learner-centered process that encourages instructors to plan their courses with the end in mind" and the major steps of the approach include: (i) thinking about the students and the situational factors that may impact and amplify teaching, (ii) creating learning objectives, (iii) thinking about how to best assess those objectives, and (iv) planning the course content and activities (CITLS N.d.).

Thinking about the students played a crucial role in shaping the assignment design. Migration, Cities, Climate is an upper-level, university lecture course that undergraduates at The New School can take in their sophomore, junior, or senior year. Given this course requirement characteristics, students in the course sections varied greatly in terms of disciplinary backgrounds, with majors as diverse as global studies, urban studies, environmental studies, sociology, fashion design, jazz, and drama, among others.

Other situational factors that could impact learning were considered. The activity was performed synchronously online as all course sections met remotely due to the coronavirus pandemic. The design assignment considered online resources to explore new ways of connecting scholarly knowledge and professional practices and integrate digital interactive platforms made by migration practitioners.

In terms of determining the learning objectives and planning the activity, the assignment was thought to be a mid-semester active learning activity that seeks to bring course content to life and allow students to engage with their own understanding of how migration interrelates with the SDGs. The assignment fits in a sequence of in-class activities whose placement and goals were planned to support the course learning outcomes. The first step into designing the syllabus for this course was determining the desired learning outcomes for an interdisciplinary upper-level undergraduate course on the intersections of human mobility, urban centers, and climate issues. With the expected student demographics in mind, the learning outcomes were informed by a thorough literature review conducted in 2017 in preparation for the academic conference Climate, Cities, Migration hosted in April 2018 by the Zolberg Institute on Migration and Mobility. The course has since been taught by teams of instructors composed of a lecturer, who delivers the lectures for over a hundred students, and graduate teaching assistants, each of whom teaches a discussion section that meets separately in groups of 21 to 25 students.

The assignment design was also informed by the TILT approach. TILT stands for "Transparency in Learning and Teaching" and focuses on designing equitable assignments by emphasizing transparency in assignment design to promote college

students' success (TILT Higher Ed N.d.). TILT-informed assignment design implies clear communication from the outset about the purpose, the tasks that will need to be completed, and the characteristics of the final product. At the beginning of the semester, students received the general description, objectives, and the grading criteria of the assignment on the syllabus. According to Taylor et al. (2019), syllabus design choices and clarity about the students' role in the assignments matter for greater transparency and inclusivity and toward more socially just higher education learning practices and outcomes.

4.1 Development of the Migration and SDGs Tool

The tool developed to support higher education learning about the interrelations between migration and SDGs is a shared spreadsheet called "Migration and SDGs Tool" (see Fig. 1).

The tool was designed to be straightforward, intuitive, and interactive. The goal of the tool is to facilitate note taking, synthetizing, and comparing of the content students find on the digital interactive platforms. The first column is called "SDG" and features numbers 1 to 17 for each SDG. The second column is called "Potential Linkages with Migration According to Group" and is blank at the beginning of the activity for the groups to complete. The third, fourth, and fifth columns do not exist when the students first receive the tool; these columns are created in real time at the corresponding step (more information in the section Assignment Steps below). The third column is called "Migration-related SDG Targets According to Group." The fourth column is called "Migration-related SDG Targets and Indicators According to Spin the Wheel." The fifth column is called "Migration-related SDG Targets and Indicators According to M4D Explained."

SDG	Potential Linkages with Migration According to Group	Migration-related SDG Targets According to Group	Migration-related SDG Targets and Indicators According to Spin the Wheel	Migration-related SDG Targets and Indicators According to M4D Explained
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

Fig. 1 The migration and SDGs tool

4.2 Using Digital Resources

The assignment utilizes two digital resources that are online interactive platforms: "Spin the Wheel" (Migration Data Portal N.d.) and "M4D Explained" (M4D N.d.). Those digital resources were preferred for two reasons: (i) they can be considered more engaging because they are interactive, user-friendly, and visually appealing; and (ii) they create greater potential for seeing connections between migration and SDG targets.

4.2.1 Spin the Wheel Interactive Platform

"Spin the Wheel" is an interactive platform developed by IOM GMDAC and available at the Migration Data Portal to provide migration data and facilitate learning about how migration and SDGs are connected. Spin the Wheel is available in English, Spanish, French, and German. The platform consists of the image of the UN SDGs wheel logo containing 17 numbered slices of different colors each referring to an SDG.

On the right-hand side of the wheel, the user finds the following text:

> "The 2030 Agenda for Sustainable Development recognizes for the first time the contribution of migration to sustainable development. Migration is a cross-cutting issue in the 2030 Agenda, relevant to all of the Sustainable Development Goals (SDGs). Further, the SDG's motto to 'leave no one behind' is a clear call for sustainable development to be inclusive, including for migrants. At least ten out of 17 goals contain targets and indicators that are directly relevant to migration or mobility. The inclusion of migration in the 2030 Agenda presents countries with a series of new migration data challenges and reporting requirements. At the same time, this presents a crucial opportunity to improve migration data.
>
> Spin the wheel to explore how each SDG relates to migration and learn more about migration-relevant data for each." (Migration Data Portal N.d.)

When the user clicks on a number on the wheel, they find the following information:

i. A brief description of the SDG;
ii. A list of selected "Migration-relevant SDG targets and indicators";
iii. The title and full description of the target(s) and indicator(s);
iv. The migration relevance, rationale, and hyperlinked data sources of each indicator.

The wheel contains information only about those SGDs whose targets and/or indicators are considered to have "migration relevance": SDGs 1, 3, 4, 5, 8, 10, 11, 13, 16, and 17.

The platform is useful to show the user how migration connects with SDG targets and indicators. By exploring the wheel, clicking on selected SDGs, and reading information, the user can understand both how some targets are directly connected to migration because the theme is migration-related and how other targets

are also connected to migration because they have indicator(s) for which data can be disaggregated by migratory status.

However, the platform is not particularly useful to learn about how migration and SDGs are indirectly connected in multiple additional ways. In turn, M4D Explained is a helpful resource to fill that gap.

4.2.2 M4D Explained Interactive Platform

Like Spin the Wheel, M4D Explained is an interactive platform that facilitates learning about linkages between migration and the SDGs. This platform is available in English and was developed by the Migration for Development portal, which was produced within the framework of the IOM-UNDP Global Programme on Making Migration Work for Sustainable Development. The platform consists of two sets of clickable icons: nine development sectors on the left-hand side and the 17 SDGs on the right-hand side.

On top of those icons, the user finds the following text:

> "Click on a development sector or a Sustainable Development Goal (SDG) and scroll down to explore its migration linkages, relevant Global Compact for Migration (GCM) Objectives, data and measuring tools, case studies and resources." (M4D N.d.)

When the user clicks on the selected icon, they find information grouped under five tabs:

i. Introduction (an overall text with basic information about the icon and the ways in which it connects with migration, in line with corresponding development sectors and SDGs);
ii. GCM Objectives (information about how the icon connects with the GCM Objectives, followed by the list of all GCM objectives);
iii. Data & Measuring Results (links to data made available by stakeholders like UN DESA, Migration Data Portal, IOM, International Labor Organization, World Bank/Knomad, and so on, followed by a list of how that icon is relevant for migration, broken down by SDG targets);
iv. Case Studies (a video of the #MigrationConnection series, produced by IOM through the European Union-funded initiative "Mainstreaming Migration into International Cooperation and Development," followed by resources hyperlinked);
v. Resources (key resources on the topic including UN resolutions, reports, guidelines, and briefs).

The platform is useful to show how migration is connected in multiple ways with the SDG targets and indicators. The platform invites a broader exploration of the multiple possibilities of direct and indirect connections between the 2030 Agenda, GCM, and the development agenda. By exploring the platform, clicking on the icons, and reading information, the user can understand how migration is virtually interconnected with all SDG targets.

However, by focusing on indirect connections, this platform is less straightforward and does not necessarily help the user discern the aspirational SDGs/migration linkages from the areas of direct connection that have clear targets and indicators.

4.3 Assignment Steps

Students received the detailed assignment prompt the week before they started working on it. The activity was done over two classes. The goal of the first class was to allow students to think expansively about potential connections between migration and SDGs. The activity resumed the next class, when the goal was for students to learn about how the UN migration stakeholders conceive of those connections between migration and SDG targets through exploring the digital resources Spin the Wheel and M4D Explained. Below is a detailed description of the assignment steps, which apply a variation of "think-pair-share" technique, with individual reflection followed by shared work and discussion of solutions (Bishop-Clark and Dietz-Uhler 2012).

4.3.1 Class 1

1. Students were given a list of the 17 SDGs. They had five minutes to read it individually and think about how migration fits in the SDGs.
2. It was presumed that students would quickly realize that there is no specific SDG that explicitly mentions migration. Students were asked to share with the class why they think that is the case. The discussion was meant to be a brief warm-up for the activity and set to run for six minutes.
3. Students formed nine groups of two or three students. Each group was given two SDGs, except for the ninth group that was given SDG 17 only, and asked to discuss in virtual break-out rooms for 15 min whether migration can be connected with the SGDs they were assigned.
4. Groups received a link to the "Migration and SDGs Tool" and had each 10 min to write their notes in the cells on the second column corresponding to their assigned SDGs.
5. Groups were given the list of SDG targets and were asked to think for 10 min whether the targets of their assigned SDGs are connected to migration.
6. The third column "Migration-related SDG Targets According to Group" was created. Students had 3 min to add the targets they thought were connected to migration to the cells corresponding to their assigned SDGs.
7. Students returned from the virtual break-out rooms. Each group was given two minutes to share with the class why they decided to complete the cells on the second and third columns the way they did.
8. A discussion was held for the remainder of the class time when students further asked questions about how the groups' choices were made.

4.3.2 Class 2

9. Students formed the same groups of class 1 and joined their break-out room. The fourth column "Migration-related SDG Targets and Indicators According to Spin the Wheel" was created. Students were asked to launch the Spin the Wheel platform, click on their assigned SDGs, read the information, and complete the fourth column within 15 min.
10. Groups were asked to discuss and take notes of how their answers in columns three and four converge or diverge.
11. Groups returned from the break-out rooms and shared their conclusions with the class.
12. A discussion followed for 10 min about the direct and indirect connections of migration with targets and indicators.
13. The fifth column "Migration-related SDG Targets and Indicators According to M4D Explained" was created. Students were asked to join their break-out room, launch M4D Explained, click on their assigned SDGs, read the information, and complete the fifth column within 15 min.
14. Groups returned from the break-out rooms. Each group was given two minutes to share with the class why they decided to complete the cells on the fifth column the way they did.
15. A class discussion was held for the remainder of the class time when students were asked to speak about the multiple ways in which migration is directly and indirectly connected with the SDGs.

5 Lessons Learned

The assignment helped increase student awareness of the SDG targets. At the final discussion on the first day of the assignment, students expressed how much more complex the SDGs were than they originally thought. They said that before they had a more skeptical attitude towards the 2030 Agenda because they thought the goals were merely aspirational or too idealistic, but when they explored the targets, they realized the SDGs provide a much more detailed and comprehensive roadmap for action. Phrases like "it is actually much more actionable than I thought" and "you can clearly see that the targets cover many topics" stood out in the class discussion.

At the same time, the assignment facilitated their better understanding of gaps in the 2030 Agenda. Many students pointed out how important it would be to have an additional goal focused on migration. In the discussions held on the second day of the assignment, students commented that having multiple linkages across the goals is not enough to ensure that "migrants are not left behind—just like the 2030 Agenda's slogan." Many students said that the lack of a migration-focused goal makes it harder for local policy implementers to serve migrant populations.

In the course evaluations (which did not have questions specifically about this assignment), a few students reported that the use of digital interactive platforms allowed them to see the connections between migration and SDGs, making them more knowledgeable of the multiple ways the two topics are interrelated. This outcome helped clarify the puzzlement these students initially had about the absence of an explicit mention of migration in the SDGs.

In Spring 2020, some students reported that more guidance was needed to understand what they had to do in the virtual break-out rooms. This was corrected in the subsequent iterations of the assignment by providing more guidance in written and orally and by adding the third, fourth, and fifth columns of the tool in real time, so that at each step students received only one call for action. Additionally, a few students said it was hard to work in groups when group members kept their cameras and microphones off. This challenge is not easily remediated from an inclusive teaching's perspective. Instructors should not assume all students have the resources (financially, emotionally, connectivity-wise, equipment-wise, or in terms of the remote learning environment) to participate in class the same way. In Spring 2020, the transition online was unplanned. Luckily, educators and higher education institutions could provide more resources (although insufficient in many cases) for students to participate more fully in the semesters that were planned for remote learning. Especially in Spring 2021, students said that the tool helped them organize the information they learned by facilitating shared note taking in real time and comparison across the content they found on the digital platforms.

The assignment and the tool can be adapted for higher education courses that include migration and sustainability content. Details can be altered to fit different student populations. For example, in lower-level courses, the readings might be eliminated or substituted for videos available in the resources tabs of the digital platforms. Another example is that, in courses that focus on sustainability, an instructor might spend less time explaining the sustainable development agenda if students learned this content before. Yet another example is that an instructor might provide more guidance during the review of IOM GMDAC 2018 and IOM 2018 if students are not familiarized with public policy. On the other hand, a public policy course may delve deeper into the challenges of implementing or monitoring progress towards migration-related SDGs and raise additional discussion questions based on how useful students think the guide is for practitioners. Lastly, the assignment can also be scaled down for other educational settings, like high schools, where the readings can be eliminated, and the group discussions can be more guided with a series of intermediary questions; additionally, a round of class discussion at the beginning of the activity can serve as an example and show students what they are expected to do in groups before they start working unsupervised. Overall, this assignment exhibits diverse value across disciplines and levels of learning by piquing students' interest and curiosity to explore the complexities of the SDGs.

6 Conclusion

This paper has offered a descriptive case study of an assignment and a pedagogical tool developed to support higher education learning about the interrelations between migration and SDGs. They were developed from a backward design approach and TILT perspective to facilitate two learning outcomes: identifying and learning about the SDG targets and indicators that explicitly state migration-related issues; and understanding the cross-cutting connections between migration and the SDGs. The tool helps compare the information students find in two digital interactive platforms used during the activity. Both the assignment and the tool can be adapted for use in other learning contexts.

The paper contributes to sustainability education in three ways: by emphasizing the practicalities of designing and implementing an in-class activity as a blueprint for replication in other educational settings; by showcasing an assignment that can foster emergent sustainability leadership by making students engage with the SDGs; and by offering a tool for educators to adopt an interactive, experiential learning activity that exposes students to digital interactive platforms created by global leading practitioners of migration and sustainable development. The exchange of practical steps can support sustainability-related learning outcomes in other courses and contribute to meaningful and durable change through learning that helps develop change enablers and sustainability leaders. The focus on student-activating teaching methods like experiential learning and practical assignments elevates the potential for critical thinking and transformative learning in sustainability education.

Future prospects of this assignment are two. First, adapting it to the upper-level undergraduate course Global Migration to be offered in Fall 2022 at Lafayette College. Second, conducting a scholarship of teaching and learning research project. The project is in its planning phases and will use a combination of both quantitative and qualitative methods (survey application and focus group discussions with students, respectively) to further investigate the effectiveness of the tool and the digital resources for higher education experiential learning about the interrelations between migration and the SDGs.

References

Appave G, Sinha N (eds) (2017) Migration in the 2030 Agenda. International Organization for Migration, Geneva, Switzerland. Retrieved 11 Nov 2021 https://environmentalmigration.iom.int/sites/environmentalmigration/files/migration_in_the_2030_agenda.pdf

Bishop-Clark C (2006) Problem-based service learning in a 200-level systems analysis and design course. Inform Syst Educ J 4(100):1–9

Bishop-Clark C, Dietz-Uhler B (2012) Engaging in the scholarship of teaching and learning: a guide to the process, and how to develop a project from start to finish. Stylus Publishing, Sterling, VA

Brundiers K, Wiek A (2017) Beyond interpersonal competence: teaching and learning professional skills in sustainability. Educ Sci 7(1):39

CITLS. N.d. Backward design. The center for the integration of teaching, learning, and scholarship at Lafayette College website. Retrieved 11 Nov 2021 https://citls.lafayette.edu/backward-design/

Leal Filho W, Raath S, Lazzarini B, Vargas VR, de Souza L, Anholm R, Quelhas OLG, Haddad R, Klavins M, Orlovic VL (2018) The role of transformation in learning and education for sustainability. J Clean Prod 199:286–295

IOM GMDAC (2018) Global migration indicators. IOM Global Migration Data Analysis Centre, Berlin, Germany. Retrieved 11 Nov 2021 https://publications.iom.int/system/files/pdf/global_migration_indicators_2018.pdf

IOM (2018) Migration and the 2030 agenda: a guide for practitioners. International Organization for Migration, Geneva, Switzerland. Retrieved 11 Nov 2021 https://publications.iom.int/books/migration-and-2030-agenda-guide-practitioners

JMDI (2017) Guidelines on mainstreaming migration into local development planning. UN Joint Migration and Development Initiative (JMDI), Brussels, Belgium

Laczko F, Lönnback LJ (eds) (2013) Migration and the United Nations Post-2015 development agenda. International Organization for Migration, Geneva, Switzerland. Retrieved 11 Nov 2021 https://publications.iom.int/system/files/pdf/migration_and_the_un_post2015_agenda.pdf

M4D N.d. Migration for development. Migration for Development website. Retrieved 11 Nov 2021 https://migration4development.org

McTighe J, Wiggins G (2004) Understanding by design: professional development workbook. Association for Supervision and Curriculum Development, Alexandria, VA

Migration Data Portal. N.d. Migration data and the sustainable development goals (SGDs). Migration Data Portal website. Retrieved 11 Nov 2021 https://www.migrationdataportal.org/sdgs?node=0

Naujoks D (2018) Achieving the migration-related sustainable development goals. In: 2017 Situation Report on International Migration: Migration in the Arab Region and the 2030 Agenda for Sustainable Development (eds) United Nations and International Organization for Migration. UN Economic and Social Commission for Western Asia, Beirut, Lebanon, pp 73–122

Pepper C, Wildy H (2008) Leading for sustainability: is surface understanding enough? J Educ Adm 46(5):613–629

Rosengärtner S, Lönnback LJ (2013) Developing a global partnership on migration and development in the post-2015 agenda. In: Laczko F, Lönnback LJ (eds) Migration and the united nations post-2015 development agenda. International Organization for Migration, Geneva, Switzerland, pp 117–137. Retrieved 11 Nov 2021 https://publications.iom.int/system/files/pdf/migration_and_the_un_post2015_agenda.pdf

Savage E, Tapics T, Evarts J, Wilson J, Tirone S (2015) Experiential learning for sustainability leadership in higher education. Int J Sustain High Educ 16(5):692–705

Scarff Seatter C, Celeumans K (2017) Teaching sustainability in higher education: pedagogical styles that make a difference. Can J Higher Educ 47(2):47–70

Taylor SD, Veri MJ, Eliason M, Hermoso, JCR, Bolter N, Van Olphen JE (2019) The social justice syllabus design tool: a first step in doing social justice pedagogy. J Committed Soc Change Race and Ethnicity 5(2):133–166

TILT Higher Ed. N.d. Transparency in learning and teaching in higher education. TILT Higher Ed website. Retrieved 11 Nov 2021 https://tilthighered.com/

UN DESA, IOM, and OECD (2019) SDG Indicator 10.7.2—number of countries with migration policies to facilitate orderly, safe, regular and responsible migration and mobility of people. Policy Brief 1. October 23, 2019. Population Division of the United Nations Department of Social and Economic Affairs, International Organization for Migration, and Organisation for Economic Co-operation and Development, New York, NY. Retrieved 11 Nov 2021. https://www.un.org/en/development/desa/population/publications/pdf/technical/Policy%20Brief_10.7.2.pdf

UN DESA (2020) SDG indicator 10.7.2: data booklet (ST/ESA/ SER.A/441). United Nations Department of Economic and Social Affairs, Population Division, New York, NY. Retrieved 11 Nov 2021 https://www.un.org/en/development/desa/population/publications/pdf/sdg/SDG_10.7.2_2019_Data%20Booklet.pdf

UN (2015) Transforming our world: the 2030 agenda for sustainable development. United Nations A/RES/70/1. United Nations, New York, NY. Retrieved 11 Nov 2021 https://sdgs.un.org/2030agenda

UN (2018) The sustainable development goals report 2018. United Nations Publications, New York, NY. Retrieved 11 Nov 2021 https://unstats.un.org/sdgs/files/report/2018/TheSustainableDevelopmentGoalsReport2018-EN.pdf

UN (2019) The sustainable development goals report 2019. United Nations Publications, New York, NY. Retrieved 11 Nov 2021 https://unstats.un.org/sdgs/report/2019/The-Sustainable-Development-Goals-Report-2019.pdf

Žalėnienėa I, Pereira P (2021) Higher education for sustainability: a global perspective. Geogr Sustain 2:99–106

Creating Space for Student Action and Reflection on Sustainable Development Goal 2: Zero Hunger

Melanie Miller Foster

1 Introduction

One way that institutions of higher education can influence sustainability in society is through the improvement of teaching (Berchin et al. 2018). United Nation's Educational, Scientific and Cultural Organization's (UNESCO) Education for Sustainable Development emphasizes that this type of education must be "holistic and transformational" and will "achieve its purpose by transforming society" (UNESCO 2020). UNESCO (2020) stresses that sustainability education requires that we "rethink what, where and how we learn". In this sense, it is not an issue of teaching so that students can achieve established answers, but rather that they are empowered to envision, take responsibility for, and take action towards a sustainable future. The aim of this paper is to identify systematic ways that instructors can develop high impact educational experiences that advance the leadership capacity of students through an online asynchronous course delivered to students from multiple institutions simultaneously.

Purvis et al. (2019) have found that the concept of sustainability has arisen from multiple schools of thought over time, which may account for the lack of a clear way to operationalize sustainability. The United Nations Sustainable Development Goals (SDGs) are "integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental" (United Nations 2015, p. 1). While the SDGs appear to provide a roadmap of goals, targets, and indicators to guide toward the first steps of achieving sustainability, there is no prescription as to how the goals should be operationalized. The need for further linkage of theory to practice, the development of innovation solutions that limit negative trade-offs, and the broad adoption and application of solutions is a challenging reality that today's educators and youth face (Ravikumar and Sadhwani 2020). Interdisciplinary approaches to education can be rewarding, yet challenging (Brewer 1999).

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Kuh (2008) coined the term "high impact educational practices" comprising ten best practices in undergraduate education that has since become a term that encompasses a wide range of strategies that encourage student engagement and success. High impact educational practices (HIPs) include service-learning, community-based learning, global learning, writing intensive courses and first-year seminars. Although HIPs take different forms, commonalities include encouraging high levels of critical inquiry, problem solving, the integration of learning across disciplines, and engaging students in questions that extend beyond the confines of the classroom.

This paper proposes that high impact practices, specifically project-based learning (project-based learning), can play an important role in education for sustainable development. Project-based learning is defined by the engagement of students in a "meaningful question to explore, an engaging real-world problem to solve, or a challenge to design or create something" (Larmer et al. 2017, p. 3). Students take an active role at the center of the learning by driving the inquiry process and developing their own solutions.

The gold standard of project-based learning as described by Larmer et al. (2015), includes seven essential project design elements: (1) challenging problem or question, (2) sustained inquiry, (3) authenticity, (4) student voice and choice, (5) critique and revision, (6) reflection, and (7) public product. These elements set the "Gold Standard", because many classroom activities that are labeled as "projects" lack the rigor of gold standard project-based learning, and often lead to disappointing outcomes.

When the seven essential project design elements of gold standard project-based learning are applied, research has shown that students can effectively transfer their knowledge to novel situations, engage in self-direction, and practice collaboration (Evans 2019; Strobel and van Barneveld 2009). Additionally, project-based learning may facilitate long-term retention of material and increase both instructor and students' attitudes toward the learning process (Strobel and van Barneveld 2009). Project-based learning is positively associated with student engagement, motivation, and self-efficacy (Condliffe et al. 2017), and can also facilitate the development of 21st Century Skills such as communication, collaboration, creativity, and critical thinking (Kokotaski et al. 2016). As such, project-based learning is one strategy that has the potential to deeply engage students in complex issues of sustainability in a reflective learning environment.

1.1 The Need for the Course

Agriculture is often associated with SDG 2, Zero Hunger, which calls to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture (United Nations 2015). Production agriculture features prominently in the goal's targets such as doubling agricultural productivity, and ensuring sustainable and resilient food systems. The goal also touches on social and economic factors such as increasing the incomes of small-scale food producers, particularly those of

women and indigenous people. Food security influences cross-cutting health targets including addressing nutritional needs of vulnerable populations and ending all forms of malnutrition. In this sense, SDG 2 presents food security as a multifaceted issue that spans all three spheres of sustainability—environmental, social, and economic.

In the United States, a land grant university's college of agriculture will likely include the study and teaching of all three spheres of sustainability and many aspects related to food insecurity. The same is true for my own institution, Penn State University. For decades research has focused on increasing agriculture production including finding new ways to increase yields, decrease post-harvest losses, and minimize losses due to pest and disease. Research on environmental impacts include innovations to decrease carbon emissions, utilize water resources more effectively, and develop new methodologies such as integrated pest management and agroforestry. Penn State's College of Agricultural Sciences, like many others, engages social scientists to study inequalities in agriculture systems such as labor and immigration issues, indigenous peoples and ways of knowing, and cross-cutting themes of women and youth. While economic, social, and environmental themes are researched and taught in the various departments in a college of agriculture, there are few courses that thread together knowledge from each sphere in a problem-focused approach. Blesh et. al. (2019) found that scholars referencing SDG 2, Zero Hunger, often fail to link crucial topics including ecology, nutrition, and policy science, bringing into question the integration of disciplines outside colleges of agriculture. Lozano et al. (2015) revealed that sustainable development implementation in institutions of higher education is highly compartmentalized and does not tend to integrate sustainability principles throughout the functions of an institution such as research, education, campus operations and community outreach. The concept of sustainability calls for a relentless focus on the issues such as those outlined in the Sustainable Development Goals, and the integration of disciplines to identify applicable solutions. Teaching in institutions of higher education must be realigned to reflect the complexity of real-world issues.

Students in higher education are interested in issues such as food security, demonstrating positive attitudes toward the teaching of sustainable development (Aleixo et al. 2021) and believe that studying global issues helps them understand their place in the world (Butler and Reinke 2020). Some students in higher education express a preference for future work in companies that support sustainable development, even if it means accepting a lower salary (Aleixo et al. 2021). Zeegers and Clark (2014) found that students may approach the concept of sustainability with a focus on the environmental sphere, citing a need for holistic approaches to advance student conceptions of sustainability concepts.

The covid-19 pandemic created a challenge for two-thirds of the world's institutions of higher education shifting from face-to-face to virtual learning (Marinoni et al. 2020). While the pandemic has highlighted inequalities and created numerable challenges, there is also an opportunity to reimagine the design and delivery of curriculum (Neuwirth et al. 2021). The incorporation of high impact practices such as project-based learning into online learning is one such opportunity. While project-based learning has been conducted in online formats to a limited degree (Usher and Barak 2018; Randazzo et al. 2021; Walcott and Rolle-Greenidge 2021),

there remains a distinct need to understand how project-based learning, specifically asynchronous online-based project-based learning, can be utilized as a pedagogical approach in sustainability education.

2 Methods and Course Development

In response to this need, an online asynchronous course was created at Penn State University as an explorative experiment of the application of project-based pedagogical approach to a sustainability topic. Students from three universities in three different countries participate in the food security-focused course, with variable course credit being offered at each of the three institutions but instructional responsibility remaining with the Penn State instructor. The course will be described from the instructor's perspective through the framework of the Gold Standard project-based learning essential project design elements from Larmer, Mergendoller and Boss (2015), as presented in Table 1.

3 Results from Instructor Perspective

The sections below review each of the seven essential project design elements for project-based learned as identified in Table 1 from the perspective of the instructor.

Table 1 Seven essential project design elements for gold standard project-based learning

Project-based learning element	Description
Challenging problem or question	Project is framed by a problem to be solved or a question to answer
Sustained inquiry	Extended process of finding resources and applying information
Authenticity	Project engages students in a real-world context and impact
Student voice and choice	Students have freedom to make decisions about some aspects of the project such as how they work and what they create
Critique and revision	Students give, receive, and apply feedback to improve their process and products
Reflection	Students reflect on the process, including unexpected barriers and strategies to overcome them
Public product	Students share their project with individuals beyond the classroom

3.1 Challenging Problem or Question

The course title is "Taking Action on Food Security", indicating the problem-based nature of the course, as well as an early indication that students will be called to take action. The description states that students will learn about the issue of food security and Sustainable Development Goal 2, Zero Hunger, but will also have an opportunity to explore and apply potential solutions. The expectation of application of food security knowledge is further addressed at the beginning of the course and is integrated into the course assessments, as described in the sections below.

From the instructor perspective, I acknowledge it can be uncomfortable to take such a bold stance when naming and describing a course. The course does not promise to provide the answers to food insecurity, rather, content knowledge is shared, and a space provided in which students can explore the content and trial action on a small scale.

3.2 Sustained Inquiry

For the first six weeks of the course, students engage in food security content through online asynchronous modules. Materials include recorded lectures, readings, videos, podcasts, policy reports, online maps, and reliable data sources. Students are guided to interact with these materials and engage in several different methods of assessment including participating in video and text-based discussions, identifying, and sharing related resources, quizzes, and written assignments.

Throughout the modules, students explore food security in domestic and international settings through the lens of the four pillars of food security (availability, access, utilization, and stability) as described by the Committee on World Food Security (2014). First, the pillar of availability relates to the supply of food in a particular geography through production and distribution. Second, the pillar of access is focused on economic and physical accessibility to food. Third, the pillar of utilization refers to how food is utilized in a household including the storage, preparation, processing, and cooking of food, and includes the distribution of food among members of a household. The pillar of utilization also includes how nutritional elements of the food are utilized in the body, as well as food safety, and cultural food preferences. Finally, the pillar of stability refers to the idea that food insecurity can vary over time, in accordance with seasons, in times of conflict and other adverse conditions. By looking at food security through these four pillars, students can analyze how the root causes the food insecurity situation in one context can be compared and contrasted with the food insecurity situation in a differing context.

The online modules are an opportunity for the instructor to engage with the high-quality undergraduate instruction principles as defined by Chickering and Gamson (1991) especially encouraging contact between students and faculty, communicating high expectations, and encouraging active learning. I recorded a weekly video in

real time to respond to student questions, to praise student work, and ask questions to encourage students to probe more deeply. The video is also an opportunity to highlight class activities in the week ahead, although I also post these in the course announcements to ensure that students can find guidance when needed.

3.3 Authenticity

Students engage in the authentic issue of food security by studying the definition and dimensions of food security, but also through an analysis of political, social, economic, and environmental contexts. Food security is studied through both historical and current events, and at different scales from the individual, household, local community, national to international levels. Cross cutting themes such as youth, gender, indigenous people, and health are also analyzed. Surveying the students' majors, I work to include an instance of food insecurity relevant to each discipline.

The "twin tracks" of current food security solutions are discussed at length, recognizing the importance of providing food assistance to food insecure individuals, while also seeking long-term solutions to the problem (Committee on World Food Security 2014). I have noticed that students struggle with the dichotomy of food aid versus long-term solutions to food security. It seems that students have engaged previously with food aid including food drives, volunteering at food pantries, meal packing and other types of food distribution. There appears to be little previous engagement with thinking about the root causes of food insecurity, and how students might engage with this branch of the "twin tracks". I've found that students need ample space to reflect on their previous experience with food security solutions, and then identify how they can work toward more sustainable solutions in the future.

A space is provided to give students the opportunity to reflect on the food security concepts as a group. The students are from three different universities located in Mexico, Ukraine, and the United States. An important aspect of the global and cultural learning that takes place in this online course is through the asynchronous video-based discussions in which students respond on their own time in response to a reflective prompt. One main reflective question is posed, as well as several related questions that students might ponder in their response. A best practice I employ is to present specific expectations for the video reflections, and this has appeared to lead to higher quality responses and better interaction between students. It also adds clarity to the grading process. The video reflections provide an opportunity for students to see the other students in the class, to hear the authentic reactions to the concepts and issue studied in the class, and to gain some insight to the contexts in which the other students are situated. Through these discussions stereotypes related to food security were confronted, such as the notion that wealthy countries do not have issues with food insecurity. Students from the participating countries also noticed that food aid is distributed differently, and institutions such as "food pantries" and "soup kitchens" were discovered to be contextually specific. The engagement with the video-based discussions was high, with some students watching the videos multiple times.

3.4 Student Voice and Choice

Students are tasked in the creation of an individual action plan to address the issue of food security in a designated target audience. The parameters set by the instructor include a performance period of six weeks, and projects must satisfy a specified number of hours depending on the number of course credits for which the student is enrolled. Impact data must also be collected in order to determine if the project had an impact. Students have autonomy when selecting the type of action that they will take, the project context, and the target audience. They determine when they will work on the project and create their own timeline for how their project will progress toward the established due date.

When confronted with a new way of learning via project-based learning, students can become uncomfortable with the uncertainty of how the class will progress (Virtue and Hinnant-Crawford 2019). From an instructor point of view, guiding student choice is perhaps one of the most challenging aspects of utilizing project-based learning. Instead of defining the project for students, many students are defining their own project for the first time. While it is very exciting and engaging, applying innovation and creativity can be very challenging. When confronted with so much choice, I have observed that students can become paralyzed and often resort to asking if they can engage in more comfortable and familiar actions such as writing a research paper or giving a presentation of research findings.

To identify appropriate scenarios in which students can take immediate action, I encourage students to inventory their talents, interests, and future career aspirations, and to identify communities of which they are currently members such as a student organization, dormitory or affinity groups. Once identifying an appropriate and feasible project, students then create an action plan using a provided template.

3.5 Critique and Revision

Although the course in question is an asynchronous online course, the students do meet with me at least once via synchronous video conference to discuss their draft action plan. Students submit a draft of the plan before the meeting for my review. The meeting is an essential aspect of the critique and revision process because students share their thinking with the instructor. After discussing the project with the instructor, students revise their action plan to incorporate instructor feedback.

The process of giving feedback in a one-on-one meeting is time consuming and sometimes difficult to schedule, but vitally important to guiding the project-based learning process. It is an opportunity to ask students additional questions, challenge them to dig deeper, and to find connections to existing knowledge and skills. For some students, multiple meetings are required before a solid plan emerges. While it is time intensive, I have found that it is well worth the effort to create a project

concept at this stage instead of letting students continue to flounder into the time that is designated for project work.

Students are also required to submit the action plan for review by other students. Guiding questions are posted to guide the process of giving effective and constructive feedback. This is an opportunity for the instructor to gain further insight into student thinking, and to participate side by side with students in the effort to develop better products. After resubmission of the final action plan that is revised to incorporate instructor and student feedback, students move forward to work on the project.

3.6 Reflection

It is critical to provide opportunity for student self-reflection on the project process, including unexpected barriers and strategies to overcome them. Students report on their progress every two weeks using a progress report template posted in the online learning management system. They are asked to report on three aspects of their project:

1. Progress on the project including the number of hours worked
2. Identify problems or challenges
3. Reflect on the project experience to date

Progress reports are essential to ensuring that students are making adequate progress on their project. This is especially important with online courses, which lack regular in-person classroom touchpoints. The progress reports are designed to assist students in managing their time and to reflect on if their project is one track, while still allowing for student autonomy. Progress reports are an opportunity for the instructor to identify a student that is struggling or not making adequate progress and is also an opportunity to guide students to dig deeper by asking questions to challenge their thinking or pointing to additional resources.

3.7 Public Product

Student learning is culminated with an impact report presentation to the class community. Students post digital presentations for class members to watch in a week-long period, and a feedback form is provided to guide constructive feedback on each project presentation. In terms of encouraging future reflection, one of the questions pose to students is, “What actionable steps could be taken to improve this project, if conducted again in the future?”.

Gold standard project-based learning culminates with a public presentation that includes individuals outside of the community. This is an opportunity for improvement for the Taking Action on Food Security course because currently the presentations are only available to the class participants. However, with three universities

participating, there is a sense that the presentations are being consumed by a broader community. From the instructor point of view, it is difficult to arrange a secure public presentation in an online setting. This will require thoughtful design to fully achieve this aspect of Gold Standard project-based learning.

4 Conclusions

The purpose of this chapter was to explore the application of project-based pedagogical approach to a sustainability topic in an online asynchronous format. The course was developed around the gold standard project-based learning framework from Larmer et al. (2015), and each aspect of the course was described through the seven essential project design elements.

4.1 Lessons Learned

There is initial evidence that an interdisciplinary project-based learning approach can be an appropriate pedagogic fit for sustainability-related global issues such as food security. The application of this type of pedagogy requires a shift in mindset as students take ownership and responsibility for their learning process. This can be both a difficult and rewarding process for students and instructors alike because it is a shift away from the expected flow and structure of a course that students and instructors have experienced throughout their educational careers. Project-based learning acknowledges that it is not enough for students to learn *about* a problem, but they must be able to identify meaningful and effective ways to *solve* the problem when the answers are not yet established.

Project-based learning provides space for students to take stock of their knowledge and skillsets and take small steps toward potential solutions. Essentially, the project-based learning process redefines what success looks like in a course. Rather than writing a well-researched paper or getting all the questions right on a test, success is measured by impactful project results. This shift in assessment, while it more accurately depicts what happens in a workplace, can be very jarring for students. When implementing project-based learning it is important to discuss how to collect impact data based on the project objectives. The emphasis on measuring results provides a meaningful way for the instructor to share highly advanced research skills with students in the creation of an objective and appropriate method in which to measure impact.

Project-based learning provides opportunities for reflection on the project process as well as student-generated solutions, with an emphasis on what could be done differently in the future. If facilitated correctly, there is ample opportunity to reflect no matter if projects were “successful” or not. Does the impact data collected show if the project was “successful”? If the project was deemed to be successful according

to the impact data, are there alternate viewpoints or potential negative externalities that should be considered? What was learned from the "success" or "failure" of this project? What would the student need to do differently in the future? What knowledge and skills need to be researched or developed for a greater success next time? From an instructor standpoint, this is a delightful way to teach because not matter how the projects turn out, there is opportunity for rich discussion on all these points. This is one way that the role of the instructor changes from knowledge-holding expert to that of facilitator and coach.

This instructor-centered exploration finds initial support for the notion that well-designed high impact educational practices can play an important role in sustainability education in online, on-demand environments.

4.2 Limitations and Future Directions

A limitation of this paper is that it only takes into account the view of the course instructor. The findings could be strengthened if the course was led by another instructor and their reflections and observations were added to the findings. Additionally, there is no data from student pre-assessment to post-assessment to show grow of the individual learners during their engagement in the course. A final constraint was the delivery of the course in English with limited to no supplemental materials in the primary language of the students from Ukraine and Mexico. While one of their learning goals of participating was to advance their English proficiency, the food security content could have benefited from some materials provided in alternative languages. Future research should consider the limitations described above, as well as describe students' enduring understandings and application to future work.

References

Aleixo AM, Leal S, Azeiteiro UM (2021) Higher education students' perceptions of sustainable development in Portugal. J Clean Prod 327:129429

Berchin II, Sima M, de Lima MA, Biesel S, dos Santos LP, Ferreira RV, de Andrade Guerra JB, Ceci F (2018) The importance of international conferences on sustainable development as higher education institutions' strategies to promote sustainability: a case study in Brazil. J Clean Prod 171:756–772. https://doi.org/10.1016/j.jclepro.2017.10.042

Blesh J, Hoey L, Jones AD, Friedmann H, Perfecto I (2019) Development pathways toward "zero hunger". World Dev 118:1–14. https://doi.org/10.1016/j.worlddev.2019.02.004

Brewer GD (1999) The challenges of interdisciplinarity. Policy Sci 32(4):327–337. http://www.jstor.org/stable/4532473

Chickering AW, Gamson ZF (1991) Applying the seven principles for good practice in undergraduate education. New directions for teaching and learning, vol 47. Jossey-Bass, San Francisco, CA

Committee on World Food Security (2014) Global strategic framework for food security & nutrition. Accessed at https://www.fao.org/fileadmin/templates/cfs/Docs1314/GSF/GSF_Version_3_EN.pdf

Condliffe B, Quint J, Visher MG, Bangser MR, Drohojowska S, Saco L, Nelson E (2017) Project based learning: a literature review. Working Paper, 1–78. MDRC, New York, NY
Evans CM (2019) Student outcomes from high-quality project-based learning: a case study for project-based learning works. Center for Assessment, Dover, NH
Kokotaski D, Menzies V, Wiggins A (2016) Project-based learning: a review of the literature. Improv Sch 19(3):267–277
Kuh GD (2008) High-impact educational practices: what they are, who has access to them, and why they matter. AAC&U, Washington, D.C.
Larmer J, Mergendoller J, Boss S (2015) Setting the standard for project-based learning: a proven approach to rigorous classroom instruction. Association for Supervision and Curriculum Development, Alexandria, VA
Larmer J, Ross D, Mergendoller J (2017) Project based learning toolkit series: project-based learning starter kit. Buck Institute for Education
Lozano R, Ceulemans K, Alonso-Almeida M, Huisingh D, Lozano FJ, Waas T, Hugé J (2015) A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey. J Clean Prod 108:1–18
Marinoni G, Van't Land H, Jensen T (2020) The impact of Covid-19 on higher education around the world. IAU Global Survey Report
Neuwirth LS, Jović S, Mukherji BR (2021) Reimagining higher education during and post-COVID-19: challenges and opportunities. J Adult Continuing Educ 27(2):141–156
Purvis B, Mao Y, Robinson D (2019) Three pillars of sustainability: in search of conceptual origins. Sustain Sci 14:681–695. https://doi.org/10.1007/s11625-018-0627-5
Randazzo M, Priefer R, Khamis-Dakwar R (2021) Project-based learning and traditional online teaching of research methods during COVID-19: an investigation of research self-efficacy and student satisfaction. Front Educ
Ravikumar R, Sadhwani P (2020) Utilizing a Data analytics project to increase student awareness of contemporary global issues. In: 2020 advances in science and engineering technology international conferences (ASET). IEEE, pp 1–5
Strobel J, van Barneveld A (2009) When is project-based learning more effective? A meta-synthesis of meta-analyses comparing project-based learning to conventional classrooms. Interdisc J Prob-Based Learn 3(1):44–58
UNESCO (2020) Education for sustainable development: a roadmap. Available online at https://unesdoc.unesco.org/ark:/48223/pf0000374802. Accessed 4 Dec 2021
United Nations (2015) Transforming our world: the 2030 Agenda for sustainable development. Resolution adopted by the general assembly on 25 September 2015 (A/RES/70/1). United Nations, New York
Usher M, Barak M (2018) Peer assessment in a project-based engineering course: comparing between on-campus and online learning environments. Assess Eval Higher Educ 43(5):745–759
Virtue EE, Hinnant-Crawford BN (2019) "We're doing things that are meaningful": student perspectives of project-based learning across the disciplines. Interdisc J Prob-Based Learn 13(2)
Walcott PA, Rolle-Greenidge G (2021) A cross-classroom collaborative project-based learning management system. In: Bastiaens T (ed) Proceedings of EdMedia + Innovate Learning. United States: Association for the Advancement of Computing in Education (AACE), pp 33–38. Retrieved 30 Dec 2021 from https://www.learntechlib.org/primary/p/219636/
Zeegers Y, Clark IF (2014) Students' perceptions of education for sustainable development. Int J Sustain Higher Educ

Roll the Dice: Using Game-Based Learning to Teach Sustainability in Higher Education

Lisa Heller Boragine

1 Introduction

Over the past half century, as the ecological threat to the long-term viability of human society has become more apparent, colleges and universities across the world have pledged their support for sustainability. Unfortunately, declarations and pledges have not resulted in significant changes in sustainable behaviors by institutions of higher learning (Leal Filho et al. 2017). Traditional higher education remains a fundamentally transactional space where colleges and universities provide a degree to students in exchange for tuition and fees. As a result of this mindset, instruction in higher education (HE) often takes a reductionist approach that privileges institutional positioning in the global HE marketplace over sustainability.

Institutions of HE should use their collective knowledge and reputation to facilitate a more transdisciplinary perspective toward education for sustainable development (Tejedor et al. 2018). To be effective, education for sustainable development (ESD hereafter) must shift from more traditional and reductionist approaches to learning (Lozano et al. 2013; Sprain and Timpson 2012) toward a systems approach that is immersive and comprehensive and incorporates values and behavior in problem-solving (Pappas et al. 2013). New models of interdisciplinary ESD could shift toward transformative and collaborative learning, using a mix of formal and informal approaches across curricular and non-curricular settings to foster positive environmental attitudes and behaviors (Lozano et al. 2013; Mercer et al. 2017).

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Game-based learning is one new approach to ESD that merits more attention. Game-based learning (sometimes referred to as serious games) is designed for a purpose other than entertainment and is an increasingly popular approach to ESD (Stanitsas et al. 2019; Reckien and Eisenack 2013). Although experiential training games have been used for decades in many fields (e.g., medicine, business, outdoor adventures, and military operations), games are relatively new to the HE landscape (Nicholson 2013) and the use of games is not yet widespread (Comunale 2017). Research on games shows them to be effective teaching tools for complex sustainable development issues because games facilitate the ability to understand complex problems and to collaboratively conceptualize possible sustainable solutions to societal challenges (Vervoot et al. 2022). Games may provide students with the necessary skills to address future challenges in sustainable development (e.g., by increasing participants' feelings of personal responsibility and confidence about cooperation in climate politics (Meya and Eisenack 2018).

The aim of this paper is to assist individuals interested in implementing game-based learning in ESD by providing a framework for selecting an appropriate game. Section 2 defines game-based learning and reviews the benefits of games. Section 3 introduces a new theoretical framework, called the Green Game Frame (GGF), and outlines the methods for conducting an analysis of games through application to two sample games. Section 4 presents the results of this analysis and a discussion, along with limitations and recommendations for future research. Section 5 provides a conclusion.

2 Use of Games in Higher Education

Play, a concept strongly associated with games, has been a topic for much research and contemplation over the years. In his 1938 seminal text, Huizinga considered play to be "free" and to take place inside a "magic circle" (Huizinga 1971). Games and play different in that whereas rules in play are flexible, players in a game agree upfront to rules. It would violate the principle of the game were those rules changed mid-game (Nicholson 2015).

In their comprehensive review of the literature on game-based learning, Kim et al. (2018) identified some common characteristics of games: they are goal based, have agreed-on rules, and incorporate multiple reciprocal interactions between the players and the game. For most scholars, game-based learning is defined as games that are played to learn content (e.g., designing an escape room game to teach students how to use the college library) (Alsawaier 2018). In contrast, gamification refers to the use of games mechanics in non-game contexts (e.g., a Jeopardy-style game to quiz on chapter content would be gamification because it is using the mechanics of a game in a classroom setting) (Brigham 2015). These definitions are well suited to educational contexts because the educator is reminded to keep the goal of the activity in mind during the design phase. When gamification fails, the root cause often lies

in game elements that were introduced without regard for the instructional outcomes (Alsawaier 2018; Brigham 2015; Nicholson 2018).

Games, role playing, and simulations are becoming increasingly popular as an interactive tool to teach college students about the environment, climate change, and sustainability (Bevilacqua et al. 2015; Fløttum 2017; Klöckner 2015; Meya and Eisenack 2018). There are several reasons for this interest. First, today's students expect to be entertained and engaged. They prefer image-based lessons, bite-sized information, and immediate feedback (Dawson et al. 2019; Whitton and Langan 2019). Games can provide that experience (Bevilacqua et al. 2015). Some observers even consider games to be the best educational tool available for ESD (Dieleman and Huisingh 2006; Chappin et al. 2017).

Second, game systems are immersive and influence values and behavior to improve problem-solving (Pappas et al. 2013). Games are adept at teaching challenging topics because they go beyond theoretical settings to direct tangible experience, which can provide unique insights and skills on complex sociocultural situations. The capacity for games to motivate and engage is well documented (Brigham 2015; Kim et al. 2018; Nicholson 2018; Prensky 2007). Powers (1986), author of *The Commons Game*, compares his simulation to the successful cross-cultural simulation game BaFa' BaFa, which helps students understand social dilemmas, address problems analytically and substantively, and become motivated to act in response to such challenges. Students engaged in these types of simulations not only participate more fully in the experience but also are more motivated to act on social dilemmas after the experience (Powers 1986).

Third, games are effective in simulating and teaching people about complex systems. Research by Dieleman and Huisingh (2006) applied Kolb's theory of experiential learning to a variety of game-based learning, theorizing that because games deal with systems behavior, they can help people understand complex systems (e.g., climate change)—perhaps because games are process-oriented systems themselves, and playing games can give participants an intuitive understanding of that complex process (Foltz et al. 2019; Wardrip-Fruin 2009; Salen and Zimmerman 2004). In fact, complex systems are so challenging to study that simulation games have evolved into one of the preferred methods for studying systems in both education and management, especially because games are easily modified to meet lesson objectives (Cushman-Roisin et al. 2008; Castronova and Knowles 2015).

Fourth, as environmental issues are increasingly framed in political terms, games offer a neutral territory to discuss difficult topics. Talking about climate change with partisan audiences can backfire (Zhou 2016), but because games currently have very little political association (Bogost 2007), games strip familiar political associations from the discourse, eliminating cognitive noise. It is possible that a game can help frame issues as less of a political concern and more of a civic responsibility (Wu and Lee 2015).

Fifth, research demonstrates that the tangible experience of playing a game will allow participants to embody systems not just cognitively but also emotionally. Wu and Lee (2015) argue that because games deliver first-hand experience and allow people to envision scenarios, games are an engaging way for players to build empathy

and perspective around issues such as climate change. Games may enable people to envision hopeful future scenarios and thus encourage people to work on, rather than disengage from, problems. The more concrete the vision for the future, the more people remain hopeful rather than giving in to despair (Ojala 2017). Framing ESD as a game can seem less overwhelming. Playing an interactive game can be less intimidating than a head-on consideration of the issue. Somehow, as big as the problems seem, they are simulated problems, and it is "just a game," so mistakes are more forgiving, and tragic scenarios appear less scary.

3 Methods

This section introduces a new theoretical framework to be used as an assessment tool for evaluating a potential game. The components of the GGF are reviewed before demonstrating how the framework might be used to evaluate two games: one commercially available tabletop game and one online multiplayer game.

Multiple existing frameworks have been used to describe how games function. Experiential learning frameworks, such as Kolb's experiential learning cycle, are seen as a natural fit for games (Kolb and Kolb 2010; Brigham 2015; Nicholson 2015). Garris et al. (2002) establish an input-process-outcome game model to explain the motivation to play games as a blend of attractive game characteristics and valuable instructional content within a repeating game cycle. Alsawaier (2018) advocates self-determination theory (SDT), new literacies study (NLS), and behaviorism frameworks. Nicholson (2013) also relies on the connection between games and SDT as a theoretical framework for meaningful gamification. Kim et al. (2018) provide a useful review of game and gamification frameworks, including (1) the MDA framework, which relies on a blend of mechanics (moving parts), dynamics (game interactions), and aesthetics (emotions and feelings); (2) the Werbach and Hunter's gamification framework, which categorizes elements as Dynamics (the goal of a game), the Mechanics (promotes engagement) and components (tangible ingredients); and Schell's gamification framework which defines the game elements of story, mechanism, technology and aesthetics. Kim et al. use these models to develop their own Integrative Gamification Framework, with elements of Story, Dynamics, Mechanics, and Technology.

However, most of the existing frameworks approach games as explanatory models rather than assessment tools. In some cases, models are focused on mechanics and flashy designs rather than learning outcomes, which Nicholson (2013) warned against doing. In other cases, the variables in a few models are overly complex and difficult to understand without discipline-specific knowledge. Two theoretical frameworks, SDT and behaviorism, stand out for including concepts relevant to pro-environmental behavior beyond the gaming environment. SDT relies on autonomy, competence, and relatedness (Alsawaier 2018; Nicholson 2015). Behaviorism considers the likelihood that gamification can produce long-term behavioral change based on the use of rewards and penalties.

The GGF is introduced here as an assessment tool to visually and simply evaluate a sustainability game for its ability to create conditions that facilitate a switch from the sender-receiver model of education to a more interactive learner-centered approach. The GGF model draws on previous models and on transdisciplinary research from multiple fields to identify essential variables in an effective game that will create the conditions needed for participants to be receptive to learn about and engage in sustainability.

The GGF model identifies four essential variables in game-based learning: systems, agency, flow, and engagement (the four petals in Fig. 1). The premise is that a game with adequate levels of each of these components frames the game to create the conditions necessary for participants to be more receptive to the debriefing experience and therefore more motivated to engage in the learning outcomes and pro-environmental behavior. Each element in this model works synergistically, amplifying the effect of each of the parts. The game thus frames the process as an apolitical noncontroversial event that triggers conditions for learning.

First, an effective sustainability game creates conditions for systems thinking. Research establishes a strong connection between systems thinking and environmental concern (Davis and Stroink 2016; Lezak and Thibodeau 2016). Systems thinkers are likely to have a more expansive self-concept, exhibit a pro-environmental identity, and express cognitive and affective empathy (Davis et al. 2018). Some of the different kinds of systems thinking help with big-picture thinking (Maani and Maharaj 2004). Systems thinking operates outside of political contexts, which might facilitate pro-climate views and a better understanding of climate change, even in partisan audiences (Ballew et al. 2019). By engaging in systems thinking, people are

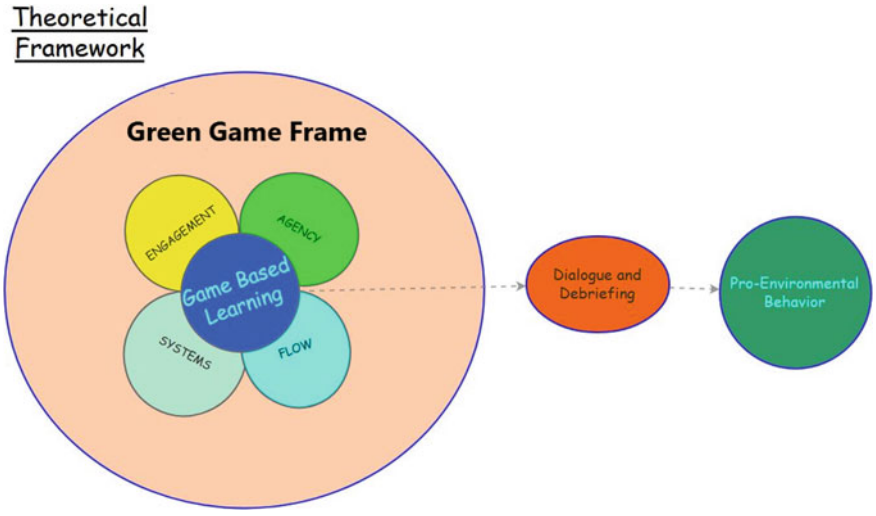

Fig. 1 Green game frame (GGF) theoretical framework

better able to see beyond political mental constructs to understand the interconnected nature of things.

Second, a well-designed game incorporates agency (i.e., how active or passive the player is during the experience). Players become involved, and as they make choices in the game, they can take ownership of their experience. Although agency alone will not suffice to build behavior, without agency, an individual may be less empowered to act.

Third, a well-designed game promotes flow. Csikszentmihályi (1997) defined flow as that experience of timeless immersion where the participant's full attention is effortless absorbed by working on the activity. Flow fosters competence by creating an experience that is challenging without provoking anxiety. To establish optimum flow in a game, a designer needs to consider how to match the challenge to the ability of the player and give the player personal control of the experience (Chen 2006). This pursuit of flow requires a delicate balance. The challenge can be neither so complex that the player becomes discouraged nor so easy that the player is soon bored.

Fourth, a compelling game is engaging. When people are asked to define the elements of a good game, one of the first responses is likely to be that a good game is fun. In fact, engagement is one of the primary motivations for adding games or gamification to an activity (Brigham 2015). However, although entertainment value certainly represents one of the primary criteria for choosing an average tabletop game, more important criteria apply when selecting a game that is intended to meet educational learning objectives.

Fifth, it is not sufficient for a game to simply address the preceding four variables and then let students play the game and be on their way. An educational game must encourage dialogue in one or both of two ways: (1) deliberately embedding dialogue experiences into the game mechanics and (2) facilitating a debriefing session after the game ends. A tremendous amount of learning takes place during a debriefing that works to set the message. In his discussion of debriefing in experiential education games, Nicholson (2013) argues that debriefing provides an opportunity for integrating individual learning with the viewpoints of the other participants. A skilled debriefing helps participants mentally disengage from the game so that they can connect their actions during the activity with their evolving mental models. Debriefing is valuable because it provides a link between the simulated game environment and the real world (Garris et al. 2002; Pivec 2007). Without a debriefing session, the effectiveness and usefulness of any activity or game are significantly diminished (Nicholson 2013).

Debriefing and dialogue are particularly important when engaging in complex topics such as sustainable development (Dieleman and Huisingh 2006). Goldberg et al. (2019) find that the mere act of participating in a global warming discussion with friends and family increases openness to the topic and creates a reinforcing social feedback loop whereby participants are more likely to be exposed to new ideas and subsequently are more open to listen. This outcome is more likely when facilitators engage students in a debriefing session and discussion immediately following the game. Through a post-activity debriefing where they are fully engaged and experience intrinsic motivation, participants are encouraged to stay open and primed for

pro-environmental behavior. To evaluate a game using the GGF, the five criteria—systems, agency, flow, engagement, and debriefing and dialogue—are individually assessed on a 3-point scale for each criterion, for a total possible 15 points awarded for a perfect game. A game that completely satisfies any given criterion is awarded the full 3 points. Games that partially meet a criterion receive 2 points. Games where a criterion is minimally addressed are awarded 1 point. Those games that completely fail to meet the criterion receive no points.

The first game chosen for this analysis is Catan: Global Warming, an expansion pack for the commercially available Settlers of Catan® tabletop game. Illingworth and Wake (2019) developed this expansion pack to teach students about the challenges of global warming by using a popular tabletop game environment. This game fits this analysis for several reasons; prominently, the expansion pack and the game are thoughtfully designed. Illingworth and Wake (2019) have a well-documented process. They describe the process of developing, prototyping, and playtesting the game, and they document the results in their peer reviewed academic paper (Illingworth and Wake 2019). They explain the choice to build an expansion pack for Settlers of Catan because of its availability, commercial popularity (millions of games sold internationally), fair use policy, and ability to reference other expansion packs (Illingworth and Wake 2019).

This game design is pedagogically and scientifically sound, and the game and supporting materials are easily and freely available. Illingworth and Wake (2019) follow established game design principles to build the game, citing well-known game scholars such as Salen and Zimmerman (2004). They establish excellent opportunities for dialogue around global warming, both before and after the game. They consult with climate scientists to include scientifically accurate information in the design notes that are available to students. The game had been downloaded over 1,600 times as of the publication of their article (Illingworth and Wake 2019).

In the original version of this game, players of Catan compete to be the first to settle the remote Isle of Catan by building roads and cities and earning victory points until someone wins. Whereas players in the original Catan are awarded resources randomly, in Catan: Global Warming, participants receive and expend resources at a cost and must manage the impacts of costs and resource consumption on the island's growing population. Catan: Global Warming is designed so that resources may be exhausted, making the island uninhabitable and triggering the end of the game. As an additional twist, before they start playing, the players are asked to decide as a group on the winning conditions for the game. An additional debriefing session may occur at the end of the game.

The second game selected for this analysis is New Shores: A Game for Democracy (New Shores hereafter), a stand-alone e-learning platform game that can be played in person or in a fully remote environment. It has a set start and finish and takes between 40 min to 2 h to play, making it playable within one or two class periods. In New Shores, students learn to balance short-term individual gains against shared responsibility for common resources. Created by the System Solutions Center with a grant from the European Union, this game provides accompanying pedagogical materials, such as a research-based methodology guide that explains the principles

of group communication, philosophy behind serious games, and benefits of systems thinking. Also included are detailed ice-breaker activities, pre- and post-classroom activities intended to assist youth educators in facilitating a workshop experience, and a pre- and post-survey built into the game system that students can complete. The game is freely available in Polish, German, and English. The Systems Solutions Center built this game based on scientific research and adapted it to address UN sustainable development goals. This award-winning game is designed to teach about the challenges of sustainable management of ecological resources and about the tragedy of the commons. Although it does not require a deep level of knowledge about these issues from the participants, the game mechanics are clearly constructed by someone who understands climate science. As with Catan, players of New Shores are asked to settle and develop a remote island community. They can choose between investing in individual assets (e.g., a personal library or jacuzzi) or sharing resources with their community (e.g., to build schools, theaters, and hospitals). They can decide to harvest coal, berries, and trees to earn money to develop their island; however, development and deforestation can raise CO_2 levels, which can worsen hurricanes and flooding. Suggested activities and debriefing prompts are available for the facilitator's use at the end of the game to discuss the process and outcome of the game.

4 Results and Discussion

4.1 Results

The results of the analysis are summarized in Table 1. The analysis of Catan: Global Warming is based on the narrative portion of the Illingworth and Wake (2019) article and their self-reporting of events as they playtested and prototyped their game. The analysis of New Shores is based on the author's personal experience in facilitating the game with students in face-to-face and remote learning classrooms with 6–18 students (during the Fall 2021 and Spring 2022 semesters, Stonehill College and Bridgewater State University). This paper is not meant to present an objective analysis but rather to give the reader an assessment tool for ESD.

4.1.1 Catan: Global Warming

Catan: Global Warming receives a rating of 3 for systems because it adequately addresses systems thinking. Built into a game's structure is the motivation to understand systems because players need to understand how systems work to participate in the game (Farber 2018). Even when systems concepts are not introduced by the facilitator, Illingworth and Wake (2019) reported students observing elements such as the presence of escalating climate change feedback loops in the game.

Table 1 Game Results

Game	Criterion 1: systems	Criterion 2: agency	Criterion 3: flow	Criterion 4: engagement	Criterion 5: debriefing	Game score
Catan: global warming*	3	3	1	3	2	12
New shores**	3	3	1	3	3	13

*All results based on Illingworth and Wake (2019) study
**All results based on the author's personal analysis

This game also earns a rating of 3 for agency. Participants in this game collectively define winning before the game starts, which indicates strong agency. Illingworth and Wake describe how "the game demonstrated the consequences of individual action and that mitigating the negative effects of global warming requires a collective response (2019, p. 13)." They suggest that a future game iteration "might invite participants to join the designers in the process of creating the scenario" (Illingworth and Wake 2019, p. 15).

Flow is the weakest part of Catan: Global Warming, garnering only a rating of 1, as this is a complex game with many moving parts. Although most participants seemed to rise to the challenge, a few participants were either not familiar with the game or not acquainted with gaming environments in general, and these participants reported that the rules were not easy to follow. Illingworth and Wake (2019) acknowledge the importance of both considering the game literacy of a target audience in the future and providing tutorials or almanacs.

Enjoyment alone is not enough to ensure engagement, but enjoyment correlates with intrinsic motivation, which engages an individual to enable learning. A total of 47 of the 52 participants in the study answered yes (i.e., the game is fun to play). Those who responded in the negative included students who found the game to be "too complicated, too slow paced" or "not fun enough" (Illingworth and Wake 2019, p. 12). Nevertheless, only a significant minority expressed these views, and this game receives an engagement rating of 3.

In their study, Illingworth and Wake (2019) provided an opportunity for each individual player to debrief twice: once before the Catan: Global Warming game is played, when participants are required to make group decisions around the game's win condition, and once after the game concluded, in a post-survey. The discussion before the game created agency and ownership of the experience. The post-game survey allowed the participants to contextualize their personal experience. When participants were asked to comment on whether the game had generated ideas on global warming, 40 of the 52 participants responded affirmatively. This result indicates that even absent a facilitator, the game mechanics successfully generate reflections on new ideas among some participants. This game receives a rating of 2 instead of 3 because facilitation is not a required element of gameplay and because, without

the survey, the game offers no guarantee that individuals will actively reflect on their experiences.

In sum, the Catan: Global Warming game rates positively in systems thinking, agency, engagement, and debriefing but registers some problems with flow among some participants. Overall, with a few adjustments for flow and possibly debriefing, Catan: Global Warming seems to fit the criteria for an effective game for use in teaching about global warming and thus earns a final score of 12 out of 15.

4.1.2 New Shores: A Game for Democracy

The second game, New Shores, receives a rating of 3 for facilitating systems thinking among participants in undergraduate classrooms in which the author was a guest facilitator during 2021 and 2022. As the island is developed by the players, a higher incidence of hurricanes and floods is evident. The disasters encourage dialogue among players and reflection on the impact of individual decisions on the larger island ecosystem.

This game receives a rating of 3 for agency. At the beginning of the game, players are explicitly asked to individually define the meaning of winning the game. Individual players are encouraged to choose their own course of action. Players are then given a certain number of action points that they can choose to spend during each round (e.g., to accumulate the most wealth, plant the most trees, or generate the highest standard of living on the island).

As with Catan: Global Warming, flow is the weakest part of New Shores, with a rating of 1. During the debriefing sessions, it was common for players unfamiliar with online gaming environments to report feeling lost and confused. In one small class of six students, most of the students confessed to not being entirely sure about what was going on in the game. Participants who are lost also feel frustrated and therefore are less likely to learn.

Despite their frustrations, when asked, students reported having fun playing the game, so the game earns a rating of 3 for engagement. It is important to note that the threshold for fun in a classroom is likely lower than that for a game played for entertainment. One student put it this way: “In general, I really like games, but I love games if that’s an option over different types of things in class” (Anonymous student in discussion with the author, February 10, 2022).

The New Shores game receives a score of 3 for debriefing. This game requires a facilitator to play the game. Recommended guidelines, background, and facilitation materials are supplied to the facilitator and prove to be effective tools for reflection on sustainable development (Centre for Systems Solutions 2017). For example, players not uncommonly observe during debriefing sessions that it is difficult to lower CO_2 levels once they are elevated.

In sum, New Shores rates very strongly in systems thinking, agency, engagement, and debriefing but exhibits problems with flow related to individual students who struggle to understand the game. The game receives a final score of 13 out of 15.

4.2 Discussion

Not surprisingly, both New Shores and Catan: Global Warming are highly rated games—these are thoughtfully designed games built with learning outcomes in mind that were selected for analysis by experienced game practitioners. The games center around island communities that need to work together to reach the best outcome (systems), but they provide individual players with the autonomy to decide to act as each wishes (agency). A unique procedural argument is presented by the participants defining winning—does the player win by individually amassing the most points, even if the ecosystem collapses? Alternatively, are players collectively trying to win the game by delaying the inevitable system collapse? These questions and subsequent discussion points frame the conversation so that the participant is forced to consider not only the end goal and the long-term consequences of individual behavior but also the associated collective consequences. These are fun interactive games (producing engagement), with opportunities for debriefing and discussion about the learning outcomes before, during, and/or after the game.

It is striking that both games exhibit low flow. To reach a flow state, a challenge cannot be so complex that the player becomes discouraged, but it also cannot be so easy that the player is bored. These two games are particularly challenging for those students with limited gaming experience outside of the classroom, who seem to struggle to understand and follow game conventions and are uncertain about the different rules of play (e.g., when turns start and end, how many actions they can take during a round, and when those actions should occur). This poor flow certainly inhibits the ability to learn and represents an important consideration when choosing a game for the classroom.

4.3 Limitations and Recommendations for Future Research

The analysis of Catan: Global Warming is based on Illingworth and Wake (2019) experience developing and playing their game. The analysis of New Shores: A Game for Democracy is based on the author's personal qualitative classroom experiences. Although limitations to this approach might reinforce bias, the purpose of this paper is not to provide a definitive analysis of either game but rather to demonstrate how the GGF might be used to evaluate a game for its ability to incorporate and teach systems thinking, agency, flow, engagement, and debriefing. Readers are encouraged to apply the construct, criteria, and process developed here to analyze their own choice of games. Future large scale mixed method studies are encouraged to bring more comprehensive findings.

In addition, the analysis in this paper points to the importance of basic game literacy. Students familiar with game mechanics will have an easier time playing games. Instructors should consider techniques for teaching game literacy to less experienced students before gameplay (Castronova and Knowles 2015). Complex

games might be more engaging for players, but difficulties arise because students new to games can only digest so much fresh information at one time. Instructions provided immediately before the game may not be sufficient for students who are beginning from a limited baseline of knowledge. Future researchers are encouraged to focus on best practices for teaching game rules.

5 Conclusion

Over the past fifteen years, even as the number of ESD games continues to increase steadily (Stanitsas et al. 2019), games continue to be underutilized in higher education (Comunale 2017; Pivec 2007). Games in general offer enormous potential, so why this hesitancy? Several possible contributing factors are identified.

Games in general offer enormous potential for ESD; however, mediocre games abound. It is easy for a game to include elements of engagement and to be fun to play. Many games are immersive and engaging, however that doesn't correlate with meeting learning objectives (Cheng et al. 2015). In their systematic literature review, Stanitsas et al. (2019) analyzed the characteristics of 77 ESD games and found many serious games don't contribute to educational needs. Furthermore, instructors unfamiliar with educational games may feel unprepared and may think it will take too much time to select the "right" game: one that is not only fun, but also effective at teaching learning outcomes. Instructors may be reluctant to incorporate game-based learning because they fear the potential consequences of failure (Whitton and Langan 2019).

The evaluation of the use of games in an academic setting should proceed from two perspectives: (1) gaming, which considers what makes the game fun; and (2) learning, or how well the game embeds learning objectives (Nicholson 2015). In an educational setting, a fun environment is not sufficient. Games must be assessed based on their ability to embed learning objectives. Using the GGF framework can assist educators address legitimate concerns and thoughtfully select an appropriate ESD game.

Given the current climate of higher education—which is risk averse to innovation and overly responsive to market forces—using ESD games in HE might offer a unique opportunity to expedite the shift from a transactional model to a paradigm of collaborative learner centered ESD. If this model shift transpires, overall society, not just HE, will benefit. Furthermore, this benefit is mutually reinforcing: by refocusing a liberal arts education away from consumption and toward a stronger ecological and more participatory worldview, the value of education is reinforced.

For over 100 years, games and play were dismissed as idle behavior or even seen as a threat to productive society during the growth of the capitalistic factory system (Hearn 1976). Using a game to address sustainability concerns may seem odd given that long-established cultural norms have framed games as trivial. However, it is well past time to implement games as a valued and integral component of a curriculum on sustainable development. It is time to roll the dice and play games.

References

Alsawaier RS (2018) The effect of gamification on motivation and engagement. Int J Inform Learn Technol 35(1):56–79. https://doi.org/10.1108/IJILT-02-2017-0009

Ballew M, Goldberg M, Rosenthal S, Gustafson A, Leiserowitz A (2019) Systems thinking as a pathway to global warming beliefs and attitudes through an ecological worldview. PNAS 116(17):8214–8219. https://doi.org/10.1073/pnas.1819310116

Bevilacqua M, Ciarapica FE, Mazzuto G, Paciarotti C (2015) Cook & Teach: learning by playing. J Clean Prod 106:259–271. https://doi.org/10.1016/j.jclepro.2014.11.085

Bogost I (2007) Persuasive games: the expressive power of videogames. MIT Press, Cambridge

Brigham TJ (2015) An introduction to gamification: adding game elements for engagement. Med Ref Serv Quart 34(4): 471–480. https://doi.org/10.1080/02763869.2015.1082385

Castronova E, Knowles I (2015) Modding board games into serious games: the case of climate policy. Int J Serious Games 2(3):41–62. https://doi.org/10.17083/ijsg.v2i3.77

Centre for Systems Solutions, in cooperation with Tandem n.o. and Rogers Foundation for Person-Centered Education (2017). New shores: a game for democracy. https://newshores.crs.org.pl/

Chappin EJL, Bijvoet Z, Oei A (2017) Teaching sustainability to a broad audience through an entertainment game–the effect of catan: oil springs. J Clean Prod 156:556–568. https://doi.org/10.1016/j.jclepro.2017.04.069

Chen J (2006) Flow in games. PhD diss., University of Southern California

Cheng M-T, Shet HC, Annetta LA (2015) Game immersion experience: its hierarchical structure and impact on game-based science learning. J Comput Assist Learn 31:232–253. https://doi.org/10.1111/jcal.12066

Comunale MA (2017) Getting into the game: an explanatory case study to examine the experiences of faculty incorporating digital game based learning in higher education. PhD diss., Drexel University. Available from ProQuest Dissertations & Theses Global (1914685963)

Csikszentmihályi (1997) Finding flow. Basic Books, New York

Cushman-Roisin B, Rice NJ, Moldaver M (2008) A simulation tool for industrial ecology: creating a board game. J Ind Ecol 3(4):131–143. https://doi.org/10.1162/108819899569601

Davis A, Stroink ML (2016) The relationship between systems thinking and the new ecological paradigm. Syst Res Behav Sci 33(4):575–586. https://doi.org/10.1002/sres.2371

Davis AC, Leppanen W, Mularczyk KP, Bedard T, Stroink ML (2018) Systems thinkers express an elevated capacity for the allocentric components of cognitive and affective empathy. Syst Res Behav Sci 35(2):216–229. https://doi.org/10.1002/sres.2475

Dawson P, Henderson M, Mahoney P, Phillips M, Ryan T, Boud D, Molloy E (2019) What makes for effective feedback: staff and student perspectives. Assess Eval High Educ 44(1):25–36. https://doi.org/10.1080/02602938.2018.1467877

Dieleman H, Huisingh D (2006) Games by which to learn and teach about sustainable development: exploring the relevance of games and experiential learning for sustainability. J Clean Prod 14(9):837–847. https://doi.org/10.1016/j.jclepro.2005.11.031

Farber M (2018) Game-based learning in action: how an expert affinity group teaches with games. Peter Lang Publishing Inc., New York

Foltz A, Williams C, Gerson SA, Reynolds DJ, Pogoda S, Begum T, Walton SP (2019) Game developers' approaches to communicating climate change. Front Commun 4:29. https://doi.org/10.3389/fcomm.2019.00028

Garris R, Ahlers R, Driskell JE (2002) Games, motivation, and learning: a research and practice model. Simul Gaming 33(4):441–467. https://doi.org/10.1177/1046878102238607

Goldberg M, van der Linden S, Maibach E, Leiserowitz A (2019) Discussing global warming leads to greater acceptance of climate science. PNAS 116(30):14804–14805. https://doi.org/10.1073/pnas.1906589116

Hearn F (1976) Toward a critical theory of play. Telos 1976(30):145160. https://doi.org/10.3817/1276030145

Huizinga J (1971) (reprint) Homo Ludens: a study of the play element in culture. Angelico Press, Takoma, WA
Illingworth S, Wake P (2019) Developing science tabletop games: catan and global warming. J Sci Commun 18(4):1824–2049. https://doi.org/10.22323/2.18040204
Kim S, Song K, Lockee B, Burton J (2018) Gamification in learning and education: enjoy learning like gaming. Springer, New York. https://doi.org/10.1007/978-3-319-47283-6
Klöckner CA (2015) The psychology of pro-environmental communication: beyond standard information strategies. https://doi.org/10.1057/9781137348326
Kolb AY, Kolb DA (2010) Learning to play, playing to learn: a case study of a *ludic* learning space. J Organ Chang Manag 23(1):26–50. https://doi.org/10.1108/09534811011017199
Leal Filho W, Wu YCJ, Brandli LL, Avila LV, Azeiteiro UM, Caeiro S, da Rosa Gama LR (2017) Identifying and overcoming obstacles to the implementation of sustainable development at universities. J Integr Environ Sci 14(1):93–108. https://doi.org/10.1080/1943815X.2017.1362007
Lezak SB, Thibodeau PH (2016) Systems thinking and environmental concern. J Environ Psychol 46:143–153. https://doi.org/10.1016/j.jenvp.2016.04.005
Lozano R, Lukman R, Lozano FJ, Huisingh D, Lambrechts W (2013) Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. J Clean Prod 48:10–19. https://doi.org/10.1016/j.jclepro.2013.03.034
Maani KE, Maharaj V (2004) Links between systems thinking and complex decision making. Syst Dyn Rev 20(1):21–48. https://doi.org/10.1002/sdr.281
Mercer TG, Kythreotis AP, Robinson ZP, Stolte T, George SM, Haywood SK (2017) The use of educational game design and play in higher education to influence sustainable behaviour. Int J Sustain High Educ 18(3):359–384. https://doi.org/10.1108/IJSHE-03-2015-0064
Meya J, Eisenack K (2018) Effectiveness of gaming for communicating and teaching climate change. Climatic Change 149:319–333. https://doi.org/10.1007/s10584-018-2254-7
Nicholson S (2018) Creating engaging escape rooms for the classroom. Child Educ 94(1):44–49. https://doi.org/10.1080/00094056.2018.1420363
Nicholson S (2013) Completing the experience: debriefing in experiential educational games. J Systemics, Cybern Inform 11(6): 27–31. https://doaj.org/article/54fad19f527244988702ca38d128c6c9
Nicholson S (2015) A recipe for meaningful gamification. In: Wood L, Reiners T (eds) Gamification in education and business. Springer, New York. https://doi.org/10.1007/978-3-319-10208-5_1
Ojala M (2017) Hope and climate change: the importance of hope for environmental engagement among young people. Environ Educ Res 18(5):625–642. https://doi.org/10.1016/j.futures.2016.10.004
Pappas E, Pierrakos O, Nagel R (2013) Using bloom's taxonomy to teach sustainability in multiple contexts. J Clean Prod 48:54–64. https://doi.org/10.1016/j.jclepro.2012.09.039
Pivec M (2007) Editorial: play and learn: potentials of game-based learning. Br J Edu Technol 38(3):387–393. https://doi.org/10.1111/j.1467-8535.2007.00722.x
Powers R (1986) The commons game: teaching students about social dilemmas. J Environ Educ 17(2):4–10. https://doi.org/10.1080/00958964.1986.9941402
Prensky M (2007) Digital game based learning. Paragon House, St. Paul, MN
Reckien D, Eisenack K (2013) Climate change gaming on board and screen: a review. Simul Gaming 44(2–3):253–271. https://doi.org/10.1177/1046878113480867
Salen K, Zimmerman E (2004) Rules of play: game design fundamentals. MIT Press, Cambridge
Sprain L, Timpson WM (2012) Pedagogy for sustainability science: case-based approaches for interdisciplinary instruction. Environ Commun 6(4):532–550. https://doi.org/10.1080/17524032.2012.714394
Stanitsas M, Kirytopoulos K, Vareilles E (2019) Facilitating sustainability transition through serious games: a systematic literature review. J Clean Prod 208:924–936. https://doi.org/10.1016/j.jclepro.2018.10.157

Tejedor G, Segalàs J, Rosas-Casals M (2018) Transdisciplinarity in higher education for sustainability: how discourses are approached in engineering education. J Clean Prod 175:29–37. https://doi.org/10.1016/j.jclepro.2017.11.085

Vervoot J, Mangnus A, McGreevy S, Ota K, Thompson K, Rupprecht C, Tamura N, Moossdorff C, Spiegelberg M, Kobayashi M (2022) Unlocking the potential of gaming for anticipatory governance. Earth System Governance 11:1–12. https://doi.org/10.1016/j.esg.2021.100130

Wardrip-Fruin N (2009) Expressive processing: digital fictions, computer games, and software studies. MIT Press, Cambridge. https://mitpress.mit.edu/books/expressive-processing

Whitton N, Langan M (2019) Fun and games in higher education: an analysis of UK student perspectives. Teach High Educ 24(8):1000–1013. https://doi.org/10.1080/13562517.2018.1541885

Wu JS, Lee JL (2015) Climate change games as tools for education and engagement. Nat Clim Change 5:413–418. https://doi.org/10.1038/nclimate2566

Zhou J (2016) Boomerangs versus javelins: how polarization constrains communication on climate change. Environ Politics 25(5):788–811. https://doi.org/10.1080/09644016.2016.1166602

Be(coming) an Ambassador of Transformative Change from the Inside Out

Theres Konrad

1 Introduction

Intrapersonal competency has recently received attention as a key competency in sustainability (Brundiers et al. 2020). Together with implementation competency, it has been added to Wiek et al.'s (2011) framework of key competencies in sustainability. This framework originally included systems-, futures, values-, and strategic-thinking and interpersonal competency (Wiek et al. 2011). Interpersonal competency has been found to be what students develop most in project-based sustainability courses (Konrad et al. 2020; Oxenswärdh and Persson-Fischier 2020; Soini et al. 2019). Konrad et al. (2021) further specified this competency into interpersonal attitudes, knowledge, and skills; and identified four processes that support their development. Particularly for future leaders, interpersonal competency is important as it is the key competency that underpins and links all the other ones for collaborative problem-solving (Brundiers et al. 2020). Schneider et al. (2019) point out that the type of leadership needed is 'reflective leadership' as e.g. transdisciplinary sustainability projects go hand in hand with self-transformation.

Intrapersonal competency—which is closely linked to interpersonal competency—can be understood as "the ability to reflect on one's own role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires" (UNESCO 2017, p. 10). Intrapersonal competency further includes the "ability to reflect and act on that awareness in order to regulate, motivate, and continually evaluate one's actions (in relation to self and other humans and non-humans) as well as to improve one's self" and to maintain motivation (Redman et al. 2021, p. 314). The question, "How can you possibly be of any real use as a leader on a larger scale if you can't lead yourself through the thicket of your own emotions and thoughts?" brings the importance of the discourse

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on intrapersonal competency to the fore (Senge et al. 2013, p. 51), particularly in the context of educating sustainability leaders of the future (Redman et al. 2021).

The introduction and acknowledgement of 'preventative self-care' as a professional skill (Brundiers and Wiek 2017), the notion of 'inner worlds' (Ives et al. 2019), and the discussion and implementation of mindfulness practices into sustainability education (Frank et al. 2019; Papenfuss et al. 2019; Wamsler et al. 2018) currently support the long neglected discourse (Ives et al. 2019; Wamsler 2020). Thus far, sustainability science and education has been largely outward-focused (Ives et al. 2019). However, Ives et al. (2019) as well as Pomeroy and Oliver (2021) consider the sustainability crises we are facing to be emergent properties of our 'levels of consciousness', our states of mind, or 'inner worlds'. Constituted by our values, beliefs, worldviews, and attitudes, our mindset—as the source of our actions—is a deep leverage point for change, and therefore, deserves and requires more attention (Abson et al. 2017; Brundiers et al. 2020; Göpel 2016; Meadows 1999; Pomeroy and Oliver 2021; Wamsler 2020). Introspection, self-care, and, generally, attention dedicated to one's self can seem self-indulgent and generate concerns that important work towards sustainability transformations will be left undone (Macnamara 2012). However, Macnamara (2012) makes clear that.

> Whatever the justification the end result is that when we put ourselves last (or second) the time comes when our bodies or minds will scream for attention with resentment, illness and burnout. Giving all our time to others and seldom to ourselves is ultimately not personally sustainable (Macnamara 2012, p. 51).

Macnamara (2012) highlights that on the pathway towards a positive future for all self-care is vital.

The aims of the present paper are twofold: First, to continue the ongoing discussion of how engaging with our inner worlds, the self, the intrapersonal dimension is linked to changes towards sustainability in the outer world (Brundiers et al. 2020; Giangrande et al. 2019; Ives et al. 2019; Pomeroy and Oliver 2021; Redman et al. 2021; Sellberg et al., 2021) and, hence, requires changes within sustainability education. With the incorporation of intrapersonal competency in the key competencies in sustainability framework (Brundiers et al. 2020), the second aim of this paper is to suggest three social theories and practices that can inspire intrapersonal competency development on the course level, with the prospect of self-reflective future leaders approaching the challenges ahead from a place of inner consciousness and sustainability. The three social theories and practices presented are Theory U, permaculture, and non-violent communication (NVC). While widely applied in practice outside academia, their presentation intends to contribute to building bridges between sustainability academics and practitioners.

Through the close interlinkage with interpersonal competency, insights from interpersonal competency development can give preliminary guidance for course design. Therefore, this paper asks:

How can intrapersonal competency, with its close links to interpersonal competency, be developed in sustainability education?

The course "#CSX: Community Supported Economy. New entrepreneurial narratives in words and deeds." serves as an illustration and provides a 'look behind the scenes' at how intrapersonal competency development can be implemented at the course level with the goal of supporting sustainability transformations in society.

This paper can be useful for course designers, students and learning facilitators[1] alike, and invites the reader to explore ways to examine one's own inner world to make both sustainability interventions and Education for Sustainable Development (ESD) stronger.

2 Approach

To respond to the question of how intrapersonal competency can be developed in sustainability education this paper draws on the author's doctoral research on interpersonal competency development in project-based sustainability courses (Konrad 2021). A grounded theory-inspired multi-method, comparative, multi-case study approach (Strauss and Corbin 1996; Yin 1984) and the triangulation of multiple perspectives (students, instructors, stakeholders, tutors) allowed the researcher to gain in-depth insights on learning outcomes, processes, and environments. Next to this empirical and theoretically-supported foundation of interpersonal competency development, a literature review further informs the present paper.

Moreover, the engagement in *Gaia Educations Design for Sustainability* (GEDS) certified course as well as the immersion in the *U.Lab 2x* journey led by the Presencing Insitute, let the author gain first-hand experiences with Theory U, permaculture, and NVC and now inform the author's practice as an independent learning process designer and facilitator.

Being familiar with both the student and the instructor perspective, the author herself had the chance to both, give and receive input, engage in experiencing and experimenting, and thanks to the GAIA, U.Lab, and other learning communities, engage in individual and shared reflection sessions for learning.

As an independent learning process designer and facilitator with a PhD in education for sustainable development, the approach of present paper is a combination of sustainability research and practice. To answer the question of the present paper, interpersonal competency development relevant in the context of intrapersonal competency development is introduced before the three social theories and practices.

[1] 'Learning facilitator' is used interchangeably with 'instructor'. However, the former term is closer to the author's understanding of her own role in the classroom.

3 Links Between Intra- and Interpersonal Competency

As intrapersonal competency was only recently added to the key competencies in sustainability framework (Brundiers et al. 2020), no teaching and learning processes have been described yet. However, as intrapersonal competency is closely linked to interpersonal competency (ibid.), insights from interpersonal competency development can serve as a starting point to actively incorporate intrapersonal competency development in sustainability education.

Learning processes found to support the development of interpersonal attitudes, as part of one's mindsets, typically combine *experiencing* and *reflecting*; learning processes which are then followed by *experimenting* (Konrad et al. 2021). The same research then showed, for instance, that a self-confident attitude observed in practice by a sustainability professional can invite a student to revisit one's own attitude in, e.g., approaching stakeholders on sustainability issues. Here, *experiencing* and *reflecting* are combined. Creating more opportunities to, e.g., engage with stakeholders allows for the process of *experimenting* as well. Project-based course formats have been shown to be conducive to the development of key competencies, particularly interpersonal competency (Birdman et al. 2021; Brundiers and Wiek 2013; Konrad et al. 2020; Oxenswärdh and Persson-Fischier 2020; Soini et al. 2019). The multitude of different interaction types occurring in such courses—with peers, instructors, and stakeholders, and potentially, with tutors as mentors—allows for different learning processes to fruitfully enrich each other to further competency development (Konrad et al. 2021).

As key competencies in sustainability reveal themselves in practice (Barth 2015), applied course formats based on experiential learning theory (Kolb and Kolb 2012), such as project-based learning, lend themselves to key competency development overall. What seems to be particularly critical for intrapersonal competency though, is that space for reflection and introspection—space for the self—is actively incorporated in order to augment the formal and informal spaces that are already automatically created through the different interaction types that occur in such settings (Konrad et al. 2021) (Fig. 1)

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4 Theory U, Permaculture, and NVC—Cultivating Intrapersonal Competency

Scholars have long been calling for the development and use of innovative pedagogies for educating future change agents capable of pushing sustainability transitions and transformations forward (Barth 2015; Thomas 2009; Wals and Corcoran 2012; Wiek et al. 2014). To account for this, the key competencies in sustainability framework by Wiek et al. (2011) has informed sustainability program and course (re-) design around the world. With the recent inclusion of intrapersonal competency in the framework

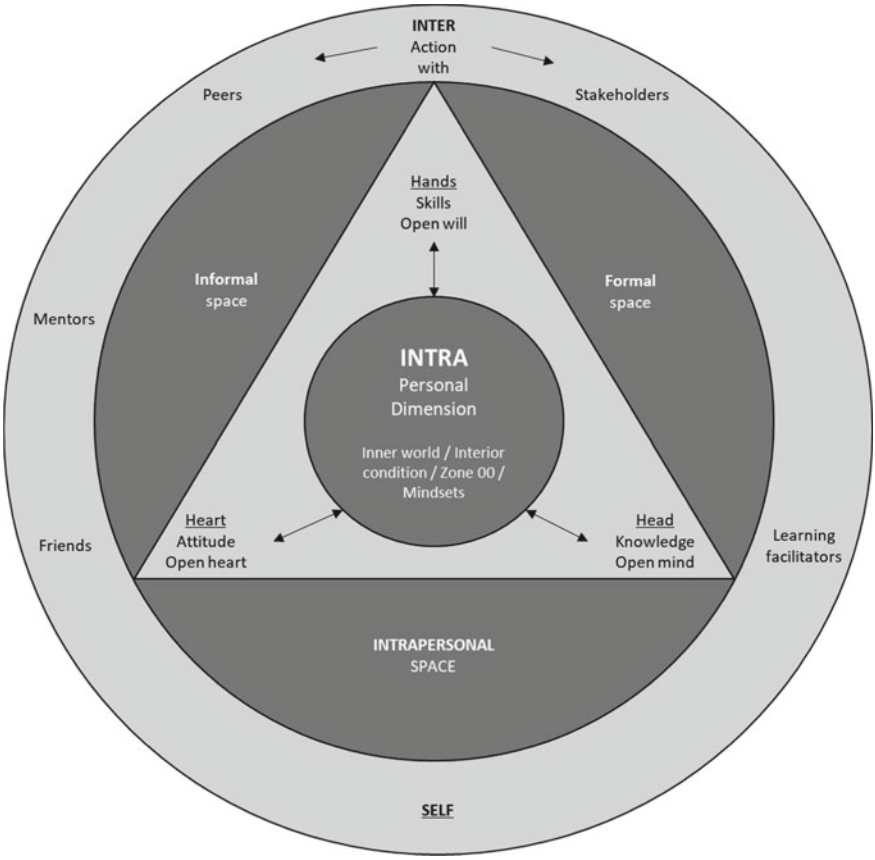

Fig. 1 Adapted from Konrad (2021) and inspired by Theory U and permaculture. Interpersonal competency development is fostered by both formal and informal learning environments, or spaces. Peers, tutors/mentors and friends provide support in an informal atmosphere, which serves to help develop interpersonal attitudes, knowledge, and skills; while instructors/learning facilitators and stakeholders present a more formal atmosphere for interpersonal competency development (Konrad et al. 2021). Intrapersonal competency calls for space as well (Giangrande et al. 2019). Adequate time needs to be consciously provided to allow for introspection and taking care of one's 'inner world' (Ives et al. 2019)

(Brundiers et al. 2020; Redman and Wiek 2021), practices have to be identified that implement this additional competency at the course level as well. This has begun to happen with the integration of mindfulness practices in sustainability programs (Frank et al. 2019; Papenfuss et al. 2019; Wamsler et al. 2018). Here, three social theories and practices are introduced that can further enrich sustainability teaching and learning environments, and allow for intrapersonal competency development.

First, Theory U is introduced, which talks about 'interior conditions' (Fig. 1) and consciousness as foundations for interventions. Second, permaculture is presented, which uses the concept of 'zone 00' (Fig. 1) when referring to the self as the closest

point of intervention for change. The third, non-violent communication (NVC), is focused on how to uncover the (unmet) needs behind our emotions and behavior; and thereby, allow us to connect more deeply to ourselves and to each other through the needs we all have in common.

4.1 Theory U

> The success of an intervention depends on the interior condition of the intervenor.
>
> – Bill O'Brien via *Theory U*, Otto Scharmer

Theory U, introduced by action researcher Otto Scharmer (2018) and disseminated at the Presencing Institute,[2] is based on three main premises: First, that you can only understand a system when you change it. Second, that a system can only be changed if the consciousness of the individuals operating within it change. And, third, that individual consciousness can only change if one is able to see the system in its entirety.

Within the framework of Theory U, one method which is aimed at providing a better understanding of entire systems, is the 3D mapping, or **co-sensing** method. Co-sensing begins from a place of *open mind*, i.e. seeing with fresh eyes; *open heart*, i.e. seeing through the eyes of others; and *open will* (Fig. 1), i.e. 'letting go' and 'letting come' (Pomeroy and Oliver 2021; Scharmer 2018). With inner listening, sensing, and presencing as its foundations, the method is about understanding a system that a group or organization is collectively trying to change (systems-thinking competency)[3] by including a variety of stakeholder perspectives, and attempting to consider perspectives that may be missing or underrepresented within the group (values-thinking competency). Further, it is about sensing the highest future potential of a system (futures-thinking competency). Part of the co-sensing method is also reflecting on the steps to be undertaken when moving from the status quo system model to the one of the highest future potential (strategic-thinking competency). As the 3D mapping process is intended to be conducted in a collaborative and facilitated setting, inter- and intrapersonal competency is, ideally at least, modeled by the facilitator.

A deeper connection to often untapped sources of information, such as intuition and emotions, is promoted through the conscious practice of sensing and presencing. A shift of consciousness, from ego- to eco-system awareness, is sought (Koenig et al. 2021). **Moments of silence** and inquiring about one's **intentions** before (inter-) acting with other course participants stems from the premise that **energy follows**

[2] https://www.presencing.org/ [30.01.22].

[3] Theory U is not about competency development or planning per se but about the 'emergence of future possibilites' by integrating all our ways of knowing (Pomeroy and Oliver (2021)). However, moments during the 3D mapping process where key competencies in sustainability (Brundiers et al. (2020); Wiek et al. (2011)) might show themselves in practice and might be further developed are indicated with the respective key competency in parentheses.

attention. The Theory U process strives for 'ABC'—**awareness-based collective action**; hence, conscious collaborative action, which both requires and enhances intra- and interpersonal competencies.

4.2 Permaculture

> With permaculture design each of the functions would have backups and be met in at least three ways—multiple elements for every important function.
>
> – Looby Macnamara via People & Permaculture

The term permaculture originally stood for permanent agriculture, but has evolved to stand for permanent sustainable culture (Macnamara 2012). It is a design method that begins with the investment of time in site **observation** and study. Following this, the **planning** phase starts with the focus on creating a more or less self-reliant and self-sustaining system, following the principle of **minimum effort for maximum effect**. In essence, permaculture practitioners strive for thinking and acting like an ecosystem (Macnamara 2012, p. 30). Key permaculture principles include 'observe and interact', '**apply self-regulation** and accept feedback', 'integrate rather than segregate', 'use small and slow solutions', 'use and value diversity', and 'creatively use and respond to change'.[4] These principles are used to facilitate **conscious design of actions** or interventions in a given system.[5] With her book "People and Permaculture", Looby Macnamara (2012) shows how permaculture principles can be transferred to other systems. Instead of gardens and landscapes, social systems like teams, organizations and individuals are seen as landscapes to which the design principles are applied. Permaculture planning differentiates between various zones. In 'social' permaculture, zone 00 is analogous to what Theory U refers to as the interior condition, hence the intrapersonal dimension—the self. While it is the zone closest to one's self in which to intervene, it is not necessarily the easiest. However, it is not only the one where we ourselves can potentially have the most impact, rather it is considered essential, as "[w]e are central to all that we do and if we do not manage our own energy well then this will have a ripple effect through the other zones." (Macnamara, p. 43). Social permaculture, as introduced by Macnamara (2012), calls for special care and attention to be paid to zone 00—the self, or the inner dimension. One of the key premises of permaculture is that for every important function in a system there should be three ways to assure its provision. For the social sphere, and one's personal resilience, this can translate into the following: Three ways to satisfy every identified need. This requires, first of all, an awareness of these needs. The practices involved in non-violent communication include generating such an awareness.

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[4] This last principle is reminiscent of Brundiers and Wiek's (2017) Professional Skill of responsive project management.

[5] Looby Macnamara (2012, p. 47) offers a collection of guiding questions for each principle to help prepare for system intervention. These could be used in sustainability education to interview one's self.

4.3 Non-violent Communication

> Needs: To take responsibility for one's own feelings
>
> – Marshall B. Rosenberg via *Nonviolent Communication*: A Language of Life

Non-violent communication (NVC), after Marshall Rosenberg, is also called compassionate communication (Rosenberg 2015). NVC focuses on self-understanding as a foundation for understanding others. Needs such as connection to others, autonomy, or meaning, are something humans share. NVC provides both a feelings and a needs inventory[6] intended to provide a more nuanced language; and thereby, an increased visibility and awareness of needs and the degree to which they remain unmet in the current surroundings. The ability to acknowledge one's own feelings and to be able to relate them to one's own (unmet) needs leads to better self-understanding and a higher level of self-compassion. This is a place from which to interact in kinder ways—both with one's self and with others.

Overall, NVC invites the individual to take responsibility for and shape one's own understanding of needs and emotions. Similar to Theory U's interior condition and social permaculture's zone 00, NVC is intended to change the way we interact by beginning with one's self. Sending "I"-messages by asking one's self first: *What has happened/is happening right now?* (**observations**) *How does it make me feel*? (**emotions**) *How are my feelings related to my* ***need(s)****? What do I wish for?* (**requests**) (Rosenberg 2015).

NVC is designed to avoid blaming, and instead paves the way for more honest and authentic encounters between individuals, based on what we all share: certain feelings in relation to (unmet) needs. NVC intends to open space for **empathy** and dialogue and aids in de-escalating conflicts by allowing individuals to connect with each other on this basis. As Macnamara (2012, p. 44) points out: "Unmet needs can leave us with unwanted feelings and emotions and take us into a spiral of erosion" which, drawing on systems-thinking, might have cascading effects elsewhere (Wiek et al. 2011). Therefore, having a connection to one's self, knowing one's needs and acting accordingly, is also the baseline for what Theory U states; namely, that the quality of interventions, including interactions, depends on each individual's inner state.

These three streams of knowledge and practice were briefly introduced to point out how they link to intrapersonal competency and each other; and thereby, can serve to cultivate intrapersonal competency, on which sustainability efforts depend.

[6] For a needs inventory see https://www.cnvc.org/sites/default/files/needs_inventory_0.pdf [26.01.22].

5 Results

5.1 CSX—Course Context and Concept Introduction

Project-based sustainability courses have been shown to be conducive learning environments for interpersonal and other competency development (Birdman et al. 2021; Konrad et al. 2021). On this premise, a newly designed course for the Leuphana-Sustainable Entrepreneuship Certificate (L-SEC)[7] is used as an example to illustrate the ways in which intrapersonal competency development can be accounted for in course design.

The course "#CSX: Community Supported Economy. New entrepreneurial narratives in words & deeds." is a course for second semester graduate students pursuing the L-SEC at Leuphana University of Lüneburg, Germany. The course takes place within the module "Reflecting on Research Methods", and is embedded within two other modules: "Engaging with Knowledge and Sciences" (semester 1) & "Connecting Science, Responsibility and Society" (semester 3). Course sessions take place bi-weekly, which translates into seven sessions of three hours each.

The acronym 'CSX' is derived from 'CSA', which stands for Community Supported Agriculture (Rommel 2017; Rommel and Koch 2021). The 'X' implies that CSA principles are applied to contexts other than agriculture. One of the core principles of the CSX concept is that producers and consumers are directly linked, and embark together on a shared-risk enterprise. Responsibility is taken together for societal needs satisfaction.

CSX presents an alternative entrepreneurial pathway that is needs- instead of market-oriented. At its heart are people and the relationships they create (Rommel and Koch 2021). It is an alternative, while not new, form of economic activity with its primary focus on people, their needs, and their overall wellbeing.

For the course, the following vision was developed: A book is co-created during the course which describes already existent and investigated CSX endeavors, as well as the students' own emerging CSX projects. The mission of the course is to allow students to relate to existing CSX initiatives, to reflect on and learn from actual practice, and to transfer this knowledge to their own projects in order to co-create, experiment, and develop innovative sustainability ideas.

The learning objectives for the course encompass key competencies in sustainability (Brundiers et al. 2020), including intrapersonal competency, and professional skills (Brundiers and Wiek 2017), as well as skills in qualitative research (Table 1).

The idea of a co-created book and the cooperation with the CSX network association[8] is based upon Meadows (1999) premise on how to change paradigms: By giving alternatives and solutions visibility. To further pursue this aim, the CSX TALK, an

[7] https://www.leuphana.de/en/institutes/centre-for-sustainability-management-csm/social-entrepreneurship/leuphana-sustainable-entrepreneurship-certificate-L-sec.html [30.01.22].

[8] https://gemeinschaftsgetragen.de/en/ [30.01.22].

Table 1 The application of constructive alignment (Biggs 1996) to the present course context: Thinking learning outcomes, processes, and forms of assessment together upfront. The right column gives a non-exhaustive list of references to consult for further information on learning objectives, processes, or assessment in each row.

Learning objectives	Learning processes	Assessment as learning/Evaluation	Selected references
Interpersonal competency (IC)			
Collaborative teamwork (CT)	Receiving input on CT; experiencing, reflecting, and experimenting with teamwork tools and methods (e.g. code of conduct, team meeting design)	**Code of conduct**, transparency on **agenda** planning, **Photovoice Gallery Walk** (team work process and progress in pictures); **Students-instructor reflection** sessions (coaching, including team dynamics)	Brundiers and Wiek 2017; Ciolan and Manasia 2017; Konrad et al. 2021
Impactful stakeholder engagement (ISE)	Receiving input on ISE; experiencing and experimenting with and reflecting on engagement practices (in class and/or with stakeholders)	Facilitated and/or reported sensing activity—**3D mapping**; **CSX Talk**	Brundiers et al. 2010; Konrad et al. 2021; Presencing Institute
Compassionate communication	Receiving input on NVC; experiencing and experimenting = practicing NVC in all interactions	Observation; written report, **(self-) reflection questions, giving and receiving feedback** in peer interactions	Brundiers and Wiek 2017; Rosenberg 2015
Intrapersonal competency	**Reflecting,** introspection**,** e.g. using a permaculture inspired interview guideline; **experiencing,** embodiment, e.g. exercises such as keeping one's own balance; telling about one's self in metaphors; **experimenting** based upon experiencing and reflecting	Exchange inspired by **NVC** and the practice of listening (**Theory U**) in peer interactions; debriefings of exercises = Students-instructor reflection; process tracking via **Photovoice**; written and oral self-reflection in course outputs: book & CSX Talk	Brundiers et al. 2020; Frank 2020; Giangrande et al. 2019; Konrad and Freeth, in review; Pomeroy and Oliver 2021; Redman et al. 2021; Woiwode et al. 2021
Systems- and values-thinking competency			
Systems understanding	Receiving input on the purpose of and briefing in the practice of 3D mapping	**3D mapping workshop**	Presencing Institute; Scharmer 2018
Futures-, strategic-, and values-thinking competency			

(continued)

open format for exchange, as well as additional events are incorporated into the course in order to reach a wider audience.

Inclusion of the social theories and practices described above, such as 3D mapping, introspection informed by NVC and permaculture, and deep examination of one's own zone 00, is intended to support students in becoming ambassadors of transformative change from the inside out.

Table 1 (continued)

Learning objectives	Learning processes	Assessment as learning/Evaluation	Selected references
Backcasting method	Modeling backcasting: presenting the course vision and the strategy for realizing it; experimenting with backcasting, including visioning—alone and in teams	Project sketch attached to the project report; **in-class presentation,** coaching	Macnamara 2012; Meadows 1999; Wiek and Iwaniec 2014
Implementation competency			
Taking conscious action together ['ABC']	Transferring: Experimenting with CSX in practice, based upon insights gained from investigation and competencies developed	Project presentations and **student organized** and/or **facilitated events** (e.g. community-building)	Brundiers et al. 2020; Presencing Intitute; Scharmer 2018; Wiek and Kay 2015
Professional and research skills			
Responsive project management	Experiencing and experimenting: Teamwork, coaching	Realization of a **co-created book** portraying already existing and students' emerging CSX endeavors	Brundiers and Wiek 2017
Application of qualitative research methods	Receiving input and modeling of method application; experiencing and experimenting: transfer to other contexts	Audio-,visual-, and written **presentation/performance** of method application (e.g. Gallery Walk, facilitated workshop)	Kolb and Kolb 2012; Wang and Burris 1997
Writing	Creative and academic writing assignments (e.g. letter from the future, CSX portrays)	Written assignments and co-created book	See e.g. Meadows 1994; R. Hopkins; G. Monbiot

The Photovoice method (Wang and Burris 1997), as a research, teaching, learning, and reflection tool that invites students to use their own creativity and personalities, is used to track the course in pictures (Konrad 2021). These picturese serve as memory hooks for collective meaning making sessions, to tap into potentially yet untold narratives that occur during students' engagement with the process of realizing their personal visions, departing from zone 00.

Embodiment exercises, such as what it means to take care of one's own balance (inspired by Tango,[9] for instance), or storytelling sessions where individual participants describe themselves using metaphors[10] can provide additional ways to experience one's self in new ways, while tapping into the status quo of self-perception.

[9] See Konrad and Freeth (in review) and the author's blog post #3: "To dance beautifully, each one must stand in their own axis"; https://blog.thereskonrad.org/?p=262 [30.01.22].

[10] A metaphoric way of self-discovery allows the author's project *Verbal Pollination – stories to empower*; https://verbalpollination.thereskonrad.org/?page_id=9 [30.01.22].

5.2 *Now What?—What to Do to Become an Ambassador of Transformative Change from the Inside Out?*

Brundiers and Wiek (2017) asserted that change starts within, and not outside ourselves. Theory U, permaculture, and NVC each offer practices that support sustainability transformations in the world, beginning with one's self. The present article has only scratched the surface of each of these practices and how they link to intrapersonal competency and its development. Therefore, this paper should be seen as an invitation to delve deeper into these fields, and to invigorate the conversation about how to be(come) ambassadors of transformative change from the inside out.

Instructors are role-models; and thus, are seen as "the single most important factor when it comes to success in students' learning and it is the teacher's competencies that create learning opportunities with the greatest potential learning outcomes" (Bürgener & Barth, 2018, p. 822). Therefore, learning facilitators and course designers are encouraged to begin with their own zone 00 s.

Theory U emphasizes the importance of clarifying one's own **intention** before engaging in any (inter-) action. To this end, each course session or a team meeting could begin with a moment of silence to provide the opportunity for each individual participant to truly arrive in the present situation, and to simultaneously reconnect with one's self. In our fast-paced world, a moment of silence can be a gift. As stated above, energy follows attention; therefore, clarifying our intention for ourselves before we engage with others (e.g. on a sustainability challenge) supports us in being more focused on the task, while simultaneously training us in self-centering and taking care of our own energy households. 3D mapping, or co-**sensing**, is another way to experience several key competencies in sustainability, while at the same time developing skills in both **presencing and sensing**, and observing what wants to emerge from this state.

Permaculture places equal emphasis on the importance of observing first before engaging in hands-on action; and thus, departs from a can-do, solution-oriented attitude. This practice can be translated to the design of landscapes, courses, and—finally—one's own way of being. We are all potential creators and agents of change, and it is our **mindset** that determines the direction. In line with the most commonly used sustainability dimensions (environment, society, economy), permaculture ethics include Earth Care, People Care, and Fair Share. One key additional concept that can be learned from the permaculture model is the importance of planning in a way that ensures that **multiple elements care for every important function**. On the level of course design, this translates into accounting for at least three ways to provide students the opportunity to achieve each learning objective, such as intrapersonal competency. In terms of taking care of zone 00—the self—this principle suggests mapping out how personal needs can be satisfied in at least **three ways to increase one's own personal resilience**: Taking care of one's inner state, as repeatedly stated, is central for our actions in the world.

NVC provides us with practices that build a new communication culture; it makes needs and feelings visible to help guide us in our (inter-) actions. Striving for a culture

of compassionate communication, NVC empowers each one of us to truly get to know ourselves by identifying our own needs, which provides a basis for their appropriate satisfaction as well as for honest encounters with others. Also, this ultimately supports personal resilience—of students, instructors—of people.

Interpersonal competency development can provide preliminary guidance for how intrapersonal competency development can take place in the classroom. **Experiencing** co-sensing, for instance by engaging in a 3D modeling workshop, allows participants to reflect and sense a system from different perspectives. **Reflecting** upon zone 00 allows each participant to uncover for one's self what it entails to truly thrive. **Experimenting**, for example, by applying NVC in practice is a way to discover one's self and others anew through dialogue and empathy. These practices have the potential to create change in the immediate surroundings where they are applied, and may as well be the starting point for the transformation we want to see happening in the world at large. Macnamara (2012) reminds us that.

> If we cannot change ourselves then how can we want or expect the rest of the world to alter? When we change one person in a relationship then the dynamic shifts. We alone can transform ourselves and through this we can change the world. Our growth and development will alter the environment around us. (…) what we do for ourselves we do for the greater good. (Macnamara 2012, p. 52)

Intrapersonal competency might be developed in sustainability education by letting (principles of) Theory U, permaculture, and NVC inspire both, course design as well as course designers and facilitators. Next to them being role-models, the presented principles and practices can serve as starting points for course interventions to allow students to be(come) the leaders of the future.

6 Discussion

Intrapersonal competency is crucial for sustainability change agents (Redman et al. 2021). Schneider et al. (2019) call for the enhancement of competencies that support "reflective leadership". Knowing and taking care of one's own needs and being able to maintain motivation "in the face of adversity is a crucial skill […] to facilitate the needed sustainability transformations" (Redman et al. 2021, p. 319). First of all, however, attention and thereby, energy should be directed into things we can change:

> zone 00, ultimately the place of most influence. Our own self is the place of *minimum effort for maximum effect*. Any activity that we can do to centre ourselves, align with our aspirations, increase our well-being, improve our communication skills and expand our knowledge is within our circle of influence. Just by demonstrating these things our words will start to have more weight with the people around us. When we have more presence and focus and keep the commitments we make, others are more likely to listen. When we are awake to our own leadership we are able to move forward. (Macnamara 2012, p. 192)

> Redman et al. (2021, p. 320) back this up by pointing out that "no matter how great your systems thinking or how amazing the strategies you develop, if an individual does not have a strong sense of personal identity, the skills to support their own well-being, and the motivation

> to make change, they will not be able to facilitate the sustainability transformations they once dreamed of leading".

The transformational, solution-oriented approach of sustainability science strives for real world changes towards sustainability (Wiek et al. 2012). However, the focus is still on the changes needed in front of our eyes. The inner dimension—what is happening behind our eyes –, has long been neglected. Woiwode et al. (2021) stress that little attention has been paid thus far to inner transformations for sustainability or the deep leverage point of mindsets (Abson et al. 2017). Several scholars, such as Dlouhá et al. (2019), Freeth (2019), Horlings et al. (2020), and Scharmer (2018) have started to bring our attention to the power of introspection and the inner, personal dimension of sustainability. As the personal aspects of transdisciplinary research tend to be overlooked, Sellberg et al. (2021) have recently introduced the heuristic of the 'Triple-S', now caring for Science, Society and the Self. If researchers, practitioners—people—are meant to sustain themselves throughout the change processes they are trying to push forward, the strived well-being for all needs to start with one's self.

This paper followed two intentions. First, to further the ongoing discussion of the interlinkages between the intrapersonal dimension, our inner worlds, and the sustainability transformations we seek in the outer world (Ives et al. 2019), a goal which was addressed through the introduction of three social theories and practices—Theory U, permaculture, and NVC. These were only briefly presented as an invitation for further self-study. Their introduction further served the second intention of the present paper; namely, to present practices to promote intrapersonal competency that can be applied in daily life as well as in sustainability education settings.

The course "#CSX: Community Supported Economy. New entrepreneurial narratives in words & deeds." served as an example to illustrate how—based upon insights from interpersonal competency development—intrapersonal competency development can be accounted for in sustainability education. Constructive alignment (Biggs 1996), the thinking together of learning outcomes, processes, and assessment upfront, can further enrich course design. First, intrapersonal competency can be set as an explicit learning objective, hence envisioned. Then, backcasting can be used to determine how this and other key competencies can be developed, specifiying processes and assessments to support further learning.

Both the course title and its focus were inspired by the call for new narratives. Macnamara (2012) asked "What are the limiting factors for achieving a socially just and sustainable future? What's taking us off in the wrong direction? Is it lack of information, imagination, education or resources?" (Macnamara 2012, p. 168). She goes on to state that:

> Perhaps we do not have a clear vision of what we would actually like as a society, and share the ambition of wanting to get there. If we knew where we wanted to get to, and were all aligned to the values of co-operation and sustainability we would be able to prioritise actions that took us in this direction. (…) People need access to attractive alternative ways of living. (Macnamara 2012, p. 168)

George Monbiot's TEDtalk "The new political story that could change everything"[11] and Rob Hopkins' elaborations on imagination[12] further back up Meadows (1999) suggestion:

> So how do you change paradigms? […] you keep pointing at the anomalies and failures in the old paradigm, you keep speaking louder and with assurance from the new one, you insert people with the new paradigm in places of public visibility and power. (Meadows 1999, p. 18)

There is a call to tell and share **new stories**—new narratives humanity can grow into. In addition to the need to set clear intentions, what is needed is visibility—of alternatives, of solutions, of answers. Community-supported 'X' may turn into a lighthouse for new entrepreneurial journeys with people in mind first. Theory U; with its call to start with an open mind, an open heart, and an open will to facilitate awareness-based collective action, may serve as an inspiration to consciously identify steps that truly want to emerge in the present moment, and lead us to the highest future potential we can imagine. Permaculture teaches us to observe and imagine what is possible before planning and doing hands-on work. Transferred to the social context, it invites us to look first to the closest zone of potential intervention: ourselves. *What nourishes us? What feeds our souls and selves? How can I take care of myself so that I can take care of others, too?* NVC—like Theory U and permaculture—can support us in better understanding systems. This includes individual systems –, ourselves. Uncovering our own needs and taking them seriously is what Brundiers and Wiek (2017) called 'preventative self-care'.

Taking care of one's self is not selfish but rather, a necessary pre-condition for being a sustainability change agent that is able to endure (Redman et al. 2021). Yes, new stories at the society level need to be told. Also, the discourse needs to be changed in terms of what consitutes good academic and teaching practices, as already called for a decade ago (Fischer et al. 2012; Ives et al. 2019). However, the key story that this paper intends to transmit is the need to start with the zone closest to you—yourself.

With the inspiration of the social theories, practices, and frameworks presented here, and the acknowledgement of mindsets as deep leverage points (Abson et al. 2017; Meadows 1999): *How does your story sound? What story do you want to tell about yourself?*

7 Limitations

This paper is based upon empirical research on interpersonal competency development. Thus, what the paper presents is a preliminary suggestion of how intrapersonal competency development might be accounted for on the course level, informed by

[11] https://www.ted.com/talks/george_monbiot_the_new_political_story_that_could_change_everything [30.01.22].

[12] https://www.robhopkins.net/ [30.01.22].

learning processes identified in the context of interpersonal competency development. The described course starts in April 2022. Therefore, the realization of the anticipated learning outcomes is yet to be observed and assessed. While this might be a valuable opportunity to investigate intrapersonal competency development as a step towards appropriate and needed adaptations of sustainability education, the question remains how to best assess someone's intrapersonal dimension (Schneider et al. 2019).

A further literature review on mindfulness practices could deepen this discussion on the inner dimension of sustainability and how it links to sustainability transformations overall.

8 Conclusion

Intrapersonal competency development needs to be accounted for within sustainability education if the sustainability leaders of the future, the students, are to instigate and persevere at the societal change processes ahead. Therefore, Theory U, social permaculture, and non-violent communication have been presented as social theories and practices that can allow sustainability transformations to begin on our own doorsteps. Being clear on one's intention and having an awareness of our own and societal needs allows for focused attention and a communication culture based on empathy, which fosters collaborative problem-solving. Social permaculture can further serve to build personal resilience; key in facing the sustainability challenges ahead. Learning processes derived from interpersonal competency development serve as preliminary guidance to plan for intrapersonal competency development in the classroom. Theory U, social permaculture, and non-violent communication can contribute to the long neglected discourse on the inner dimension of sustainability—the self, and our mindsets from which our actions depart. At the same time, they invite to find application in sustainability practice; from the classroom to interventions taken outside academia. Both, students as well as faculty, are called to be(coming) ambassadors of transformative change from the inside out to demonstrate that sustainability transformations are not only possible—they are underway.

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For further self-study: Theory U: https://www.presencing.org/

Center for NVC: https://www.cnvc.org/

References

Abson DJ, Fischer J, Leventon J, Newig J, Schomerus T, Vilsmaier U, von Wehrden H, Abernethy P, Ives CD, Jager NW, Lang DJ (2017) Leverage points for sustainability transformation. Ambio 46(1):30–39. https://doi.org/10.1007/s13280-016-0800-y

Barth M (2015) Implementing sustainability in higher education: learning in an age of transformation. Routledge studies in sustainable development. Routledge

Biggs J (1996) Enhancing teaching through constructive alignment. High Educ 32(3):347–364. https://doi.org/10.1007/BF00138871

Birdman J, Wiek A, Lang DJ (2021) Developing key competencies in sustainability through project-based learning in graduate sustainability programs. Int J Sustain Higher Educ Vol. ahead-of-print No. ahead-of-print

Brundiers K, Wiek A (2013) Do we teach what we preach? An international comparison of problem- and project-based learning courses in sustainability. Sustainability 5(4):1725–1746. https://doi.org/10.3390/su5041725

Brundiers K, Wiek A, Redman CL (2010) Real-world learning opportunities in sustainability: from classroom into the real world. Int J Sustain High Educ 11(4):308–324. https://doi.org/10.1108/14676371011077540

Brundiers K, Wiek A (2017) Beyond interpersonal competence: teaching and learning professional skills in sustainability. Educ Sci 7(1). https://doi.org/10.3390/educsci7010039

Brundiers K, Barth M, Cebrián G, Cohen M, Diaz L, Doucette-Remington S, Dripps W, Habron G, Harré N, Jarchow M, Losch K, Michel J, Mochizuki Y, Rieckmann M, Parnell R, Walker P, Zint M (2020) Key competencies in sustainability in higher education—toward an agreed-upon reference framework. Sustain Sci (Online). Advance online publicationhttps://doi.org/10.1007/s11625-020-00838-2

Bürgener L, Barth M (2018) Sustainability competencies in teacher education: Making teacher education count in everyday school practice. J Clean Prod 174:821–826. https://doi.org/10.1016/j.jclepro.2017.10.263

Ciolan L, Manasia L (2017) Reframing photovoice to boost its potential for learning research. Int J Qual Methods 16(1):1–15. https://doi.org/10.1177/1609406917702909

Dlouhá J, Heras R, Mulà I, Salgado FP, & Henderson L (2019) Competences to address SDGs in higher education—a reflection on the equilibrium between systemic and personal approaches to achieve transformative action. Sustainability 11(13):3664

Fischer J, Ritchie EG, Hanspach J (2012) An academia beyond quantity: a reply to Loyola et al. and Halme et al. Trends Ecol Evol 27(11):585; author reply 587-8. https://doi.org/10.1016/j.tree.2012.07.016

Frank P (2020) Developing affective-motivational competence within education for sustainable consumption through self-reflexive learning activities [Doctoral thesis]. Leuphana Universität Lüneburg, Lüneburg, Germany

Frank P, Sundermann A, Fischer D (2019) How mindfulness training cultivates introspection and competence development for sustainable consumption. Int J Sustain High Educ 20(6):1002–1021. https://doi.org/10.1108/IJSHE-12-2018-0239

Freeth R (2019) Formative accompanying research with collaborative interdisciplinary teams [Doctoral thesis]. Leuphana Universität Lüneburg, Lüneburg, Germany

Giangrande N, White RM, East M, Jackson R, Clarke T, Saloff Coste M, Penha-Lopes G (2019) A competency framework to assess and activate education for sustainable development: addressing the UN sustainable development goals 4.7 challenge. Sustainability (Online), 11. https://doi.org/10.3390/su11102832

Göpel M (2016) The great mindshift: how a new economic paradigm and sustainability transformations go hand in hand. Springer Open

Horlings LG, Nieto-Romero M, Pisters S, Soini K (2020) Operationalising transformative sustainability science through place-based research: the role of researchers. Sustain Sci 15, 467–484. https://doi.org/10.1007/s11625-019-00757-x

Ives CD, Freeth R, Fischer J (2019) Inside-out sustainability: the neglect of inner worlds. Ambio. Advance online publication. https://doi.org/10.1007/s13280-019-01187-w
Koenig O, Seneque M, Pomeroy E, Scharmer O (2021) Journal of awareness-based systems change: the birth of a journal. J Aware-Based Syst Chang 1(1):1–8. https://doi.org/10.47061/jabsc.v1i1.678
Kolb AY, Kolb DA (2012) Experiential learning theory. In: Seel NM (ed) Encyclopedia of the Sciences of Learning, pp 1215–1219
Konrad T, Wiek A, Barth M (2020) Embracing conflicts for interpersonal competence development in project-based sustainability courses. Int J Sustain High Educ 21(1):76–96. https://doi.org/10.1108/IJSHE-06-2019-0190
Konrad T, Wiek A, Barth M (2021) Processes of interpersonal competence development—insights from a comparative study of project-based sustainability courses. Int J Sustain High Educ 22(3):535–560
Konrad T, Freeth R (in review). Bearing fruit: Interpersonal competency development in sustainability education
Konrad T (2021a) Time for refl-action: interpersonal competence development in project-based sustainability courses (1). Doctoral thesis, Leuphana University of Lüneburg, Lüneburg, Germany. CrossRef
Konrad T (2021b) Time for refl-action: interpersonal competence development in project-based sustainability courses (1) [Doctoral thesis]. CrossRef
Macnamara L (2012) People & permaculture: designing personal, collective and planetary well-being. Permanent Publications.
Meadows D (1999) Leverage points: places to intervene in a system. The Sustainability Institute, Hartland
Meadows D (1994) Guided Envisioning of a sustainable world: inspired by a speech written for the third biennial meeting of the international society for ecological economics, October 24–28, 1994, San Jose, Costa Rica. https://donellameadows.org/wp-content/userfiles/Guided-Envisioning-of-a-Sustainable-World-1.pdf
Oxenswärdh A, Persson-Fischier U (2020) Mapping master students' processes of problem solving and learning in groups in sustainability education. Sustainability (Online) 12(13). https://doi.org/10.3390/su12135299
Papenfuss J, Merritt E, Manuel-Navarrete D, Coutier S, Eckard B (2019) Interacting pedagogies: a review and framework for sustainability education. J Sustain Educ 20
Pomeroy E, Oliver K (2021) Action confidence as an indicator of transformative change. J Transform Educ 19(1):68–86. https://doi.org/10.1177/1541344620940815
Redman A, Wiek A (2021) Competencies for advancing transformations towards sustainability. Front Educ 6 (Article 785163):176. https://doi.org/10.3389/feduc.2021.785163
Redman A, Rowe D, Brundiers K, Brock A (2021) What motivates students to be sustainability change agents in the face of adversity? Sustain Climate Change 14(5). https://doi.org/10.1089/scc.2021.0024
Rommel M (2017) Zukunftsfäjige Wirtschaftsgemeinschaften (CSX): Übertragung der CSA-Logik auf andere Versorgungsfelder [Masther thesis]. Carl von Ossietzky Universität, Oldenburg, Germany
Rommel M, Koch F (2021) Gemeinschaftsgetragen Wirtschaften: economists for future. Makronom. https://makronom.de/gemeinschaftsgetragen-wirtschaften-39659
Rosenberg MB (2015) Non-violent communication: a language of life, 3rd edn. Puddle Dancer Press
Scharmer OC (2018) The essentials of theory U: core principles and applications. Berrett-Koehler Publishers
Schneider F, Giger M, Harari N, Moser S, Oberlack C, Providoli I, Schmid L, Tribaldos T, Zimmermann A (2019) Transdisciplinary co-production of knowledge and sustainability transformations: three generic mechanisms of impact generation. Environ Sci Policy 102:26–35. https://doi.org/10.1016/j.envsci.2019.08.017

Sellberg MM, Cockburn J, Holden PB, Lam DPM (2021) Towards a caring transdisciplinary research practice: navigating science, society and self. Ecosyst People 17(1). https://doi.org/10.1080/26395916.2021.1931452

Senge P, Scharmer O, Winslow D (2013) 30 years of building learning communities: a dialogue with Peter Senge, Otto Scharmer, and Darcy Winslow. In Molloy J, Wallace D (eds) Reflections: The sol journal on knowledge, learning, and change, vol 12, Number 4. Society for Organizational Learning, Frank Schneider

Soini K, Korhonen-Kurki K, Asikainen H (2019) Transactional learning and sustainability co-creation in a university—business collaboration. Int J Sustain High Educ 20(6):965–984. https://doi.org/10.1108/IJSHE-11-2018-0215

Strauss A, Corbin J (1996) Grounded theory: grundlagen qualitativer sozialforschung. BELTZ Psychologie Verlags Union

Thomas I (2009) Critical thinking, transformative learning, sustainable education, and problem-based learning in universities. J Transform Educ 7(3):245–264. https://doi.org/10.1177/1541344610385753

UNESCO (2017) Education for sustainable development goals: learning objectives. United Nations Educational, Scientific and Cultural Organization. https://www.unesco.de/sites/default/files/2018-08/unesco_education_for_sustainable_development_goals.pdf

Wals AEJ, Corcoran PB (eds) (2012) Learning for sustainability in times of accelerating change. Wageningen Academic Publishers

Wamsler C (2020) Education for sustainability. Int J Sustain High Educ 21(1):112–130. https://doi.org/10.1108/IJSHE-04-2019-0152

Wamsler C, Brossmann J, Hendersson H, Kristjansdottir R, McDonald C, Scarampi P (2018) Mindfulness in sustainability science, practice, and teaching. Sustain Sci 13(1):143–162. https://doi.org/10.1007/s11625-017-0428-2

Wang C, Burris MA (1997) Photovoice: concept, methodology, and use for participatory needs assessment. Health Educ Behav 24(3):369–387

Wiek A, Iwaniec D (2014) Quality criteria for visions and visioning in sustainability science. Sustain Sci 9(4):497–512. https://doi.org/10.1007/s11625-013-0208-6

Wiek A, Kay B (2015) Learning while transforming: solution-oriented learning for urban sustainability in Phoenix, Arizona. Curr Opin Environ Sustain 16:29–36. https://doi.org/10.1016/j.cosust.2015.07.001

Wiek A, Withycombe L, Redman CL (2011) Key competencies in sustainability: a reference framework for academic program development. Sustain Sci 6(2):203–218. https://doi.org/10.1007/s11625-011-0132-6

Wiek A, Ness B, Schweizer-Ries P, Brand FS, Farioli F (2012) From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects. Sustain Sci 7(S1):5–24. https://doi.org/10.1007/s11625-011-0148-y

Wiek A, Xiong A, Brundiers K, van der Leeuw S (2014) Integrating problem- and project-based learning into sustainability programs. Int J Sustain High Educ 15(4):431–449. https://doi.org/10.1108/IJSHE-02-2013-0013

Woiwode C, Schäpke N, Bina O, Veciana S, Kunze I, Parodi O, Schweizer-Ries P, Wamsler C (2021) Inner transformation to sustainability as a deep leverage point: fostering new avenues for change through dialogue and reflection. Sustain Sci 46(2):30. https://doi.org/10.1007/s11625-020-00882-y

Yin RK (1984) Case study research: design and methods. SAGE Publications

Active Learning to Foster Economic, Social, and Environmental Sustainability Awareness

Javier Sierra and Ángela Suárez-Collado

1 Introduction

It is generally recognized that universities and higher education institutions must play a crucial role as drivers of change (Sonetti et al. 2019). In this situation, one of the most relevant challenges that institutions face is how to improve study plans to go beyond conventional educational models and develop and implement innovative multidisciplinary approaches to education for sustainable development (ESD) (Melles 2019; Lengyel et al. 2019). In a fast-evolving world that is becoming progressively complex over time, significant efforts have been made in recent years to identify ways to adopt institutional practices and reform the curricula for improving overall sustainability (Pizzutilo and Venezia 2021). Against this background, there is a gap in the literature between the recognized relevance of ESD and the actual level of integration and implementation in higher education (Figueiró et al. 2022). In this context, different perspectives related to the economic, social, cultural, and environmental dimensions of sustainable development concur in higher education institutions (Rouhiainen and Vuorisalo 2019). This has produced a scenario in which several ways to deal with sustainability-related issues at the individual, group, or institutional level coexist (Kemp and Scoffham 2022). As a result, there is still a threshold for improvement can be reached by increasing the presence of sustainability-related topics in a wide range of degrees and courses (Leal Filho 2020).

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To achieve the goal of transforming our societies into truly sustainable ones, it may not be sufficient to correct current forms of education and introduce innovations; rather, education must be converted into a real tool for change (Ferrer-Balas et al. 2010). In this vein, undergraduate students willing to take an active role in promoting sustainability need to learn not only how to convert original ideas into successful projects, but also to effectively align economic, social, and environmental objectives (Sierra and Suárez-Collado 2021b). Therefore, future sustainability leaders must be equipped with a set of crucial sustainability-oriented capabilities (SOC) (Claro and Esteves 2021) and leadership skills (Marathe et al. 2020). This is especially important for economics, business, and management study plans, as undergraduate students in these areas need to comprehend the relationship between key economic sectors, evolving social needs, and the SDGs, as well as any challenges that may arise when addressing these issues (Delgado et al. 2019; Adomßent et al. 2014; Stafford-Smith et al. 2017; Coleman and Gould 2019). To succeed in this task, it is fundamental to embrace pedagogical praxes grounded in a critical perspective concerning the consequences that economic decisions can have for society and the environment, and to do so from a global perspective (Sund and Pashby 2020).

Nevertheless, research on the effectiveness of innovative teaching and learning methodologies to raise sustainability awareness among young adults and help them develop leadership skills is still required, especially in relation to the learning outcomes that are expected from economics, business, and management students (Claro and Esteves 2021). Within this framework, this study aims to answer the following research questions: To what extent are active learning strategies useful to foster economic, social, and environmental sustainability awareness among undergraduate students? And how can active learning help students develop crucial skills to lead sustainability-oriented projects?

To answer these questions, the study presents an innovative educational method based on the combination of two simulations and three serious games used to recreate three different spheres of economic, social, and environmental sustainability. These activities were applied separately in two different settings to represent three levels of analysis and management concerning sustainability-related issues: local, national, and international. These frameworks were designed to address sustainability from two perspectives based on different approaches to the issue of distance. The first focal point was the political distance between citizens and management bodies, used to highlight the fact that different sustainability-related problems should be addressed from different management levels. In this case, the three spheres represented three different levels of public economics management. The local sphere was recreated using the SimCity computer game; the national sphere was represented by a simulation of the national parliament; and the international sphere was replicated by a simulation of the Council of the European Union. The second focal point, geographical distance, was employed to address the relationship between the location where the economic decisions are made and the effects they may have on society and the environment in different parts of the world. The local sphere was also replicated using the SimCity computer game; the national sphere was recreated using the Power Grid

board game; and the international sphere was represented through the Ethica -The Ethical Finance Game board game.

The combination of these approaches made it possible to create a two-pronged framework that helped students understand the complexity of managing sustainability issues, the role that public and private actors play in this regard, and the potential effects that individual decisions and behavior can have on the environment. At the same time, these strategies assisted them in developing a set of key skill-based and affective learning outcomes. The first strategy (focused on political distance) was used with 136 undergraduate students in 2016 and 2017, while the second (regarding geographical distance) was used with 67 undergraduate students in 2018. The 203 participants were undergraduate Business Management majors. This study used qualitative information provided by the students in essays submitted after participating in the games and simulations. The authors conducted content analysis using Nvivo11 software to analyze the changes in student awareness and the usefulness of the simulations. The results suggest that the educational strategy helps students develop crucial cognitive, skill-based, and affective learning outcomes.

The design and results of this experience are further explained in the following four sections. Section two discusses the use of active learning methods for teaching and learning sustainability-related topics; section three details how these two educational strategies can be combined to recreate a multi-level framework to help students understand the complexity of managing sustainability; and section four introduces the main results regarding the students' perceptions about the challenges that may arise when dealing with sustainability at the local, national, and international level. Finally, the conclusion reflects on the advantages provided by this innovative educational approach with regard to educating the sustainability leaders of the future.

2 Active Learning and Education for Sustainable Development

There is a lively debate in the literature regarding the success of management and business schools in educating future leaders in the skills required to promote sustainable initiatives and businesses (Marathe et al. 2020). In this regard, sustainability-oriented managers and professionals need to master a set of key capabilities if they are to successfully combine economic, social, and environmental performance (Bryant et al. 2021). While graduate students have significant leadership potential in sustainability-related issues, educational strategies must be carefully designed and implemented to address these types of educational objectives (Ordaz et al. 2021). Instead of adopting a passive position, undergraduate students need to take an active role in their own learning process to be able to later demonstrate leadership skills and, indeed, improve these abilities in their workspace (Thomas et al. 2020). Under

these circumstances, one of the challenges in higher education is to promote reflection on the cognitive and affective processes underlying students' learning, everyday life preferences, and decision-taking (Wamsler 2020).

In this regard, the frequently undervalued 'soft skills' become crucial to help future managers lead sustainability-related initiatives (Dzhengiz and Niesten 2020). To succeed in managing projects designed to tackle global sustainability challenges, graduates in economics, business, and management studies must be able to identify the right questions, confront conventions, and rethink and improve businesses (Wamsler 2020). Previous studies aimed to identify and categorize sustainability capabilities in higher education by specifying the traditional set of cognitive, skill-based, and affective learning outcomes and adapting them to the area of sustainability. Wiek et al. (2011) presented a five-category framework which has been further developed and improved by subsequent studies. This framework included systems thinking competence, strategic competence, normative competence, anticipatory competence, and interpersonal competence. Dzhengiz and Niesten (2020) proposed a four-category framework based on sustainability-related theoretical knowledge ('to know'); multidisciplinary, decision-making, and systems thinking ('to do'); key competencies required to interact with multiple and diverse stakeholders ('to interact'); and the affective and self-competence skills required to develop empathy for sustainability issues ('to be'). Brundiers et al. (2021) reviewed previous studies to propose another framework that includes five competencies: 'implementation', required to develop projects and take actions; 'strategic-thinking', to deploy sustainability transition strategies; 'values-thinking', to be able to map, specify, apply, combine, and negotiate sustainability values; 'futures-thinking', to craft future sustainability visions and non-intervention scenarios; and 'systems-thinking', to be able to analyze and understand complex problems in their current state and in a contextualized historical setting. Benito Olalla and Merino (2019) undertook a comprehensive review of the literature on sustainability-competences and presented a five-pillar framework to categorize a wide range of competencies for sustainability. In addition to the three categories of 'to know', 'to do', and 'to be' included in the approach suggested by Dzhengiz and Niesten (2020), they divided the 'to interact' category into two new spheres: 'to live together', understood as to "expose individuals to the values implicit within human rights, democratic principles, intercultural understanding and respect and peace at all levels of society and human relationships to enable individuals and societies to live in peace and harmony"; and 'to transform oneself and society', meaning "to gain knowledge, develop skills, and acquire new values that equip individuals and groups with tools and mindsets for creating lasting change in organizations, communities, and societies" (Benito Olalla and Merino 2019: 243).

Active learning has been recognized by several studies as a powerful educational strategy to help students develop the above-mentioned SOC and leadership skills (Claro and Esteves 2021; Marathe et al. 2020). Among the wide range of active learning strategies, role-play activities such as games and simulations have been shown to be effective educational methodologies for creating an environment in which students can fully immerse themselves in a real-world situation, rather than

simply leaving them in a passive role, assimilating theoretical content (Usherwood 2014). These teaching and learning instruments are based on evolving contexts that require the students to tackle several issues and problems, interact with their peers, and face the consequences of their decisions (Gredler 2004). At the same time, games and simulations expose students to real scenarios including several problem-based challenges, and for this reason, these approaches have been identified as being of high value, helping students apply theoretical knowledge in a practical way (Sierra 2020a; Sierra and Rodríguez-Conde 2021). Moreover, it has been shown that the advantages of games and simulations as educational strategies can outweigh the potential weaknesses and problems that may arise during their implementation (Kröger 2018). This may explain why their use as a teaching and assessment tool in higher education has increased in recent years (Kallenstrup 2018).

3 Educational Strategy: Three Spheres to Address Sustainability

This teaching and learning strategy combined three serious games and two simulations to represent three spheres where economic, social, and environmental sustainability-related issues can be addressed. The activities were applied separately in two different settings to help students understand the challenges and particularities of working with sustainability-related issues at the local, national, and international level. The difference between the two settings resulted from the diverse meanings and the implications of the concept of distance.

Despite the particularities of how sustainability-related issues were addressed from these three spheres in the two educational settings, all the activities had a common structure. First, students had to manage sustainability-related issues at each of the levels. Second, in every activity, the students applied theoretical knowledge acquired during the semester in a practical way to address real-world problems in changing scenarios. Third, students had to reflect on their experience in an essay in which they were asked to also address the issue of leadership skills. Fourth, both settings included a final debriefing session, where students had the chance to share their thoughts with their colleagues, benefit from peer learning, and receive feedback from the instructors. The details of the educational settings are explained below.

3.1 Addressing Sustainability in a Multi-Level Management Setting

In the first setting, the emphasis was on the political distance between citizens and management bodies, understood as the fact that—depending on their scope or magnitude—sustainability issues must be addressed at the local, national, or international

level to ensure that they can be resolved. The local sphere was recreated using the SimCity computer game; the national sphere was addressed in a simulation of the national parliament; and the international sphere used a simulation of the Council of the European Union (Sierra 2020b).

Local level: SimCity

To recreate the local level, students played the role of city mayor in SimCity. In this game, players create small towns, provide basic public services, and manage their expansion into more complex cities. The first step consists of determining the location for the future city. To make this decision, which influences the future of the town in several ways, players must consider a variety of variables such as geographic location and characteristics (proximity to the sea, access to rivers, distance to mountains, forests, or arable land, among other elements), the potential for benefiting from natural resources (wind direction, aquifer quality, mineral availability, solar energy, etc.), and the distance to other potential new cities and land configurations, among other characteristics that change over the course of the game. During the first stage, the players have to develop basic infrastructure (paving streets and roads, installing key public buildings like schools, hospitals, etc.) and start providing public services (access to water, energy generation, waste management, etc.). At the same time, they have to divide up the land for three possible uses (residential, commercial, or industrial), which also has implications for the future development of the town.

Once the city has been created, SimCity develops its full potential to enhance economic, social, and environmental sustainability awareness among the students. The game becomes more complex over time, as the initial city evolves into a more diverse society in which an increasing number of private actors interact with citizens and, at the same time, influence the role of the public sector (the students). Therefore, during the game, the local authorities must improve the provision of public services by increasing their diversity and quality, in order to expand welfare and meet the citizens' expectations. To that end, the students have to take into consideration economic, social, and environmental sustainability criteria to implement a wide range of initiatives related to public spending and taxation. As in real life, these alternatives are determined by budget limitations and the satisfaction of the population, two limiting variables that become more complex over time. Although the game allows players to choose from among a wide range of options to develop public services and infrastructure, to meet the objectives of the educational strategy, the students were asked to focus on four crucial areas: healthcare, education, water and sanitation, and transportation. This setting helped the students understand the complexity of managing these sectors at the local level, addressing problems related to SDGs 3 (Health and well-being), 4 (Quality of education), 6 (Clean water and sanitation), and 11 (Sustainable cities and communities). The activity was done in a computer room, where students played for a period of four hours. Even though this time was sufficient to achieve the learning objectives (it was the length of the trial version available on the website), many students continued to play the game.

National level: National Parliament

The national sphere was recreated through a simulation of the '*Congreso de los Diputados*' (Spanish National Parliament). In this context, the students were randomly distributed among the different political groups in the Parliament and worked in teams to develop their positions and demands on the topics of debate: inequality in Spain (SDGs 4, 5, and 10) and poverty-related health problems (SDGs 1, 2, and 3). Prior to the simulation, they had to present their position using economic theory; the real economic and social scenario; and the position of each political party in relation to environmental issues. This position paper had to be given to the teachers prior to the debate, to ensure that the students were prepared to participate in the activity, and was distributed to all the groups before the simulation to help their peers follow the arguments of the other political groups. Finally, a debate was held in which the different teams defended their positions and negotiated with their peers. The discussion continued for around two hours and, finally, a draft decision document was voted on. Again, a debriefing session was organized at the end.

International level: Council of the European Union

To recreate the international sphere, a simulation of the Council of the European Union was organized. In this case, the students were randomly allocated to represent the EU member states. Two different contexts were simulated. In 2017, the simulation entailed a recreation of the Foreign Affairs Council (SDGs 16 and 17), and in 2018 it addressed the 2030 Climate and Energy Framework (SDGs 13, 14, and 15). Like the simulation of the Spanish National Parliament, participants representing the same nation wrote a position paper detailing their stance regarding the debate topic. Again, this document paper was circulated to all the groups to help them organize for the activity. A debate was then held in which the different countries defended their respective views, considering the real economic and political opinions of the states they represented. In the final step, the students voted on the draft document and the amendments defended by all the countries.

3.2 Addressing Sustainability in Different Geographic Locations

The focus of the second setting was the concept of geographical distance, particularly the fact that economic decisions can have consequences at the local, national, and international level, even though individuals are not always aware of the effects their behavior can have on society and the environment. Again, the SimCity videogame was used to recreate the local level following the same approach as explained above. In addition, the Power Grid[1] board game was applied to recreate the national level

[1] https://www.riograndegames.com/Game/5-Power-Grid.

and Ethica—The Ethical Finance Game[2] board game to represent the international level (Sierra and Suárez-Collado 2021a).

National level: Power Grid

The national sphere was recreated using the Power Grid board game, where the goal of the players is to compete in the energy market to provide energy to the largest number of cities. During the game, players must decide how much and how to invest to expand the grid and increase the number of cities connected to their network. Players must decide where they want to build their power plants and expand their grid. To achieve this, they can draw on different renewable and non-renewable energy sources to run several types of power plants: coal, oil, mixed (coal and oil), waste, uranium, and renewable resources. The characteristics of these plants—such as construction and fuel costs—vary, which produces different results as the game evolves and becomes more complex. Renewable plants are an exception, since once installed they do not require the acquisition of resources for their operation. To install the plants and obtain the fuel needed to produce energy, players compete with their opponents in a power plant market (based on an auction in which all the players participate), and access energy sources in a resource market based on fixed prices. During the game, students must carry out their actions considering the location of their power plants and the possibilities of extending the network throughout the territory, depending on the decisions made by the other players. To make their spending and investment decisions, players use 'electros' (the game money), and during the different rounds, they receive an amount of money depending on the number of operating plants under their control. Using this framework, the game is played in rounds of five phases: (1) defining the order of play; (2) power plant auction; (3) resource purchase; (4) plant installation and grid expansion; and (5) the so-called 'bureaucracy' phase, in which players receive money based on the results obtained because of their investment and expansion decisions in the energy sector. The winner of the game is the one who succeeds in providing energy to the largest number of cities through the grid.

Power Grid reflects the workings of the energy sector in a simplified way, although it is highly reflective of reality. Consequently, players can contemplate the importance of research, development, and innovation policies, highlighting the role these issues play in improving efficiency, increasing effectiveness, and promoting the sustainability of the sector. Therefore, this activity addressed SDGs 7 (Affordable and clean energy), 9 (Industry, innovation, and infrastructure), and 13 (Climate action). In addition to the original version of the game, there are different maps available to play in different areas of the world, both in developed and developing countries. Although the rules are essentially the same, the different versions have variations in relation to available resources and technology and different network expansion options. To facilitate the immersion of the students in the training experience, in this case, the maps of Spain and Portugal were used. Although the game is designed for two to six players, we organized the students into groups of two or three people with approximately 15 players participating in the same game. The aim of this decision

[2] https://educationaltoolsportal.eu/en/tools/ethica-ethical-finance-game.

was to promote teamwork and debate among the groups to analyze the possibilities of the sector and the different investment spending decisions that could be made, always applying the criteria of economic, social, and environmental sustainability. Two different board games were played in the same room, meaning that there were around 30 students playing at the same time. The sessions lasted approximately two hours, and the teachers provided guidance and answered any questions that arose.

International level: Ethica—The Ethical Finance Game

The Ethica—The Ethical Finance Game board game was used to recreate the international level. In this game, players can represent one of three different roles (bank customers, investors, or cooperative business entrepreneurs), and the overall purpose is to help students understand and evaluate the economic, social, and environmental effects of decisions regarding savings, businesses, and investments. All the players participate by representing either families or banks, seeking to become the most ethical investor. This requires them to find a balance between the potential financial benefits and the social and environmental consequences that result from investment decisions.

The game is played on a board that represents the world, showing the businesses that may receive the investments in different places. This is also used to monitor the players' performance over the course of the game depending on their performance in financial, social, and environmental terms. The game consists of two or three rounds (years) during which simple rules apply, even though there is a possibility of opting for more complex formats designed for experienced players. In every round, the players make various rational decisions, which at the same time may be determined by some random events. These random scenarios are defined by luck (tossing two dice to indicate whether a year is good or bad and to make mathematical calculations) and some changing circumstances that appear on Investment and Global News Cards (IGNC). Each round is organized into eight phases, during which the players choose between different investment options; roll the dice to 'experience' a good or bad year; compute the sum of the investments or the interest generated by savings; consult the IGNC to discover whether random events may disturb the economy; settle the bank accounts of each player; and evaluate and debate the financial, social, and environmental outcomes for the year.

As described, this game is based on topics such as banking, trade and investment, employment, and poverty and inequality. Therefore, the activity helped the students to apply theoretical knowledge in a practical way to address issues related to SDGs 1 (No Poverty), 2 (Zero hunger), 5 (Gender equality), 8 (Decent work and economic growth), 10 (Reduced inequalities) and 12 (Responsible consumption and production). Six or more players can participate at the same time. In this experience, the students played in pairs or groups representing the different profiles, resulting in a total of around 15 people in each game. Two board games were actively in use in the same room, meaning that there were around 30 people playing. Also, in this case, the educators offered guidance and answered questions during the sessions, which lasted around two hours.

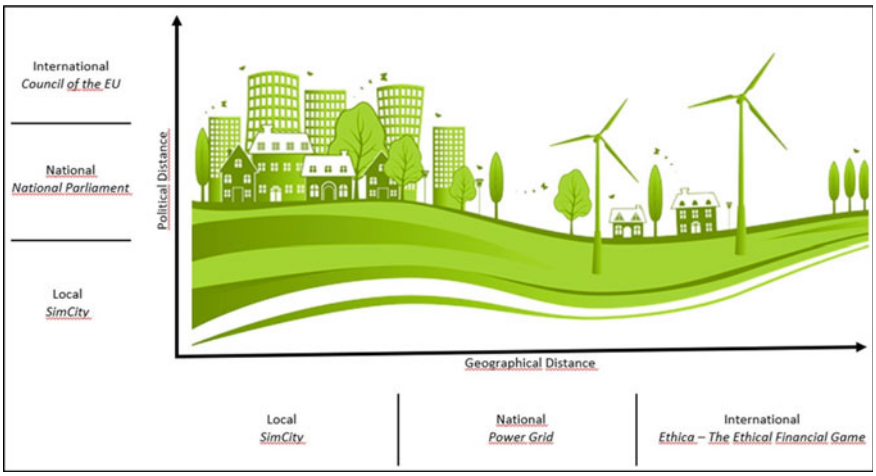

Fig. 1 Two-pronged framework for enhancing sustainability awareness with active learning

As shown in Fig. 1, the combination of these two educational settings creates a two-pronged framework defined by two axes reflecting both political and geographical distance. Thus, the approach produces a background of concentric spheres that helps the students understand the complexity of managing sustainability issues at different levels, the potential challenges that may arise at each level, the role that public and private actors play in dealing with sustainability-related issues, and the potential consequences that economic decisions, made either as citizens, business managers, consumers, or public representatives, can have on society and the environment.

4 Methodology

The aim of this study is to contribute to the field of education for sustainable development by exploring the extent to which active learning strategies raise sustainability awareness among undergraduate students and help them develop key capabilities for education for sustainable development. To achieve this goal, a descriptive and exploratory study was conducted based on a content analysis of 203 essays submitted by the students after participating in the games and simulations presented in the previous section. Content analysis is a common methodology in qualitative research in the field of education and other social sciences (Fisher and Bonn 2017), and has also been used to explore sustainability-related topics (Benito Olalla and Merino 2019; Claro and Esteves 2021).

The text corpus was made up of the 203 essays in which the students explained their experience, reflected on the complexities of managing sustainability-related issues, and detailed the extent to which these activities helped them develop crucial learning outcomes for ESD. Given that these active learning activities were organized

Table 1 Codes used to analyze sustainability competences

Categories	Codes
Learning to know (LK)	Complexity, criticism, *efficiency,* evaluation, future, interconnectedness, interdisciplinarity, knowledge, long-term, *overshoot, scarcity,* system, thought, understanding, work
Learning to do (LD)	Action, *balance,* change, communication, *combination, equilibration,* implementation, integration, plan, process, participation, practice, solution, work
Learning to be (LB)	Ambiguity, compassion, empathy, *innovation*, motivation, perspective, *proaction,* reflection, solidarity, tolerance, uncertainty, value
Learning to live together (LL)	*Civil society,* collaboration, conflict, cosmopolitanism, culture, diversity, engagement, environment, *fairness,* justice, peace, stakeholder
Learning to transform oneself and society (LT)	Action, change, *circularity,* cosmopolitanism, empathy, future, implementation, long-term, *negotiation,* participation, reflection, *success,* thought

in a Spanish university, we used the integrated sustainability competence framework proposed by Benito Olalla and Merino (2019), which analyzes the sustainability orientation of study plans in higher education institutions in Spain. Furthermore, since it was implemented as part of the degree in Business Studies, the framework was adapted by including terms used by the students when discussing issues regarding economics, business, and management. The codes used for each of the five categories are presented in Table 1, where the added terms specifically related to Business Studies appear in italics.

Nvivo11 software was used to analyze the essays. This software is commonly employed with content analysis and was previously applied to similar analyses of sustainability-related topics (Lozano and Huisingh 2011; Benito Olalla and Merino 2019) and to analyze educational outcomes in economics, business, and management (Detlor et al. 2011).

5 Results and Discussion

The initial analysis of the corpus was done using a word cloud, in which the words ‘understanding’, ‘complexity’, ‘change’, and ‘balance’ were the prevalent terms, suggesting that students perceived the need to manage complex sustainability-related issues in a balanced way to foster a real positive economic, social, and environmental change. The detailed content analysis generated the results presented in Table 2.

Overall, the students used expressions related to the different capability frameworks regarding sustainability-related learning outcomes (Dzhengiz and Niesten 2020; Brundiers et al. 2021; Wiek et al. 2011). The relatively high frequency of terms related to the 'learning to know' and 'learning to do' categories—both terms closely linked to leadership skills—suggests that the active learning activities had a stronger influence on cognitive and skill-based learning outcomes than on affective learning outcomes, which are primarily related to the categories of 'learning to be', 'learning to live together', and 'learning to transform oneself and society'.

Table 2 Frequency of top ten references to the fifth-pillar framework mentioned in the essays (N = 203)

Learning to know	198	98%	Learning to do	186	92%
Understanding	176	87%	Change	175	86%
Complexity	173	85%	Balance	169	83%
Scarcity	164	81%	Solution	165	81%
Future	159	78%	Equilibration	154	76%
Thought	143	70%	Combination	135	67%
Criticism	135	67%	Plan	128	63%
Efficiency	129	64%	Action	124	61%
Interconnectedness	115	57%	Process	113	56%
System	102	50%	Integration	103	51%
Overshoot	89	44%	Implementation	87	43%

Learning to be	145	71%	Learning to live together	138	68%
Perspective	139	68%	Diversity	127	63%
Empathy	125	62%	Environment	125	62%
Innovation	122	60%	Justice	112	55%
Proaction	117	58%	Collaboration	107	53%
Solidarity	105	52%	Fairness	103	51%
Uncertainty	101	50%	Stakeholder	101	50%
Value	99	49%	Civil society	83	41%
Motivation	86	42%	Engagement	78	38%
Reflection	78	38%	Peace	68	33%
Tolerance	54	27%	Conflict	54	27%

Learning to transform oneself and society	123	61%			
Change	104	51%	Negotiation	78	38%
Action	102	50%	Success	76	37%
Implementation	97	48%	Reflection	67	33%
Circularity	84	41%	Thought	61	30%
Long-term	83	41%	Participation	47	23%

The prominence of the 'learning to know' category, addressed by the students in 98% of the essays, is in line with the importance usually given to these capabilities in study plans (Benito Olalla and Merino 2019). However, in this study, the second category in terms of frequency of references was 'learning to do', mentioned in 186 essays (92%), a different result than what was identified in the literature (Benito Olalla and Merino 2019). This may be because of the inherent characteristics of the degree in which the activities were conducted, as these students often want to develop skills and capabilities to work in private companies in the business sector, and to learn to perform in a professional environment and apply theory in a practical way (Thomas et al. 2020). In consonance with this, the dynamics of the games and simulations may have also contributed to the emphasis on the 'to do' component of the activities, hence augmenting the presence of these references in the essays. This is shown by the terms most commonly used by the students: 'change', 'balance', 'solution', 'equilibration', and 'combination'. This focus on LD highlights the effectiveness of the methodology to enhance leadership-related skills, which are essential to equip undergraduate students with the required SOC to promote and manage sustainability-oriented projects.

Even though analyzing the general category of affective learning outcomes in three pillars may have affected the results, which in turn may diminish their relative importance, the students referred to several concepts closely related to leadership and managerial skills, such as 'innovation', 'proaction', 'change', 'action', and 'implementation'. In this regard, despite the relatively lower importance of the LB, LL, and LT categories in comparison to LK and LD, these results are higher than what is usually emphasized in study plans (Benito Olalla and Merino 2019). Therefore, even though the LK and LD categories are prominent in this study, the results show that active learning increased the relative relevance of the LB, LL, and LT categories. This is highlighted by the fact that 71% of the students used terms from the LB category, while 68% and 61% of the participants included words and expressions from the LL and LT domains, respectively. This is notable, since it is more difficult to enhance the capabilities related to these three categories via theoretical lectures or traditional activities, but at the same time they have been identified as essential to foster real change in higher education and equip students with the capabilities they will need in their future academic and professional careers, as well as in their personal lives (Wamsler 2020; Figueiró et al. 2022). Overall, this experience stressed the effectiveness of active learning methodologies to adopt integrated educational strategies useful to address sustainability-related topics and promote crucial skills for leadership (Bryant et al. 2021; Wamsler 2020).

6 Conclusion

This study has shed light on the question of the usefulness of active learning strategies to raise economic, social, and environmental sustainability awareness among undergraduate students and enhance leadership skills. The experience showed the

effectiveness of these teaching and learning activities to help students improve the SOC capabilities they need to develop crucial learning outcomes for ESD, and the methodology proved to be an effective way to assist students in developing the crucial practical skills required to lead sustainability-oriented projects. In addition, the results showed that active learning can serve as a powerful approach to highlight affective learning objectives, a category that is more difficult to address with theoretical lectures or traditional practical tasks alone.

Nevertheless, the study has some limitations. First, the content analysis was done using qualitative information gathered through two sets of activities that were organized separately. In this regard, it would be interesting to combine the two settings in order to discover whether a more comprehensive activity would produce different results. Second, as the activity was organized in a Business Studies course, it is not possible to extrapolate the results to other areas.

Overall, the study provides some useful lessons that can guide educators, researchers, and policy makers in their efforts to improve educational strategies aimed at raising sustainability awareness and accelerating the implementation of the SDGs. Accordingly, this experience may be valuable to educators designing and improving active learning activities in economics, business, and management with a focus on developing crucial leadership skills.

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References

Adomßent M, Fischer D, Godemann J, Herzig C, Otte I, Rieckmann M, Timm J (2014) Emerging areas in research on higher education for sustainable development—management education, sustainable consumption and perspectives from central and eastern Europe. J Clean Prod 62(January):1–7. https://doi.org/10.1016/j.jclepro.2013.09.045

Benito Olalla C, Merino A (2019) Competences for sustainability in undergraduate business studies: a content analysis of value-based course syllabi in Spanish universities. Int J Manag Educ.https://doi.org/10.1016/j.ijme.2019.02.006

Brundiers K, Barth M, Cebrián G, Cohen M, Diaz L, Doucette-Remington S, Dripps W et al (2021) Key competencies in sustainability in higher education—toward an agreed-upon reference framework. Sustain Sci 16(1):13–29. https://doi.org/10.1007/s11625-020-00838-2

Bryant J, Ayers J, Missimer M, Broman G (2021) Transformational learning for sustainability leadership—essential components in synergy. Int J Sustain High Educ 22(8):190–207. https://doi.org/10.1108/IJSHE-01-2021-0014/FULL/PDF

Claro PB, Esteves NR (2021) Teaching sustainability-oriented capabilities using active learning approach. Int J Sustain High Educ 22(6):1246–1265. https://doi.org/10.1108/IJSHE-07-2020-0263

Coleman K, Gould R (2019) Exploring just sustainability across the disciplines at one university. J Environ Educ 50(3):223–237. https://doi.org/10.1080/00958964.2019.1582471

Delgado C, Venkatesh M, Branco MC, Silva T (2019) Ethics, responsibility and sustainability orientation among economics and management masters' students. Int J Sustain High Educ 21(2):181–199. https://doi.org/10.1108/IJSHE-02-2019-0058

Detlor B, Julien H, Willson R, Serenko A, Lavallee M (2011) Learning outcomes of information literacy instruction at business schools. J Am Soc Inform Sci Technol 62(3):572–585. https://doi.org/10.1002/ASI.21474

Dzhengiz T, Niesten E (2020) Competences for environmental sustainability: a systematic review on the impact of absorptive capacity and capabilities. J Bus Ethics 2019 162(4):881–906. https://doi.org/10.1007/S10551-019-04360-Z

Ferrer-Balas D, Lozano R, Huisingh D, Buckland H, Ysern P, Zilahy G (2010) Going beyond the rhetoric: system-wide changes in universities for sustainable societies. J Clean Prod 18(7):607–610. https://doi.org/10.1016/j.jclepro.2009.12.009

Figueiró PS, Neutzling DM, Lessa B (2022) Education for sustainability in higher education institutions: a multi-perspective proposal with a focus on management education. J Clean Prod 339:130539. https://doi.org/10.1016/J.JCLEPRO.2022.130539

Fisher J, Bonn I (2017) Sustainability and undergraduate management curricula: changes over a 5-year period. Aust J Environ Educ 33(1):18–33. https://doi.org/10.1017/AEE.2016.31

Gredler ME (2004) Games and simulations and their relationship to learning. In: Jonassen DH (ed) Handbook of research on educational communications and technology. Lawrence Erlbaum Associates Publishers, Mahwah, NJ, US, pp 571–582. https://doi.org/10.1109/BALTIC.2012.6249194

Kallenstrup M (2018) Learning effects of negotiation simulations: evidence from different student cohorts. In: Simulations of decision-making as active learning tools. Springer International Publishing, pp 165–183. https://doi.org/10.1007/978-3-319-74147-5_13

Kemp N, Scoffham S (2022) The paradox model: towards a conceptual framework for engaging with sustainability in higher education. Int J Sustain High Educ 23(1):4–16. https://doi.org/10.1108/IJSHE-08-2020-0311

Kröger S (2018) Realising the potential of EU simulations—practical guidance for beginners. Eur Polit Sci 17(1):161–175. https://doi.org/10.1057/s41304-016-0096-1

Leal Filho W (2020) Viewpoint: accelerating the implementation of the SDGs. Int J Sustain High Educ 21(3):507–511.https://doi.org/10.1108/IJSHE-01-2020-0011/FULL/PDF

Lengyel A, Szőke S, Kovács S, Dávid LD, Bába ÉB, Müller A (2019) Assessing the essential pre-conditions of an authentic sustainability curriculum. Int J Sustain High Educ 20(2):309–340. https://doi.org/10.1108/IJSHE-09-2018-0150

Lozano R, Huisingh D (2011) Inter-linking issues and dimensions in sustainability reporting. J Clean Prod 19(2–3):99–107. https://doi.org/10.1016/J.JCLEPRO.2010.01.004

Marathe GM, Dutta T, Kundu S (2020) Is management education preparing future leaders for sustainable business?: opening minds but not hearts. Int J Sustain High Educ 21(2):372–392. https://doi.org/10.1108/IJSHE-02-2019-0090

Melles G (2019) Views on education for sustainable development (ESD) among lecturers in UK MSc taught courses: personal, institutional and disciplinary factors. Int J Sustain High Educ 20(1):115–138. https://doi.org/10.1108/IJSHE-02-2018-0032

Ordaz K, Tan K, Skett S, Herremans IM (2021) Developing leadership qualities in environmental sustainability through university co-curricular activities. Int J Sustain High Educ 22(7):1609–1629. https://doi.org/10.1108/IJSHE-10-2020-0421/FULL/PDF

Pizzutilo F, Venezia E (2021) On the maturity of social responsibility and sustainability integration in higher education institutions: descriptive criteria and conceptual framework. Int Jo Manag Educ 19(3):100515. https://doi.org/10.1016/J.IJME.2021.100515

Rouhiainen H, Vuorisalo T (2019) Higher education teachers' conceptions of sustainable development: implications for interdisciplinary pluralistic teaching. Environ Educ Res 25(12):1713–1730. https://doi.org/10.1080/13504622.2019.1657069

Sierra J (2020a) The potential of simulations for developing multiple learning outcomes: the student perspective. Int J Manag Educ 18(1). https://doi.org/10.1016/j.ijme.2019.100361

Sierra J (2020b) The importance of simulation in teaching and learning economics: the students' perspective. Innov Educ Teach Int 57(5):1–11. https://doi.org/10.1080/14703297.2019.1647268

Sierra J, Rodríguez-Conde M-J (2021) The microfinance game: experiencing the dynamics of financial inclusion in developing contexts. Int J Manag Educ 19(3):100540. https://doi.org/10.1016/J.IJME.2021.100540

Sierra J, Suárez-Collado Á (2021a) The transforming generation: increasing student awareness about the effects of economic decisions on sustainability. Int J Sustain High Educ 22(5):1087–1107. https://doi.org/10.1108/IJSHE-06-2020-0221

Sierra J, Suárez-Collado Á (2021b) Understanding economic, social, and environmental sustainability challenges in the global South. Sustainability 13(13):7201. https://doi.org/10.3390/SU13137201

Sonetti G, Brown M, Naboni E (2019) About the triggering of UN sustainable development goals and regenerative sustainability in higher education. Sustainability 11(1):254. https://doi.org/10.3390/su11010254

Stafford-Smith M, Griggs D, Gaffney O, Ullah F, Reyers B, Kanie N, Stigson B, Shrivastava P, Leach M, O'Connell D (2017) Integration: the key to implementing the sustainable development goals. Sustain Sci 12(6):911–919. https://doi.org/10.1007/s11625-016-0383-3

Sund L, Pashby K (2020) Delinking global issues in Northern Europe classrooms. J Environ Educ 51(2):156–170. https://doi.org/10.1080/00958964.2020.1726264

Thomas I, Holdsworth S, Sandri O (2020) Graduate ability to show workplace sustainability leadership: demonstration of an assessment tool. Sustain Sci 15(4):1211–1221. https://doi.org/10.1007/S11625-020-00797-8/TABLES/2

Usherwood S (2014) Constructing effective simulations of the European union for teaching: realising the potential. Eur Polit Sci 13(1):53–60. https://doi.org/10.1057/eps.2013.29

Wamsler C (2020) Education for sustainability: fostering a more conscious society and transformation towards sustainability. Int J Sustain High Educ 21(1):112–130. https://doi.org/10.1108/IJSHE-04-2019-0152

Wiek A, Withycombe L, Redman CL (2011) Key competencies in sustainability: a reference framework for academic program development. Sustain Sci 6:203–218. https://doi.org/10.1007/s11625-011-0132-6

Academic Community Expectations on Climate Change Learning and Engagement: A Case Study at University of Passo Fundo

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1 Introduction

The temperature of the Earth is changing, mainly related to the increase in carbon emissions, which can negatively and intensely impact the world population. Countries all over the world have been facing several extreme weather events, with increased frequency and level of impact. These events include prolonged droughts, intense rains, floods and landslides, causing severe damage to the population, biodiversity, and infrastructure. Climate change can be seen as a moral problem, because its causes are linked to large CO_2 emissions, mainly from industrialized and richer countries, while countries that suffer the most are in poorer regions (Leal Filho et al. 2018).

In face of this urgent challenge, various actors from all sectors are taking action. In the educational context, universities are reflecting their concern about climate change by means of a set of different strategies. Many of them have developed actions to minimize the impacts caused by climate change. These actions can be either within the scope of campus operations, or in teaching, research and outreach (Leal Filho 2011; Fissi et al. 2021). According to Leal Filho et al. (2018), universities already have different centres and disciplines that carry out research in these areas in their own way, but there is still a long way to go before disciplines can come together and experience untapped potential in order to fully face the multidimensional challenges of climate change.

In this way, the academic community becomes the main ally for the development of climate action since it is in this community that decision-makers arise, forming future leaders and informed and active citizens. Therefore, it is imperative that the academic community understand and respond to the effects of a changing climate (Oliver et al. 2021). In their study, Molthan-Hill et al. (2019) describe that

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climate change could be addressed in some topics within the mandatory disciplines of different courses, for example, in the course of accountability, carbon accounting could be addressed; carbon literacy could be explored in disciplines of the course human resource management; engineering courses could teach topics related to carbon reduction in areas such as construction, energy infrastructure, waste management, among others. All courses should include climate change impacts and how to mitigate and adapt to them, given the potential and urgency of the topic and its interdisciplinary component.

Several studies have been investigating the perception of the academic community on the university efforts towards climate action. According to the results of García-González et al. (2020), students identify a variety of problematic issues, related to pollution, poverty, climate change and global warming, and demand from the university further training to deepen their knowledge on these sustainability challenges. In the study of Aleixo et al. (2021), a survey was applied to the students and most answers indicate that the group wants to learn and get engaged on climate action at the university. Also, the research developed by Salovaara et al. (2021) shows that most students investigated in the university demonstrate their concern about climate change issues, regardless of their discipline or study level.

Therefore, studying the perception and engagement of the academic community on climate change, as well as describing their enthusiasm about it, is extremely important, since it becomes a relevant study to support mitigation and adaptation efforts. This challenge and potential action support further investigation of the changes needed within the university to maximise its role in climate action.

Partner universities of the project Transforming Universities for a Changing Climate (Climate-U) are also investigating the views of students regarding climate change and institutional efforts at their universities. A survey was applied in four countries to collect data on this topic (Salvia et al. 2022) and learning, research and outreach opportunities received special attention. University of Passo Fundo, located in the south of Brazil, is one of the Climate-U partner universities and is applying Participatory Action Research (Climate-U 2021) by means of an institutional Green Office.

In this context, this paper aims to describe the academic community's challenges and expectations about climate change learning and engagement, presenting a case study at University of Passo Fundo.

1.1 Project Transforming Universities for a Changing Climate and Its Qualitative Case Studies

The Climate-U project aims at strengthening the contribution of universities in lower-income countries to address the challenge of climate change. It includes a team at University College London, UK (Principal Investigator) and supports local actions on climate change in some countries through the creation of Participatory Action

Research (PAR) Groups in Universities (Climate-U 2021). The project includes studies in Brazil, Kenya, Mozambique, Fiji, Jamaica, Morocco, India, and Tanzania (Climate-U 2022). In Brazil, the PAR activities are developed at University of Passo Fundo (UPF), University of São Paulo and Federal University of Pará.

The main challenge associated with the PAR at UPF is making sure students engage in the initiatives and feel empowered in the process. The university needs to understand how to better promote engagement opportunities and in which formats, so that students of all courses can feel more connected with the topic of climate change.

This challenge and potential for action support further investigations on the changes needed within the university to maximise their role towards climate action. In this context, an additional component was integrated to the Climate-U initiatives at UPF by means of a qualitative case study. This study aims at gathering insights on what the academic community expects in terms of climate change learning and engagement opportunities and how they would like to be involved in the process of change. The data collection focused on three university groups: students, professors and managers. The investigation intended to respond to the following Climate-U research sub-questions:

- What is the epistemic status and framing of climate change in the university, and how are its contested aspects addressed? In what ways are students, professors and community members involved in co-construction of ideas around climate change?
- What challenges and obstacles are encountered by universities in bringing change in relation to these issues?

2 Methodology

2.1 Location

The research was developed at the University of Passo Fundo (UPF), which involved students, professors and managers of the institution. University of Passo Fundo is located in the city of Passo Fundo, in the state of Rio Grande do Sul, Brazil. The university has around 11,000 students and over 650 professors and 850 employees (UPF 2022).

Before the data collection process, this research was approved by the Ethics Committee of the university (CAAE: 57669222.0.0000.5342).

2.2 Methodological Steps

- The method was developed through the combination of a set of semi-structured interviews with the students and a focus group with professors and managers of the university. The interview script covered the following topics: the extent to which climate change is reflected in teaching, research and outreach opportunities and generates student engagement; factors that are hindering student engagement in climate change-related initiatives; and strategies to overcome these challenges. The script contained 14 questions and is presented in the Appendix.

The interviews were conducted between May/22 and June/22. The courses were selected considering the different fields classified by UNESCO, such as Life sciences (Biological Sciences), Architecture and building (Architecture), Business and administration (Administration) and Law (UNESCO 2011). Table 1 summarises the characteristics of the students interviewed (course, level and gender).

The focus group of professors and managers had 6 participants (3 professors and 3 managers). The professors of the courses of Social Service and Architecture, and the Managers as representatives of the Vice-Rectories of Research, Outreach and Undergraduate of the university. The focus group was applied on May/22 and covered institutional challenges in addressing climate change and expectations to include this topic in the curricula of all courses at the university. Table 2 summarises the course/sector and gender information from each focus group participant.

The data analysis was developed through content analysis, as defined by Bardin (2011). According to this method, the researcher interprets the contents of the study materials from verbal analysis in a progressive and systematic way. For this study, four categories were applied to study the collected data of interviews (challenges, learning, potentialities and expectations) and two categories for the data collected in the focus group (challenges and expectations).

Table 1 Students' interviews

Group	UNESCO fields	Courses	Level (semester of study)	Gender	Code
Students	*Science*—Life Sciences	Biological Sciences	5th	F	S1
	Engineering, manufacturing and construction—Architecture and building	Architecture	9th	M	S2
	Social sciences, business and law—Business and administration	Administration	1st	M	S3
	Social sciences, business and law—Law	Law	7th	M	S4

Table 2 Professors and managers' focus group

Group	Courses/Sector	Gender	Code
Professor	*Social service*	F	P5
	Social service	F	P6
	Architecture	M	P7
Manager	*Vice-rectory of research*	M	M8
	Vice-rectory of outreach	F	M9
	Vice-rectory of undergraduate	M	M10

3 Results

The results obtained highlighted that students want to learn more about climate change and its impacts. With the results of student interviews, it is clear that the university must understand the need to raise awareness about the interdisciplinary study of climate change. In the focus group with the managers and professors, it was possible to understand that the university needs to be engaged in relation to climate change actions, due to the necessity of approaching Climate Change Education, including climate change in the curricula and at actions developed by the university, in order to transform the academic community into citizens aware and with sufficient knowledge about the climate cause.

3.1 Students

Some key points were highlighted during the students' interviews. The main important insights of the interviews were divided and classified in four aspects, in relation to the student's answers: challenges, learning, potentialities and expectations. Figure 1 illustrates the four aspects and some main points mentioned during the interview.

3.1.1 Challenges

In the aspect of challenges, the students described some challenging facts in relation to study climate change during their courses. Some points are described below:

- Lack of clarification on climate change education materials, being very technical and specific for professionals on the area, not being adapted for lay people.

"*It is not easy to understand about climate change, because it is too specific for the people that study about the climate, being difficult to understand the effect in a more practical way*" (S3).

- Lack of general activities on the topic and lack of disciplines that teach about it.

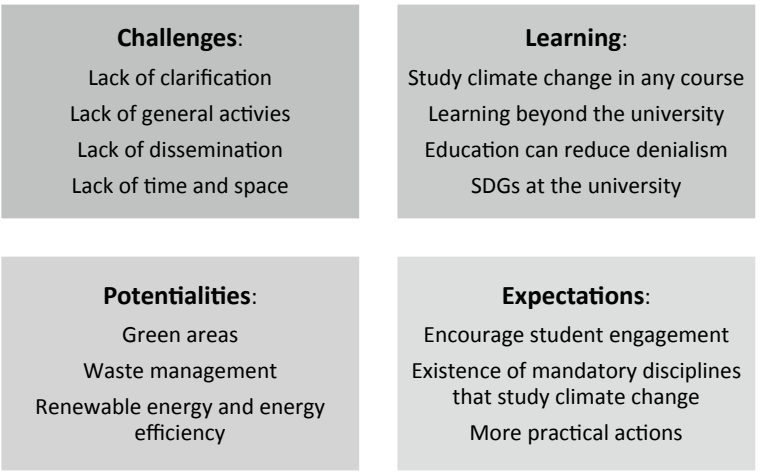

Fig. 1 Key challenges, potentialities, expectations and learning opportunities shared in the interviews

"*Sometimes, we don't have activities directly related to climate change, because the professors follow specific topics of the mandatory disciplines, without opening their minds.*" (S2).

"*We just had a seminar about climate change because we choose the theme.*" (S1).

- Lack of dissemination of actions related to sustainable development and climate change by the university.

"*I would like that my course could communicate with others, in relation to climate change, and the outreach integrating the whole faculty, because outreach is the university's right arm.*" (S4).

- Lack of time and space to study sustainability between mandatory disciplines.

"*I would take a course specifically on climate change, but because of the lack of time, I would prioritise a topic more specific to professional training related to my course.*" (S3).

3.1.2 Learning

To the topic learning, the students commented some ideas that they wanted in their courses, about climate change education:

- "*It's important to study climate change in any course*" (S4)
- "*The learning can be taken beyond the university, habits that can be incorporated into every action of the day*" (S2)

- "*It's essential to study climate change and its effects, and mitigate them, regardless of the course, due to the interdisciplinary of the topic*" (S2)
- "*It's through education and people awareness that denialism can be reduce*" (S1)
- "*Contact with the topic climate change, through an approach during a course*" (S1)
- "*Through the study of the Sustainable Development Goals—SDGs at the university*" (S1)
- "*Student education on climate change, highlighting the student involvement, but also the need for greater university involvement*" (S3)

3.1.3 Potentialities

In the view of the student, what they saw as potentialities for the university. One student mentioned the potential of the university, through the green areas and the waste management as described below:

- Green areas of the main campus: student described that the university has a great potential in the fight against climate change because of the extensive green areas and many trees that university has in its campus.
- Waste management at university: student acknowledge the efforts made by the universities, in terms of availability of trash cans distributed across the campus (for different materials) and the provision of educational materials (explaining how to separate waste)

"*I see the climate change at the university as the afforestation of the campus and the waste management, the trash cans distributed on campus and the educational materials (banners) explaining what is organic waste and what is dry waste*" (S3).

On the other hand, all students mentioned the important role of the outreach, and how it can be a potential way to implement the study of climate change at the university.

"*The first contact I had with climate change at the university was through outreach projects*" (S1).

"*It was through the outreach project that I became interested in issues related to climate change*" (S2).

"*The university's approach to climate change, there is a social role for the university related to the outreach programs*" (S4).

3.1.4 Expectations

In relation to the topic expectation, the students explained what actions they expect from the university. The actions are associated with empowering students for action and having more practical activities, and through mandatory disciplines covering the topic, as seen below:

Fig. 2 Key challenges and expectations shared in the focus group

- "*Encourage student engagement and invest in campus operations, teaching, research and outreach actions on climate change, supporting the student as a protagonist of the action*" (S4)
- "*Existence of mandatory disciplines that study the effects of climate change and how to combat and mitigate it, regardless of the course, due to the interdisciplinary*" (S2).
- "*Organization of more practical actions (e.g.: garbage collection, cleaning the campus/city, tree planting day, world car-free day)*" (S3)
- "*The climate change could be addressed in the mandatory disciplines, related to some activities within the disciplines*" (S1).

3.2 Professors and Managers

The results obtained through the focus group showed how climate change is being approached at the university from the perspective of teaching and management staff. Figure 2 summarises the challenges and expectations shared by the participants.

3.2.1 Challenges

Professors and managers acknowledge the existence of several barriers that hinder the development of climate-change related initiatives at the universities. The following challenges were explored in more detail:

- Professor's Authority: difficulty in changing the role of the professor to understand the importance of climate change, making students become protagonists of the cause and having the autonomy to develop activities in favour of combating climate change.

"*Some professors don't want to go out of the comfort zone and teach about climate change.*" (M8).

- Individualism: isolation actions; it is necessary to join the knowledge areas. The need to remove the individualistic face and bring the vision of the institution, being a more collective vision.

"*In many times, the sectors and faculties don't know what they are doing in relation of sustainability and climate change, there is a lack of communication.*" *(P5).*

- The creation of a negative side and view towards sustainability.

"*Sometimes they don't want to know about sustainability and climate change, because they see only in a negative way, thinking that the do not have a solution for the problem.*" (P7).

3.2.2 Expectations

Within the topic of expectations, professors and managers cited actions they expect to implement at the university. These actions are connected with training opportunities and a holistic view of the topic across the university, as seen in their comments below:

- "*Better approach of the process of sustainable development at the university, involving all the academic community*". (M7)
- "*Transversally of sustainable development and climate change in all curricula and in student training*". (M9)
- "*The student as the centre of the university: student as a protagonist*". (M8)
- "*Spread this theme to the entire university, with strategic actors, such as research, outreach, academic directories, Green Offices, Academic Clubs*". (P8)
- "*The importance of having sectors that recognized issues such as sustainable development and climate change: University Social Responsibility, SDG at university, Networks, Institutional Development Plan, work groups*". (P6)

4 Discussion

Figure 3 summarises the key insights from each profile during the interviews and focus group. Many of the answers of the three profiles (students, professors and managers) suggested to include climate change in the curricula. The students cited that the topic could be approached during the mandatory disciplines, like a symposium or a work group. In the view of professors and managers, climate change should be addressed as a mandatory discipline in all the courses, in order to mainstream and formalise the theme, with the purpose of contributing to the formation of the student, who will leave the university with sufficient knowledge for climate action, and to support adaptation and mitigation actions.

During the research, it was possible to understand that students want to learn about climate change and its implication, regardless of the course. But, despite the wish of

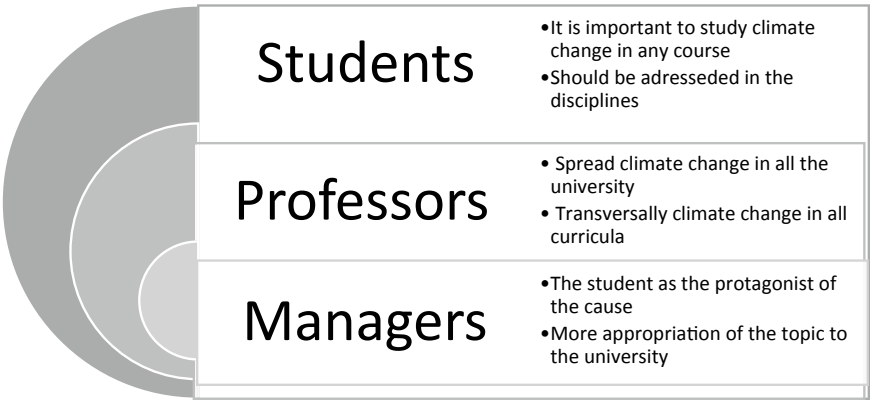

Fig. 3 Key insights from each profile

wanting to learn, there are some issues that they have to deal with, regarding climate change learning and engagement. In many cases, students feel powerless in the face of climate change, without mechanisms to bring about a change of behaviour. For example, during the interview, it could be seen two extreme views on students: one focused on personal initiatives (like changing personal habits and becoming vegan, for example) and the other focused on not doing anything, since any change seems too complex (or because students do not know how to act). The lack of time is also an important factor, as many students do not have time to enjoy the campus life—and get more involved in initiatives promoted by the university.

Also, the students talked about what they would like to learn about climate change, and how it could be addressed. With this research, students showed their need to learn about climate change and its implications, because they see this as a problem all courses should approach. But their main complaint is that the university is not offering as many learning opportunities (e.g., disciplines, workshops, courses on how climate change should be tackled) as they would like to have. This situation was reported by students from the different courses and education areas.

In addition, the interviews also pointed out that students need to understand the importance and benefits of being a professional aware of climate change, and how this can be a game-changer for choosing a job or a career. Due to the competitive market, students often focus on what is needed to get a job, learning and concentrating only in one area of study. Therefore, it is necessary to demonstrate, along with companies, the importance of a professional engaged with the climate cause, and how this can be a key point for career advancement.

According to the interviews, students want to learn about climate change but they diverge a little in relation to how they wanted to learn. One student described that it is necessary to have mandatory disciplines about climate change. On the other hand, another student considers that climate change could be addressed in topics as part of the mandatory disciplines.

In relation to the perspective of professors and managers, lack of methodologies and little time available can be the major problems faced by them to address climate change in teaching. The authoritarianism of the professor is a challenge because it is not easy to make them understand the importance of approaching climate change, regardless of the area of the course. According to Ávila et al. (2017), a barrier to innovation and to implementing sustainability at the university is the difficulty of cultural and behavioural change, due the regular system of educational courses, that in many times do not teach about climate change because cannot include interdisciplinary topics. Table 3 summarizes the results of each profile and the four aspects, with similarities and differences founded during this study.

Table 3 Summary of the topics

Aspects analysed	Views of students	Views of professors and managers	Similarities/Differences	Supporting references
Challenges	*Lack of activities and dissemination of climate change*	*Professor's Authority Individualism Isolated actions Negative view of sustainability*	Both profiles perceive the isolated actions at the university as a big challenge, as well as the lack of dissemination of the actions that are already taken	Salovaara et al. (2021)
Learning	*To study climate change in any course*	*Disciplines that address climate change as a topic*	Both profiles understand the need for including disciplines that study climate change effects	Trajber et al. (2019), Walshe et al. (2022)
Potentialities	*Green areas, waste management and renewable energy*	*Academic community engagement*	The students saw the campus infrastructure as a potentiality, while professors and managers saw potential in the students	Molthan-Hill et al. (2019)
Expectations	*Encourage student engagement Existence of mandatory disciplines that study the effects of climate change More practical actions*	*Transversally climate change in the curricula Student as protagonist Existence of sectors and offices/centers that address climate change*	All groups expect and want to see climate change in the curricula	Walshe et al. (2022)

Source Authors

5 Concluding Remarks

This study aimed to describe the academic community's challenges and expectations about climate change learning and engagement at the University of Passo Fundo. Through interviews and a focus group with students, professors and managers, it was possible to see how climate change is addressed in the university, and what are the challenges the academic community in learning about climate action.

According to the students, climate change is not well addressed at the university. They report on challenges associated with lack of clarification on climate change education materials, lack of activities on the topic and lack of time to dedicate to it. Their suggestions to overcome these challenges include having more practical activities (such as clean-ups) and disciplines focused on the topic. In the view of the professors and managers, they also see that the approach to climate change at university has some barriers, such as dealing with isolated actions and changing the role professors have in making students protagonists of the climate cause. But the group see as a solution the inclusion of the study of climate change in the curricula of all courses, as well as in the actions made by the university.

Two key lessons could be learnt from this study. First, the analysis confirms the importance of assessing the views of the different academic profiles, so that students' expectations can be considered when professors and managers discuss the potential changes within the university and in the curricula. Second, the project Climate-U and the PAR at UPF by means of its Green Office should support the university in addressing the students' expectations. This can be done by offering educational and practical activities on campus for example. In addition to empowering students, the office could also have the role of facilitating the connection between the different profiles.

The limited sample size and the different formats of data collection between profiles can be seen as limitations of this study. But the different study areas of the students interviewed and having different management perspectives in the focus group allowed us to gather important insights to develop further the efforts of Climate-U at University of Passo Fundo.

Future studies will further investigate the different views of staff and students, considering all the undergraduate courses of the university, and reflect on the different forms of engagement that can be applied.

Appendix A

Interview script—qualitative study

Introduction

(1) How would you define sustainable development?
(2) And what do you understand about climate change?

(3) Do you practice any actions in your routine that contribute to sustainable development and climate action? If yes, which ones?

University

(4) Do you think it is important to study about climate change and its effects, and how to mitigate them, regardless of the course?
(5) What challenges do you face in getting involved in actions to combat climate change at your university? And how do you think these challenges can be overcome?
(6) As for the university, in your course, have you ever had a discipline that addressed a subject related to climate change?
(7) If the university offered a course on climate change, would you like to take it? Yes/No, why?
(8) At the university, have you participated in any research project that addressed this topic? If not, would you like to participate?
(9) Have you ever participated in an extension project or held a mini-course/course/workshop on climate change, organised by the UPF? If not, would you like to participate?
(10) Have you ever participated in any event about climate change organized by the UPF? (e.g. lectures, symposium) If you did not participate, would you like to participate?
(11) Would you be interested in participating in actions involving the study of climate change at the university?
(12) Would you be interested in participating in occasional volunteer activities organised by the UPF to reduce the impact of climate change? (e.g. garbage/waste collection, campus/local community cleaning).
(13) In your opinion, how do you see the approach to climate change at the UPF? Do you think the institution invests in actions to mitigate the effects of climate change?
(14) Is there anything you would like to add?

References

Aleixo AM, Leal S, Azeiteiro UM (2021) Higher education students' perceptions of sustainable development in Portugal. J Clean Prod 327:129429

Ávila LV, Leal Filho W, Brandli LL, Macgregor CJ, Molthan-Hill P, Özuyar PG, Moreira RM (2017) Barriers to innovation and sustainability at universities around the world. J Clean Prod 164:1268–1278

Bardin L (2011) Análise de Conteúdo. Ed. Revista e Ampliada, São Paulo

Climate-U (2021) A protocol for participatory action research into climate justice: principles and tools. transforming universities for a changing climate working paper series, no. 3

Climate-U (2022) Project transforming universities for a changing climate. https://www.climate-uni.com, Accessed 30 June 2022

Fissi S, Romolini A, Gori E, Contri M (2021) The path toward a sustainable green university: the case of the University of Florence. J Clean Prod 279:123655

García-González E, Jiménez-Fontana R, Goded PA (2020) Approaches to teaching and learning for sustainability: characterizing students' perceptions. J Clean Prod 274:122928

Leal Filho W (2011) About the role of universities and their contribution to sustainable development. High Educ Pol 24:427–438

Leal Filho W, Morgan EA, Godoy ES, Azeiteiro UM, Bacelar-Nicolau P, Ávila LV, Mac-Lean C, Hugé J (2018) Implementing climate change research at universities: barriers, potential and actions. J Clean Prod 170:269–277

Molthan-Hill P, Worsfold N, Nagy GJ, Leal Filho W, Mifsud M (2019) Climate change education for universities: a conceptual framework from an international study. J Clean Prod 226:1092–1101

Oliver MC, Jerrim J, Adkins, MJ (2021) PISA: engagement attainment and interest in science (PEAS). Final report

Salovaara JJ, Pietikäinen J, Cantell H (2021) Perceptions of interconnected sustainability: students' narratives bridging transition and education. J Clean Prod 281:125336

Salvia AL, Rolleston C, Nussey C, Veisa F, Okinyi R, Mananze R, McCowan T (2022) Technical note: the design and implementation of the Climate-U survey 'climate change—practices, experiences and attitudes', transforming universities for a changing climate, working paper series no. 7. ISSN 2754-0308

Trajber R, Walker C, Marchezini V, Kraftl P, Olivato D, Hadfield-Hill S, Zara C, Monteiro SF (2019) Promoting climate change transformation with young people in Brazil: participatory action research through a looping approach. Action Res 17(1):87–107

UNESCO (2011) International standard classification of education. http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf. Accessed 29 June 2022

UPF (2022). Universidade de Passo Fundo. UPF em números. https://www.upf.br/estude-na-upf/apresentacao/upf-em-numeros. Accessed 30 June 2022

Walshe N, Moula Z, Lee E (2022) Eco-capabilities as a pathway to wellbeing and sustainability. Sustainability 14(6):3582

Training a New Generation of Environmental Stewards in Greece

Chrysoula Sardi and Constantina Skanavis

1 Introduction

Global environmental degradation is a severe issue. The problem stems from the industrial revolution, population increase, and strong demand for luxury goods. A lack of environmental education, knowledge, information, and attitudes harms nature and its resources. For sustainability and environmental security, a comprehensive Environmental Education system is vitally required (Yadav et al. 2022). However, the current programs cannot meet the environmental need to promote integrated and transdisciplinary research (Shrivastava et al. 2020).

Nevertheless, despite the agony for change and the availability of various viable options, significant changes have not yet occurred (Hübel and Schaltegger 2022). According to Plummer et al. (2020), creativity and transformational techniques must welcome ambiguity. Academics and practitioners disagree on the way transformation in sustainability and health promotion should be procced. Kuenkel (2018a, b, c) states that transformation literacy lies in the management of sustainable transitions, performed by decision-makers and other collaborative actors. They should work together to build transformation networks, mutually beneficial strategies, and a variety of pathways, which boost socio-ecological system aliveness. Collective planetary health stewardship acknowledges the world as a connected system. According to Bennett et al. (2018), individuals will be able to contribute to altering mindsets

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via environmental stewardship. Such stewardship operations may include environmental education, communication, network-building activities, governance or policy changes, behavior modification systems, and academic or participatory observation and investigation (Bennett et al. 2018). Young environmental stewards are important actors in social-ecological systems and have the potential to affect change. However, they risk being excluded from global transformation issues (Barraclough et al. 2021). Limited study has been conducted on the necessity of including younger generations in the transition to a sustainable society (Gallay et al. 2020).

2 Environmental Education and the Fundamental Error

Environmental Education is a potent teaching tool with a complicated and raucous past. Since its introduction in the relevant development of the 1970s, it has often been misunderstood in terms of its specific definition, origins, aims, and, at times, usefulness to society and education K-12 (Carter and Simmons 2010). According to the Tbilisi Conference (1977), Environmental Education distinguishes itself in educating the general population, training professionals in specific sectors, and developing scientists in specialized disciplines. However, to accomplish the goals of Environmental Education, each of the categories mentioned above requires Environmental Educators who have been rigorously educated and have advanced degrees in their fields. As time passed and environmental challenges became more pressing, the necessity to educate trained personnel for formal, non-formal, and informal education was stressed in the conclusions of the 1987 Moscow Conference, which included a proposal for a worldwide policy on Environmental Education. In 1992, environmental and development education was integrated during the International Conference on Environment and Development in Rio de Janeiro, Brazil. However, the significance of Environmental Education and how it should be implemented was not widely acknowledged (Palmer-Cooper 1998). The fundamental error of unsuccessful Environmental Education course and development was discovered in 1997, at the conference on Environmental Education held in Thessaloniki, Greece: "*The instructors' weak and poor environmental education, resulting in the pupils' wholly missing or partial environmental education.*" It was also said that the observed mass manufacturing of environmental information packets and brochures does not function if they are not based on a suitable and complete Environmental Education program (Tsampoukou-Skanavis 2004). As a result, the urgent need for significant Environmental Education of the trainers themselves and the assessment of knowledge about environmental concerns was identified (Skanavis and Sarri 2004). Unfortunately, educators' lack of understanding and sufficient training on environmental themes makes it challenging to execute environmental education initiatives.

Nonetheless, environmental literacy is likely to result in pro-environmental behavior (Petkou et al. 2021). As stated in the NAAE (2017), educators must understand the information and skills they will be teaching and competence at the developmental stage at which they will be teaching. Therefore, environmental educators must first understand abilities and attitudes related to environmental literacy.

3 Environmental Literacy

Existing dictionaries (Oxford and Webster 2022) define literacy in two ways:

- the ability to read and write; and
- knowledge or competence in a specific topic or profession.

Literacy is an essentially polyphonic term, and every sort of literacy includes, in addition to reading and writing, the method of thinking, speaking, interacting, and assessing (Disinger and Roth 1992). As a result, although knowledge and awareness are crucial components of Environmental Literacy, they do not complete the picture. According to Finger's (1994) study, there is often no correlation between what individuals know and what they finally do. According to McBride et al. (2013), the first effort to define Environmental Literacy has published in a Roth (1968) edition of Massachusetts Audubonby in reaction to regular media reports of "Environmentally Illiterate" people being accused of pollution: It is the human propensity to be oblivious to what seems to be an unseen danger to future devastation.

"People are naturally more impressed by the obvious illnesses," says one wise doctor, Dr. Rene Dubois, yet some of their worst enemies crawl on them undisturbed (Carson 1962: 212). Rachel Carson's "Silent Spring," one of the most important books of all time (Pimentel 2012), highlighted the pervasive dangers of DDT and other pesticides while directly attacking the chemical industry, aided in the igniting of global environmental consciousness (Price 2012: 11). According to Rothman (1998), as described in McBride et al. (2013), as part of the "legacy" of Silent Spring, the public started to voice unease, distrust, and even outright hatred against his country—in this instance, the United States—in the unquestionable obedience of progress. As a result, environmental illiteracy was no longer tolerated.

Roth (1992) noted that long-term environmental illiteracy preceded the term environmental literacy, in the same way that long-term illiteracy preceded the term literacy. According to Disinger and Roth (1992), Environmental Literacy is described in terms of behavioral observation as the capacity to detect and comprehend environmental systems' relative health and take appropriate steps to preserve, repair, or enhance the health of these systems.

The seven components of Environmental Literacy (adapted from Simmons 1995, in Hollweg et al. 2011 and McBride et al. 2013) are:

1. Influence (e.g., environmental sensitivity, attitudes, and ethics).
2. Ecological knowledge.

3. Socio-political knowledge (e.g., the relationship of cultural, political, economic, and other social factors to ecology and the environment).
4. Knowledge of environmental issues.
5. Skills related to environmental problems/issues and action strategies, systemic thinking, and forecasting.
6. Determinants of environmentally responsible behavior—focus on control and taking personal responsibility.
7. Behavior—various forms of active participation that aim to solve problems.

According to Roth (1992), as mentioned in Wilke (1997: 34), there are four aspects—knowledge, skills, impact, behavior that need to be clarified in environmental literacy education. With slight variations in wording, Hollweg et al. (2011) refers to the 4 interrelated aspects of environmental literacy: knowledge, competencies (skills & abilities), dispositions, and environmentally responsible behavior, expressed in specific contexts.

So environmentally educated people have varying degrees of:

- knowledge and understanding of a wide range of environmental concepts, problems, and issues,
- a set of cognitive skills and abilities,
- a set of cognitive and emotional dispositions,
- and suitable behavioral techniques for utilizing their gained information to create good and productive judgments in several environmental circumstances (Hollweg et al. 2011).

In this situation, the area's uniqueness is not only in the didactic method but also in the attitude toward people and how one thinks and communicates. Indeed in 1969, Schoenfeld defined environmental education as "*communication aimed at producing a citizenry that is knowledgeable concerning our environment and its associated problems*" (Jurin et al. 2010). The leading school of thinking about the remedy was interconnectedness and focusing on negative human consequences. It is undeniable that interdependence is the main idea—everything is related to everything else.

4 The Correlation Between Environmental Education, Communication, and Interpretation from an Environmental educator's Perspective

According to Jurin et al. (2010), a mythological monster may be compared to environmental education, communication, and interpretation (ECEI): "*Cerberus, the canine warden of Hades. This demonic dog is said to have three heads atop three necks emerging from a single body. The heads, although being able to attack diverse targets—at least according to folklore—were fundamentally the same beast*".

Environmental communication is a relatively young-discipline line within communication science that intersects with environmental education and health communication. One of the sub-themes that continues to dominate environmental communication is climate change communication which must be effectively conveyed to young people to be adequately addressed in the future (Skanavis and Kounani 2018).

Since 1980, environmental communication has grown in popularity as a professional discipline. According to Jurin et al. (2010), Environmental Communication is described as "the systematic creation and exchange of human communications in, from, and about the environment." Many different sub-disciplines and scientific domains are intertwined with environmental communication. These include conflict resolution, social media, advocacy campaigns, risk communication, green marketing, and corporate advocacy campaigns. Zikargae (2018) defines environmental communication as "the social and symbolic constructions of the environment." Van Swol et al. (2021) argue that environmental communicators must bridge the gap between expert and non-technical audiences to engage stakeholders in environmental transformation. Professionals must successfully interpret science, effectively communicate costs and benefits, and involve stakeholders throughout the process (Pontius and McIntosh 2020).

Academics, professors, and practitioners have a responsibility to educate, cast doubt on, and speak out in appropriate forums when "social/symbolic representations of the 'environment'," knowledge claims, or other communication practices are restricted or subsidized for harmful or unsustainable policies toward human communities and the natural world." Similarly, they are responsible via their work for identifying and pushing for activities that comply with the first normative principle: to strengthen society's ability to respond correctly to environmental "alarms" associated with human and environmental eudaimonia (Cox 2007). Environmental communication is an essential tool for disseminating environmental activities, such as reducing waste and protecting the environment, and presenting the roles of individuals, departments, corporations, and organizations to various stakeholders. Creating a sustainable society is primarily motivated by environmental communication (Zikargae 2018). At the same time, Anderson (2015: 381) argues that environmental communication has reached a tipping point, moving from grassroots to highly organized campaigns. Expanded outreach and multi-stakeholder cooperation are proposed to examine how "various stakeholders involved in environmental communication (i.e., scientists, politicians, advocacy groups, industry, and government) frame the issues," according to the author. "What are the public's interests and concerns?" Incorporating stakeholders may take many forms, from passive communication (e.g., public awareness campaigns) to collaborative partnerships. Several parties develop new information (e.g., participatory action research projects). Through collaboration with many disciplines of study, environmental educators may enhance awareness of the interconnectedness of all living beings and systems (Kevany 2019, p. 282). Therefore, environmental communication has its origins in the pressing need to understand better and interpret human interactions with the rest of the environment.

Environmental interpretation in informal free-choice learning settings is essential to educate tourists on complicated natural resource concerns linked with national and local protected areas and sensitive ecotourism settings. Interpretive programs are delivered by persons who identify themselves as interpreters, educators, naturalists, nature guides, docents, tour guides, or heritage interpreters, according to Skanavis and Giannoulis (2009). Interpretation may refer to either personal (i.e., interpreter-led walks, campsite programs, speeches, etc.) or non-personal activities (i.e., films, exhibits, and publications). Interpreters aim to instill in visitors a feeling of ownership and care for the resource.

So professionals of natural resources should expect to use communication, interpretation, and education abilities regularly in their job:

1. Environmental education takes place in formal settings, such as the school system.
2. Environmental communication takes place in informal settings, such as mass media and the white-based web.
3. Environmental interpretation takes place in non-formal settings such as environmentally protected areas, botanical gardens, museums, NGOs.

"*Each of these three settings—formal, informal, and non-formal—depends on a mediator. This mediator may be called a teacher, facilitator, host, interpreter, journalist, communicator, tour guide, information/outreach specialist, educator, scientist, engineer, or one of many other titles. The environmental communicator's job is to transmit environmental, scientific, and/or natural resource information to interested recipients*" (Jurin et al. 2010).

According to NAAE (2017), Environmental Educators must:

- Grasp the aims, philosophy, practice, and history of environmental education. This information offers a firm basis for educators' work.
- Embrace the obligations of environmental education. Environmental education is a profession with rigorous requirements for teaching and professional ethics.
- Plan and conduct successful teaching that combines the basics of excellent education with environmental education's distinctive qualities. Their training should prepare teachers to offer interdisciplinary, hands-on, exploratory learning experiences.
- Open inquiry and study, particularly when challenging environmental problems, need learners to evaluate their own and others' viewpoints critically. Educators should be trained to provide a learning environment that includes participation.
- Understand and practice assessment and evaluation as part of education and programs. Professional development should provide educators with methods for analyzing student growth and program performance.

We are thus talking to a ''teacher" who does not teach environmental values but rather values exploration procedures, which mobilize the emotional field of the trainees. As urged by De Almeida and Da Silva Carvalho (2018), to achieve the 2030 Agenda for Sustainable Development Goals, we must engage in learning movements that promote value and paradigm re-education via training from social actors

such as environmental educators and health advocates. According to Frehm et al. (2019), environmental educators are responsible for teaching individuals how to be successful environmental stewards. Environmental stewardship is one effective strategy for individuals to support sustainability actively (Bennett et al. 2018).

5 Environmental Stewards into Ecosystems

According to the ecology hierarchy, an ecosystem is "an interaction complex of communities and the abiotic environment impacting them within a specific region." A marsh, a grassland, a forest, a coral reef, and a dune, for example, may all be researched as independent ecosystems with their renowned species. People are also constituents of ecosystems, but in certain circumstances, humans are the driving force of an ecosystem; from this viewpoint, such systems are referred to as human-dominated systems in the scientific subject of urban ecology (Wright and Boose 2011: 53).

As we all know, human health is reliant on the availability of air, water, food, energy, leisure, cleanliness, exposure to germs, toxins, and environmental hazards, as well as a range of other factors such as gender, behavior, or sociality (Barrett et al. 2015). Consequently, relying on healthy natural systems to sustain healthy societies and civilizations has become a reality, necessitating knowledge of how humans depend on natural ecosystems and their services (Patz et al. 2012).

Ecosystem services are made up of three interconnected concepts:

- The physical components of the environment (structure)
- The operation and interconnection of those pieces (process or function), and
- The irreplaceable contribution of the environment to human welfare (benefit or benefit-providing service) (Danley and Widmark 2016).

While it is simpler to conceptualize the living world as a collection of distinct ecosystems, one ecosystem is seldom fully isolated from another (Wright and Boose 2011: 53). Ecosystem services—the benefits that people get from nature and natural capital—is a concept that is commonly used to explain human dependence on nature and to define choices we make in terms of nature's continuing value to human welfare (Bennett and Chaplin-Kramer 2016). The notion of ecosystem services has increased in popularity over the past decade due to the tremendous advantages for better decision-making. However, identifying how to apply this strategy to real-world decision issues remains a considerable and continuing difficulty (Rozas-Vásquez et al. 2019). Despite substantial research on policymakers' and practitioners' attitudes, understanding, and acceptance of the notion, implementation remains restricted services are at a crossroads. The efficacy of ecosystem scientists' communication with policymakers relies on political leadership, good governance, efficient measurement and reporting processes, and suitable language and communication tools (Keenan et al. 2019).

An environmental steward's principal responsibility is to interact with the ecosystem responsibly by balancing the usage of supply with the social and ecological demands of a bigger and more diverse portfolio of ecosystem services (Cockburn et al. 2019). Although we concentrate on direct stewardship activities, there are also indirect operations. Environmental education, sharing of fixed ecological information, network development activities, governance or policy renovations, behavior modification systems, and academic or participatory observation and research are stewardship-providing activities. Eventually, individuals will successfully alter attitudes via environmental stewardship (Bennett et al. 2018).

Biosphere stewardship also provides an innovative multi-actor approach to sustainability. Despite the critical function of environmental stewards, biosphere stewardship emphasizes the need for community action and, as a result, governance. Biosphere stewardship denotes a fresh governance modulation capable of effectively approaching sustainable transformation (Plummer et al. 2020). Despite emphasizing future generations, there has been a minimal effort on the value of young actors' responsibilities as biosphere stewards. Young stakeholders who may be agents of sustainable transformation are critical players in social-ecological systems, but they are also particularly vulnerable to the problems of climate change (Barraclough et al. 2021).

6 Training a New Generation of Environmental Stewards via Skyros Project

Plummer et al. (2021) advocate identifying stewardship motivations as a possible leverage point and one of several plausible avenues for future research related to boosting engagement in environmental stewardship for the planet's sustainability. One of the most critical aspects of stakeholder engagement is the development of communication and knowledge networks (Servaes and Rico 2020). An open, participatory approach is essential for the Sustainable Development Goals (SDGs) to gain momentum and be promoted in people's daily lives worldwide (Doni et al. 2020).

The Skyros Project, a model Greek community headquartered in Linaria, has officially launched at Skyros island in Greece. A collaboration between two public sectors resulted in the SKYROS PROJECT. To create this "golden" unity, the Environmental Education, Training, and Communication Research Unit of the University of West Attica has collaborated with the Skyros Port Authority, controlled by the Ministry of Shipping, and oversees operating and using Skyros' port. Skyros Project serves as a Communication and Education Center of Practice to implement a complete environmental campaign to communicate relevant environmental information and raise environmental awareness among participants and future environmental stewards. Participants are taught and teach others as part of the Skyros Project environmental and health education program. The ultimate objective is to encourage

ecologically responsible conduct or actively participate in environmental decision-making. The Skyros Port Authority has embraced an environmentally sustainable agenda and invested in technologies that have made this port distinctive for its green tourism dubbed "blue port with a shade of green" by the United Nations (Skanavis et al. 2018). Environmentally-friendly electric tricycles and water-saving cleaning equipment have been acquired to reduce the environmental effect in the port zone. Also, Skyros Island's dock boasts the nation's first recyclable electrical compressor. According to the annual tourist imprint monitoring, a continual data stream allows all tourism stakeholders to produce a competitive and safe product (https://www.linariaport.gr/el/). According to Khadka et al. (2020), using place-based education to enhance participants' knowledge, responsibility, hope, awareness, and behavioral intention about climate change may effectively improve understanding of climate change. This program's environmental and health promotion theory is translated into practice in a port setting. According to Skanavis et al. (2020) environmental challenges such as sustainable development, global warming, and climate change must be addressed via outdoor activities. Skyros Project initially focused on college students, exposing them to real-world environmental situations at a port to raise their environmental stewardship. Tourists and locals alike reaped the advantages of this environmental awareness approach (Antonopoulos et al. 2016).

Skyros Project provides the following services: Internship at the port, Tourist and Marine Observatories, Environmental Kids' Camp, Trash Art lab, and the Summer Academy for Environmental Educators. Environmental communication tactics effectively adopted at the port of Linaria have increased stakeholder engagement in local environmental problems, and information distribution has been received in various ways (Antonopoulos and Skanavis 2020).

The team has presented at several conferences and seminars worldwide (such as New York, Italy, Japan, Dubai, UAE, Spain, Boston, Morocco, New Jersey, Norway, Austria). The Skyros Project is a dynamic teaching technique. It has received 14 accolades in its seven years of existence: World Award (for winning the video production competition for Climate Change Awareness—Marrakesh, Morocco in 2016 at the Climate Change Summit), 2 European Awards (for winning the most popular video and the best production video category at the World Environmental Day/zero waste competition), 9 Golden National Awards (4 in tourism—4 in the environment—1 in education), 2 Silver Awards, 3 honorary distinctions.

6.1 Summer Academy for Environmental Educators

Skyros Project established the first Summer Academy for Environmental Educators in Greece in 2016, training hundreds of participants each summer through a rigorous and innovative curriculum program, involving them in environmental communication activities while exposing them to cutting-edge environmental theory (Skanavis et al. 2019). The Academy of Environmental Educators is regarded as a forerunner in teaching a new generation of environmental educators capable of

participating in the formal, non-formal, and informal promotion of responsible environmental behavior and health promotion. Participants may effectively contribute to the school system, environmental centers, cruise ships, museums, gardens, mass media, and other places to participate in topics relating to Environmental Education and Public/Community/Environmental Health.

The purpose of the Academy of Environmental Educators is to create a new educational path that is innovative for Greek standards and is based on the needs of people who train in Environmental Education and Environmental Health issues. The Academy also focuses on equipping learners with the necessary skills to effectively navigate the world of environmental and health communication.

The ultimate goal is active participation in environmental and health decision-making to safeguard and promote sustainability.

The curriculum is aimed at students and graduates of environmental sciences, health, and welfare sciences, biological and natural sciences, social sciences, and humanities institutions. It is also intended at postgraduate students of related fields, as well as individuals who work or have worked as interpreters, trainers, or journalists who want to become actively engaged in Environmental Education in:

- Formal Education—Schools,
- Non-formal Education—Environmental Interpreters—Museums, Parks, Cruise Ships
- Informal Education Camps—Mass Media and those involved in Environmental Education and Public/Community/Environmental Health.

7 Methodology

This section covers the design of the application used based on a case study approach. According to Crowe et al. (2011), the case study approach offers the opportunity to investigate a variety of complex issues in real-life settings in a manner that delves in-depth. The focal point concerning case studies addresses single entities -an individual, organization, decision, community, and similar thematic (Yin and Davis 2007).

The case study approach is a scientifically legitimate research design employed in a wide spectrum of disciplines (Crowe et al. 2011).

For the purposes of this research the case study is addressed as both the *process of learning about the case and the product of our learning* (Stake 1995). Furthermore, it serves the investigator's aim for developing a theory regarding causes of similarities or differences among instances (cases) (George and Bennett 2005: 17).

From the literary point of view, the case study employs a variety of literary techniques to create mental images that bring to life the many variables inherent in the phenomenon being studied. That's why the case study approach was chosen for this recherche project. It facilitates a better understanding and analysis of causal links and pathways that are derived from service development or new policy initiatives (Crowe et al. 2011).

Basically, the application utilized as a ‘’metaphor” of ecosystem services -which are made up of the following three interconnected concepts into parenthesis:

- **The X-raying of the components of the Skyros Project (structure)**
  Collaborative multi-stakeholder systems are transitory human interaction systems. They may help emerge new methods of jointly molding the future because of their transient nature and loose structure. They entail establishing issue-based networks of institutions and people engaged (Kuenkel 2018a). Ecosystem services allow “actors from diverse backgrounds” to come together (Keune et al. 2013). All the involved stakeholders—as the components of the Skyros Project ecosystem, were gathered and listed according to their input validity. They were then analyzed for cross-collaborations, and a figure was created to present them based on their valued weight of importance in the process of environmental awareness.
- **Graph Skyros Project operations (processes or function)**
  The notion of ecosystem services is gaining traction as an efficient framework for managing and communicating the expected implications of both global and local change (Tsampoukou-Skanavis 2004). Researchers in ecology used a systems perspective of life towards the end of the previous century to represent ecosystems as networks with various communicative feedback loops that are interconnected (Kuenkel 2018b). The phrase ’ecosystem services’ brings together, with a communicative aim, many activities of ecosystems and landscapes that have not previously been effectively connected, resulting in communication misunderstanding (Burkhard et al. 2015). Therefore, ecosystem services have their origins in the natural sciences, but have gained popularity as a phrase for communicating environmental research and policy (Danley and Widmark 2016). Based on the above Skyros Project as an ecosystem use the environmental communication as the narrative to produce environmental communication services as operations which present at a graph.
- **Portraying the Academy process which provide the outcome (benefit-providing service)**
  Ecosystem services research has been very successful in raising public awareness of the importance of biodiversity and fostering discussion about it (Tsampoukou-Skanavis 2004). Through portraying the Academy process into the Skyros Project ecosystem structure, the stakeholders are incorporated in small steps with the larger picture kept in mind, and environmental communication services flow to provide the benefit outcome which is the environmental awareness.

8 Findings

8.1 X-raying of the Components of the Skyros Project (Structure)

As a model for multi-stakeholder collaboration, Skyros Project represents the complexity of the tasks and settings while also being practical and action oriented.

The Skyros Project collaborates with a variety of stakeholders to produce environmental communication services according to Fig. 1. These stakeholders are the Research Center of Environmental Education & Communication (University of West Attica), Skyros Port Fund, External Scientific Collaborators, Public & Private Collaborators, Non-Governmental Organizations (NGOs), Local Community, Tourists, Trainees, and Volunteers.

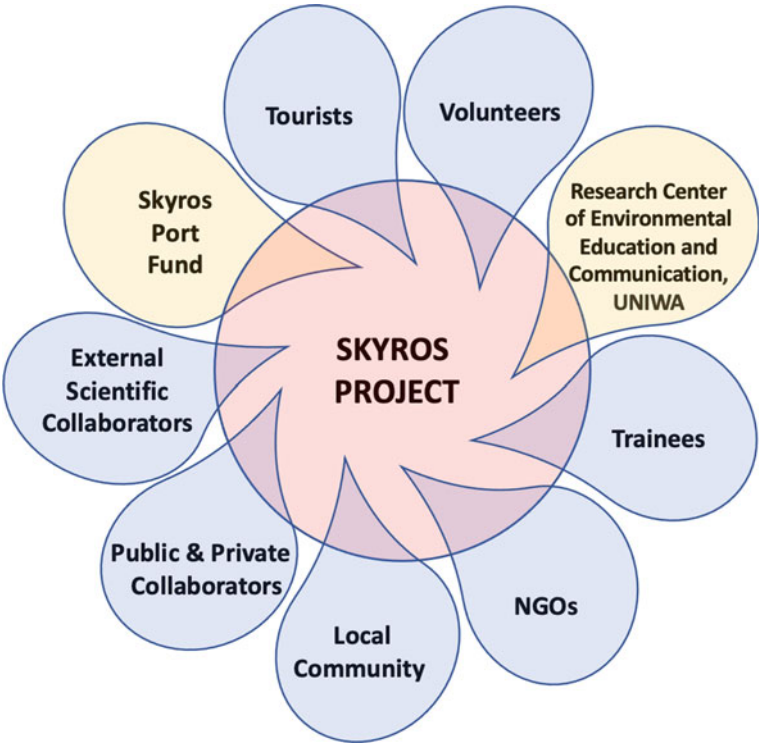

Fig. 1 Skyros project stakeholders

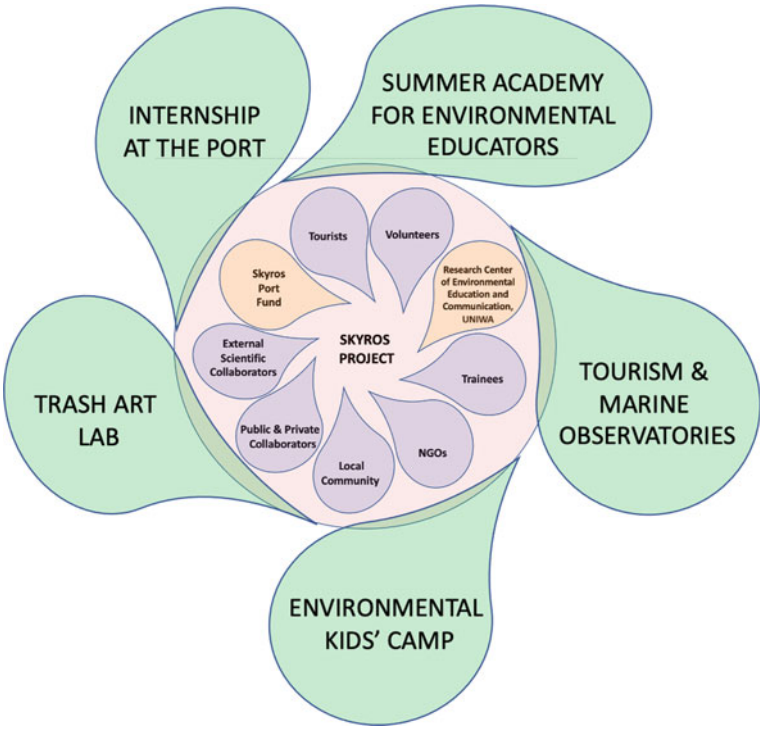

Fig. 2 Skyros project services

8.2 Graph Skyros Project Operations (Processes or Function)

Skyros Project provides the following environmental communication services (Fig. 2) in order to promote environmental awareness: Internship at the port, Tourism and Marine Observatories, Environmental Kids' Camp, Trash Art lab, and the Summer Academy for Environmental Educators.

8.3 Portraying the Academy Process Which Provide the Outcome (Benefit-Providing Service)

This section frames one of the communication services of the Skyros Project, which promotes environmental awareness, specifically, Summer Academy for Environmental Educators. Academy ecosystem, based on Skyros Project's long-standing legacy of producing and giving experiences that move, instruct, and inspire, emphasizes the 17 SDG Goals.

According to Fig. 3, from the one hand, Skyros Project as a service ecosystem connects stakeholders in order to collaborate with each other and via environmental communication, promotes environmental awareness. On the other hand, stakeholders gain the collaboration benefits which include implementation and promotion of their ideas, as well as opportunities to collaborate and co-create services with value outcomes, specifically environmental awareness. Skyros Port Fund, used as the place-based position offering environmentally friendly infrastructure, promotes responsible environmental behavior via theory and hands-on practice in an outdoor setting. Skyros Port Fund has implemented the usage of electric tricycles for traveling about the port zone to lessen the ecological impact, and an electric water saving machine has been obtained for cleaning the port zone area. In addition, the first recyclable electrical compressor was erected at Skyros Island's port. Aside from the basic comforts of a tourist shelter, the services mentioned above enhance the port's image and make it simpler to maintain cutting-edge management of the available resources and the natural environment. The port is being used as a teaching tool to raise environmental awareness and promote good health. The Research Center of Environmental Education and Communication-University of West Attica offers environmental education and communication services directly from the scientific community. This research module evaluates and certifies the training of the future environmental stewards. External Scientific Collaborators, specifically, the Department of Atmospheric Physics at the University of Patras installed at Skyros Port Authority a station to monitor suspended particles in the atmosphere. This station is used to teach trainees in real-time air quality measurements.

Collaborators such as Public, Private Collaborators, and Non-Governmental Organizations (NGOs), provide training services at the curriculum of the Academy with interactive workshops at natural setups. Activities such as the Zero Waste challenge accelerate environmental communication through experiential events and promote environmental awareness.

Also, the collaboration with the Local Community, such as local cruise (service provider) boats, provides trainees with a one-of-a-kind experience in environmentally protected regions to reconnect with nature. Consequently, trainees get a first-hand look at effectively communicating about the environment. They interact with nature and the great outdoors in new and exciting ways. In addition, tavernas, restaurants, and delicatessen, as well as local producers, collaborate to create a one-of-a-kind service/environmental communication experience: novel cooking techniques for local dishes utilizing on-site produced ingredients, cultivated in a cleaner environment. Furthermore, the students' selected lodging on Skyros Island throughout their training stay is based on a traditional type of accommodation exposing them to an ecovillage set up. The "Summer Academy of Environmental Educators" promotes through training tailored to a sustainable way of living a hands-on communication experience that boosts environmental awareness of the trainees and strengthens their skills as environmental stewards. As seen through the ecosystem services (structure, process or function, and benefit or benefit-providing service), the Academy fulfills the need for an environmental communication service.

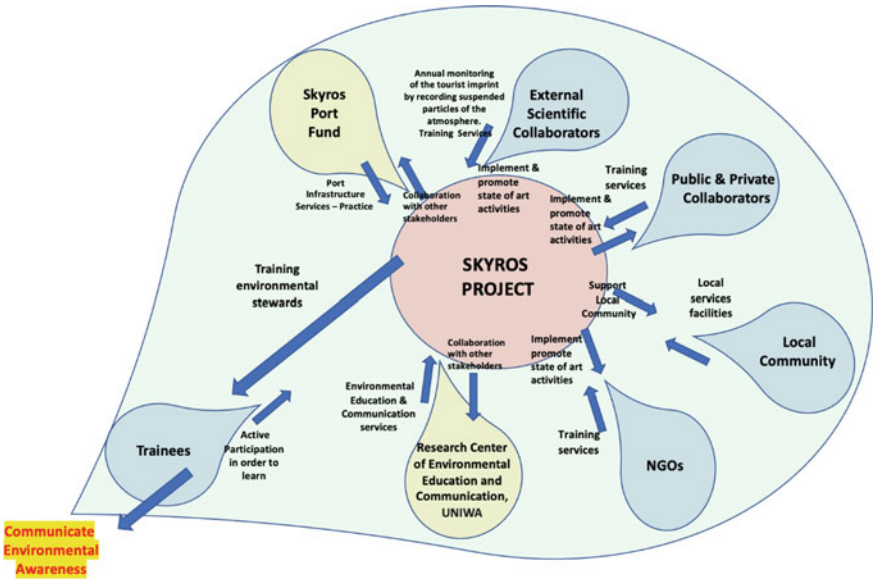

Fig. 3 Summer academy for environmental educators as an environmental communication service model

9 Teaching Modules

The program was primarily provided by NAAE (2017), according to Table 1:

Mandatory participation is required for all activities assessing the knowledge/certification process. If all the above requirements for completing the Teaching Module have been met, students will be tested by assignment on the day of assessments. The program is mandatory for one week at Linaria Port of Skyros Island, and the trainees have one more week to finish their required assessments. Successful participation resulted in issuing the Certificate of Environmental Educator from the Training & Lifelong Learning Center—University of West Attica (https://kedivim.uniwa.gr/en/course/therini-akadimia-perivallontikon-ekpaideyton/).

10 Discussion

Among completion of the program, the participants gain a unique experience based on understanding the underlying features, concepts, methodologies, and strategies for effectively serving in the arena of Environmental Education and Health Promotion. According to Yadav et al. (2022), a comprehensive Environmental Education system is critical for sustainability and environmental safeguarding. In such settings, trainees learn about the necessary educational methods, materials, and resources for

Table 1 Teaching modules

Environmental Communication and Health Promotion: An Overview	
a	Knowledge of Environmental Education and Health
b	Individual, Environment, and Health
Environmental Literacy	
a	Capabilities in asking, analyzing, and interpreting
b	Understanding of environmental processes and systems
c	Understanding and response to health and environmental problems
d	Individual and political accountability
Foundations of Environmental Health Education	
a	Fundamental objectives and characteristics of Environmental Health Education
b	The implementation of Environmental and Education
c	The evolution in the field of Environmental Health Education
Professional Responsibilities of the Trainer	
a	The exemplary practice of Environmental Health Promotion
b	Emphasis on defense and education of the right concerning Public and Community Health
c	Professional development and continuous learning
Design and implementation of Environmental Education and Health Promotion programs	
a	trainees' knowledge
b	Understanding of educational techniques
c	Environmental education and health promotion tools and resources Knowledge of teaching design
d	Plans for teaching
e	Curriculum development aims to improve learning while also encouraging involvement
Enhancing learning and promoting participation	
a	A climate of learning and exploring the environment
b	An inclusive, collaborative learning environment
c	Flexible and sensitive training
d	Human rights
Assessment and evaluation	
a	Student results
b	Assessment of teaching
c	Improving teaching
d	Design of new programs
e	Support for vulnerable groups

(continued)

Table 1 (continued)

Environmental Communication and Health Promotion: An Overview	
Practical Training	
a	Practical application of formal Environmental Education
b	Practical application of non-formal Environmental Education
c	Practical application of Environmental Health
d	Practical application of informal Environmental Education and Health Promotion

environmental education and health promotion, dissemination technologies, didactics, curriculum planning, while questioning their own degree of active environmental participation in the decision-making process. According to NAAE (2017), environmental educators must have a firm grasp on the knowledge and skills they must impart in order to be able to promote responsible environmental behavior. It is essential for teachers of environmental literacy to constantly assess their students' talents and attitudes toward the subject matter and cultivate their critical thinking, questioning, analysis, and interpretation abilities for tackling complex and unexpected situations of environmental concerns. For critical environmental issues, open inquiry and research are recommended by NAAE (2017). Also, according to Pontius and McIntosh (2020), professionals must correctly understand research, communicate costs and advantages effectively, and include stakeholders throughout the process. Furthermore, learners may analyze, identify, and plan activities to boost the general population's and vulnerable groups' health, detect emerging issues as they occur, and implement complete Environmental Education and Health Promotion programs ethically and successfully.

The above results of the Summer Academy training program boost environmental educators, which according to Frehm et al. (2019), are responsible for educating people on how to be good environmental stewards.

11 Limitations

The absence of comparable training programs, which would allow for a comparison of their setup and deliverables, is a limitation of this research.

12 Conclusion

Today, there is an enormous need for global problem solvers. State of art designed instruction and training for the next generation of environmental educators are crucial sustainability elements. Essential to excellence in environmental education is that it should result in actionable steps toward improving environmental outcomes rather

than gathering knowledge or skills that are unattainable (Shahzalal and Hassan 2019). Environmental educators should be educated on the aims, objectives, characteristics, and messages of Environmental Education and Health Promotion. Via the Summer Academy for Environmental Educators, trainees have been exposed to cutting-edge environmental theory through a rigorous and innovative curriculum based on real-time and place-based environmental experiences since 2016. Janoušková et al. (2019) argue that effective communication is one of the most significant factors for fostering new knowledge and encouraging active participation.

Consequently, communication is vital if we wish to promote sustainability awareness and if we want to inspire others to participate. The Summer Academy of Environmental Educators is portrayed through this analysis as a promising environmental communication service. Various stakeholders work together to co-create and offer environmental awareness to trainees attending the program. Individuals will eventually contribute to changing the attitudes of others via selected environmental stewardship efforts. The Academy is widely regarded as a trailblazer in training a new generation of environmental stewards capable of participating in the formal, non-formal, and informal promotion of responsible environmental behavior and health promotion in all settings. The ultimate objective is to encourage ecologically responsible behavior and engage citizens in environmental decision-making concerning sustainability issues. As an activity of the Skyros Project environmental awareness organization, the Summer Academy for Environmental Educators focuses on developing and providing new environmental communication services, giving the lead way as a model for replication in other similar setups.

References

Anderson A (2015) Reflections on environmental communication and the challenges of a new research agenda. Environ Commun 9(3):379–383. https://doi.org/10.1080/17524032.2015.1044063

Antonopoulos G, Skanavis C (2020) 'Promoting an environmental awareness center to enhance educational activities in Linaria port, Skyros. Int J Green Econ 14(2):95–107. https://doi.org/10.1504/IJGE.2020.10032074

Antonopoulos K, Plaka V, Skanavis C (2016) Linaria port, Skyros: an environmentally friendly port community for leisure crafts. In: Proceedings of the 13th international conference on protection and restoration of the environment, at Mykonos Island, Greece

Barraclough AD, Schultz L, Måren IE (2021) Voices of young biosphere stewards on the strengths, weaknesses, and ways forward for 74 UNESCO biosphere reserves across 83 countries. Glob Environ Chang 68:102273. https://doi.org/10.1016/j.gloenvcha.2021.102273

Barrett B, Charles JW, Temte JL (2015) Climate change, human health, and epidemiological transition. Prev Med 70:69–75. https://doi.org/10.1016/j.ypmed.2014.11.013

Bennett EM, Chaplin-Kramer R (2016) Science for the sustainable use of ecosystem services. F1000Research 5:2622. https://doi.org/10.12688/f1000research.9470.1

Bennett NJ, Whitty TS, Finkbeiner E, Pittman J, Bassett H, Gelcich S, Allison HA (2018) Environmental stewardship: a conceptual review and analytical framework. Environ Manag 61:597–614. https://doi.org/10.1007/s00267-017-0993-2

Burkhard B, Müller F, Schweppe-Kraft B, Grunewald K, Syrbe R-U, Rosenberg M, Vowinckel J, Lupp G, Bastian O, Holfeld M, Anders K (2015) Ascertainment and assessment of es. Ecosyst Serv–Concept, Methods Case Stud 75–143. https://doi.org/10.1007/978-3-662-44143-5_4

Carson R (1962) Silent spring (Translated by L. Kandilidis). Cactus Publications 1981, Athens, p 212

Carter RL, Simmons B (2010) The history and philosophy of environmental education. In: The inclusion of environmental education in science teacher education, pp 3–16. https://doi.org/10.1007/978-90-481-9222-9_1

Cockburn J, Cundill G, Shackleton S, Rouget M (2019) The meaning and practice of stewardship in South Africa. South African J Sci. 115(5/6). https://doi.org/10.17159/sajs.2019/5339

Cox R (2007) Nature's "crisis disciplines": does environmental communication have an ethical duty? Environ Commun J Nat Cult 1(1):5–20. https://doi.org/10.1080/17524030701333948

Crowe S, Cresswell K, Robertson A, Huby G, Avery A, Sheikh A (2011) The case study approach. BMC Med Res Methodol 11(1):1–9

Danley B, Widmark C (2016) Evaluating conceptual definitions of ecosystem services and their implications. Ecol Econ 126:132–138. https://doi.org/10.1016/j.ecolecon.2016.04.003

De Almeida R, Da Silva Carvalho PG (2018) Healthy people living on a healthy planet—the role of education of consciousness for integration as an instrument of health promotion. In: Azeiteiro U, Akerman M, Filho WL, Setti A, Brandli L (eds) Lifelong learning and education in healthy and sustainable cities. World sustainability series. Springer, Cham, pp 299–326

Disinger JF, Roth CE (1992) Environmental literacy, ERIC/CSMEE digest. ERIC Clearinghouse for Science Mathematics and Environmental Education, Columbus OH

Doni F, Gasperini A, Soares J (2020) SDG13- climate action: combatting climate change and its impacts. Emerald Publishing Limited

Finger M (1994) From knowledge to action? Exploring the relationships between environmental experiences, learning, and behavior. J Soc Issues 50(3):144–160

Frehm V, Gravinese PM, Toth LT (2019) Cultivating future environmental stewards. Florida Sci 82(4):112–121

Gallay E, Pykett A, Smallwood M, Flanagan C (2020) Urban youth preserving the environmental commons: student learning in place-based stewardship education as citizen scientists. Sustain Earth 3(1). https://doi.org/10.1186/s42055-020-00026-1

George AL, Bennett A (2005) Case studies and theory development in the social sciences. Mit press

Hollweg KS, Taylor JR, Bybee RW, Marcinkowski TJ, McBeth WC, Zoido P (2011) Developing a framework for assessing environmental literacy. North American Association for Environmental Education, Washington, DC. http://www.naaee.net

Hübel C, Schaltegger S (2022) Barriers to a sustainability transformation of meat production practices—an industry actor perspective. Sustain Prod Consum 29:128–140. https://doi.org/10.1016/j.spc.2021.10.004

Jacobs S, Haest B, de Bie T, Deliège G, Schneiders A, Turkelboom F (2013) Biodiversity and ecosystem services. Ecosyst Serv 29–40. https://doi.org/10.1016/b978-0-12-419964-4.00003-2

Janoušková S, Hák T, Nečas V, Moldan B (2019) Sustainable development—a poorly communicated concept by mass media. another challenge for sdgs? Sustainability 11(11):3181. https://doi.org/10.3390/su11113181

Jurin RR, Roush D, Danter KJ (2010) Environmental communication: skills and principles for natural resource managers, scientists, and engineers. Springer. ISBN 978-90-481-3986-6

Keenan RJ, Pozza G, Fitzsimons JA (2019) Ecosystem Services in environmental policy: Barriers and opportunities for increased adoption. Ecosyst Serv 38:100943. https://doi.org/10.1016/j.ecoser.2019.100943

Keune H, Dendoncker N, Jacobs S (2013) Ecosystem service practices. Ecosyst Serv 307–315. https://doi.org/10.1016/b978-0-12-419964-4.00023-8

Kevany K (2019) Ecopsychology and sustainable development. In: Filho WL (ed) Encyclopedia of sustainability in higher education. Springer, Cham, pp 445–448

Khadka A, Li CJ, Stanis SW, Morgan M (2020) Unpacking the power of place-based education in climate change communication. Appl Environ Educ Commun 20(1):77–91. https://doi.org/10.1080/1533015x.2020.1719238

Kuenkel P (2018a) A conceptual architecture for stewarding sustainability transformations. In: Stewarding Sustainability Transformations, pp 207–271.https://doi.org/10.1007/978-3-030-03691-1_7

Kuenkel P (2018b) The collective leadership compass: a practice model for navigating complex change. In: Stewarding Sustainability Transformations, pp 21–41.https://doi.org/10.1007/978-3-030-03691-1_2

Kuenkel P (2018c) A living systems perspective for stewarding sustainability transformations. In: Stewarding Sustainability Transformations, pp 59–96.https://doi.org/10.1007/978-3-030-03691-1_4

McBride BB, Brewer CA, Berkowitz AR, Borrie WT (2013) Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here? Ecosphere 4(5):67. https://doi.org/10.1890/ES13-00075.1

North American Association for Environmental Education (NAEE) (2017) Guidelines for excellence professional development of environmental educators. ISBN: 978-1-1-884008-78-8

Oxford University Press (2022) Oxford learner's dictionaries. https://www.oxfordlearnersdictionaries.com/definition/english/literacy

Palmer-Cooper JA (1998) Environmental education in the 21st-century theory, practice, progress, and promise. Routledge

Patz J, Corvalan C, Horwitz P, Campbell-Lendrum D, Watts N, Maiero M, Olson S, Hales J, Miller C, Campbell K, Romanelli C, Cooper D, Violetti D, Silveira FS, Ogolla DB, Kirkman G, Hodgson T, Zelaya-Bonilla S, Villalobos-Prats E (2012) Our planet, our health, our future: human health and the rio conventions: biological diversity, climate change and desertification. World Health Organ. https://doi.org/10.13140/2.1.1366.1767

Petkou D, Andrea V, Anthrakopoulou K (2021) The impact of training environmental educators: environmental perceptions and attitudes of pre-primary and primary school teachers in Greece. Educ Sci 11(6):274. https://doi.org/10.3390/educsci11060274

Pimentel D (2012) Silent spring, the 50th anniversary of Rachel Carson's book. BMC Ecol 12(1):20. https://doi.org/10.1186/1472-6785-12-20

Plummer R, Baird J, Farhad S, Witkowski S (2020) How do biosphere stewards actively shape trajectories of social-ecological change? J Environ Manag 261:110139. https://doi.org/10.1016/j.jenvman.2020.110139

Plummer R, Baird J, Dale G (2021) What makes an environmental steward? An individual differences approach. Environ Values. https://doi.org/10.3197/096327121x16141642287773

Pontius J, McIntosh A (2020) Environmental communication. In: Critical skills for environmental professionals. springer textbooks in earth sciences, geography, and environment. Springer, Cham. https://doi.org/10.1007/978-3-030-28542-5_10

Price J (2012) Stop saving the planet!—and other tips via rachel carson for twentyfirst-century environmentalists. In: Curver L , et al (eds) Rachel Carson's silent spring: encounters and legacies, federal ministry of education and research, 7, 11. http://www.environmentandsociety.org/sites/default/files/rcc_issue7_web-3.pdf

Roth CE (1968) On the road to conservation. Massachusetts Audubon, pp 38–41

Roth CE (1992) Environmental literacy: it's roots, evolution, and direction in the 1990s. In: ERIC clearinghouse for science, mathematics, and environmental education, Columbus, Ohio, USA

Rothman HK (1998) The greening of a nation? Environmentalism in the United States since 1945. Harcourt Brace, Orlando, Florida, USA

Rozas-Vásquez D, Fürst C, Geneletti D (2019) Integrating ecosystem services in spatial planning and strategic environmental assessment: the role of the cascade model. Environ Impact Assess Rev 78:106291. https://doi.org/10.1016/j.eiar.2019.106291

Servaes J, Rico L (2020) Key concepts, disciplines, and fields in communication for development and social change. In: Servaes J (ed) Handbook of communication for development and social. Springer, Singapore, pp 52–59. https://doi.org/10.1007/978-981-15-2014-3

Shahzalal M, Hassan A (2019) Communicating Sustainability: using community media to influence rural people's intention to adopt sustainable behaviour. Sustainability 11(3):812. https://doi.org/10.3390/su11030812

Shrivastava P, Smith MS, O'Brien K, Zsolnai L (2020) Transforming sustainability science to generate positive social and environmental change globally. One Earth 2(4):329–340. https://doi.org/10.1016/j.oneear.2020.04.010

Simmons D (1995) Working paper #2: developing a framework for national environmental education standards. In: Papers on the development of environmental education standards. NAAEE, Rock Springs, GA, pp 10–58

Skanavis C, Antonopoulos K, Plaka V, Pollaki S-P, Tsagaki-Rekleitou E, Koresi G, Oursouzidou C (2018) Linaria port: an interactive tool for climate change awareness in Greece. In: Addressing the challenges in communicating climate change across various audiences, pp 281–295.https://doi.org/10.1007/978-3-319-98294-6_18

Skanavis C, Giannoulis C (2009) A training model for environmental educators and interpreters employed in Greek protected areas and ecotourism settings. Int J Sustain Dev & World 16(3):164–176. https://doi.org/10.1080/13504500902919664

Skanavis C, Kounani A (2018) Children communicating on climate change: the case of a summer camp at a Greek Island. In: Leal Filho W, Manolas E, Azul A, Azeiteiro U, McGhie H (eds) Handbook of climate change communication: climate change management, vol 3. Springer, Cham. https://doi.org/10.1007/978-3-319-70479-1_7

Skanavis C, Kounani A, Tsamopoulos K, Maripas-Polymeris G, Koukoulis A, Topaltis L, Antonopoulos K (2019) Implementing sustainable development through environmental camps: the case of Skyros project. In: Filho LW, Tortato U, Frankenberger F (ed) Universities and sustainable communities: meeting the goals of the Agenda 2030, pp 147–167. https://doi.org/10.1007/978-3-030-30306-8_9

Skanavis C, Sarri E (2004) World summit on sustainable development: an environmental highlight or an environmental education letdown? Int J Sust Dev World 11(3):271–279. https://doi.org/10.1080/13504500409469831

Stake RE (1995) The art of case study research. Sage, USA. ISBN: 0-8039-5766-1

Tsampoukou-Skanavis C (2004) Environment and communication right to choose. Kaleidoscope Publications, Athens. ISBN: 960-7846-40-0

Van Swol LW, Bloomfield EF, Chang C-T, Willes S (2021) Fostering climate change consensus: the role of intimacy in group discussions. Public Underst Sci 31(1):103–118. https://doi.org/10.1177/09636625211020661

Wilke R (1997) Environmental education, teacher resource handbook: a practical guide for K-12 environmental education. Corwin Press, Inc

Wright RT, Boose DF (2011) Environmental science: toward a sustainable future. Pearson Benjamin Cummings, San Francisco. ISBN: 978-0-321-70140-4

Yadav SK, Banerjee A, Jhariya MK, Meena RS, Raj A, Khan N, Kumar S, Sheoran S (2022) Environmental education for sustainable development. Nat Resour Conserv Adv Sustain 415–431.https://doi.org/10.1016/b978-0-12-822976-7.00010-7

Yin RK, Davis D (2007) Adding new dimensions to case study evaluations: the case of evaluating comprehensive reforms. New Dir Eval 2007(113):75–93. https://doi.org/10.1002/ev.216

Zikargae HM (2018) Analysis of environmental communication and its implication for sustainable development in Ethiopia. Sci Total Environ 634:1593–1600. https://doi.org/10.1016/j.scitotenv.2018.04.050

Education for Sustainability at Distance and Online Learning Universities: Methodologies and Good Practices for Educating Sustainability Experts and Leaders of the Future

Klaus Fischer and Ralf Isenmann

1 Overview and Systematization of Current Education for Sustainable Development (ESD) Requirements

1.1 ESD 2030: Vision, Objectives, and Priority Action Areas

The central importance of education was recognized early on in the global sustainability discourse and explicitly emphasized in the final declaration of the first Rio Conference on Environment and Development in 1992 (United Nations 1992). Nevertheless, it took another ten years before the United Nations (UN) proclaimed the first World Decade of Education for Sustainable Development from 2005 to 2014. It appealed to national governments to incorporate the guiding principle of sustainable development into their respective education strategies and action plans (United Nations 2002).

This decade was followed by a World Action Program (2015–2019) initiated by the United Nations Educational, Scientific and Cultural Organization (UNESCO), which focused, among other things, on the crucial role of educational institutions (UNESCO 2014). This includes universities, which, as places of education with a role model function in society, are seen as having a high degree of responsibility for implementing sustainability-related educational goals (Kolb and Bungard 2018).

Finally, in May 2021, UNESCO launched the world digital conference "Learn for our Planet. Act for Sustainability", kicking off its 2020 program entitled "Education

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for Sustainable Development: achieving the global Sustainable Development Goals (ESD 2030)" (UNESCO 2020). Accompanying the "Decade of Action" proclaimed for the current decade, the program explicitly focuses on the implementation of the UN Sustainable Development Goals (SDGs) adopted in 2015 (United Nations 2015; UNESCO 2020). Again, a look at the priority action areas 2–4 of the ESD for 2030 framework (Fig. 1) and the addressed target groups illustrates the central role of (higher) education institutions and their teachers in education for sustainable development.

The UNESCO framework and the associated "Berlin Declaration on Education for Sustainable Development" call for nothing less than a whole-institutional transformation of educational institutions in the sense of sustainable development (the so-called "whole institution approach") (UNESCO 2020, 2021).

For universities, this means the cross-cutting anchoring of sustainability in teaching, research, governance, and operation management as well as a "third mission" and transfer to different groups and stakeholders (Grecu and Ipiña 2014).

In short, educational institutions—like all other organizations—should take responsibility as societal actors, as is also described in detail, for example, in core subjects of the internationally recognized guidance on social responsibility of organizations (ISO 26000) (International Organization for Standardization 2010).

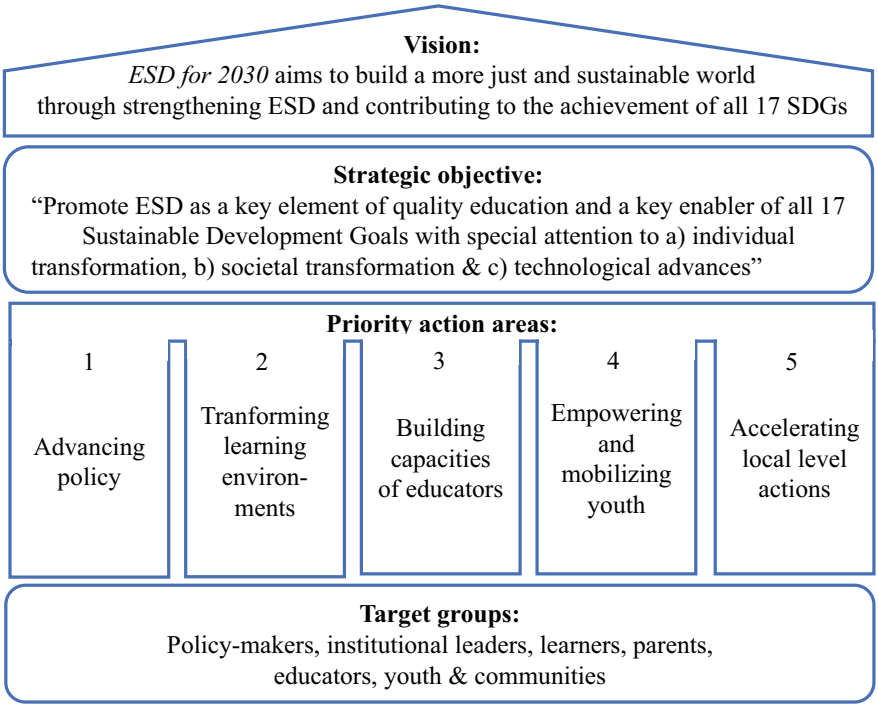

Fig. 1 "Education for Sustainable Development (ESD) at a glance" (adapted from UNESCO 2020)

Regarding this, several starting points for integrating sustainability at universities have already been well researched and presented (e.g. Müller-Christ et al. 2009; Grecu and Ipiña 2014; Leal Filho 2018; Leal Filho et al. 2018, 2019; Isenmann et al. 2020; Shulla et al. 2020; Pizzutilo and Venezia 2021).

Consequently, the development of sustainability curricula for distance and online education presented in this paper sheds light on only one aspect—albeit a central one—of the overall institutional approach to sustainability in higher education described above. Central because sustainability-related teaching and corresponding research can impact far beyond the organizational boundaries of a university (Verhoef and Bossert 2019). Students who are enabled to reflect on their behavior and who develop sustainability competencies become multipliers and "change agents" (Nölting et al. 2018) of sustainability transformation (de Haan 2010).

Here, the concept of "Gestaltungskompetenz" which means "having the skills, competencies, and knowledge needed to change economic, ecological, and social behavior, whereby these behavioral changes should not be merely reactive to existing problems" (de Haan 2010, p. 320) is instructional for ESD. This concept was also instrumental in developing the ESD curricula and methods for distance and online learning presented in this paper.

1.2 Systemizing ESD Implementation and Profiles with a Morphological Box

As shown in the preceding section, universities have various options to implement higher education for sustainable development into curricula and syllabi and incorporate sustainability into students' daily routine and life on campus. To address this complexity and somewhat fuzziness of the ESD discourse, Isenmann et al. (2020) developed a morphological box, providing a comprehensive system covering all possible opportunities for implementing ESD at universities.

Generally, a morphological box comprises the full range of conceivable characteristics of complex phenomena (e.g., Zwicky 1969), as ESD implementation at universities undoubtedly is (Landorf et al. 2008). The methodology behind it is the so-called morphological approach, providing a powerful heuristic tool for creative problem-solving. It is used for investigating the totality of realizations of multidimensional, non-quantifiable phenomena (Müller-Merbach 1976; Ritchey 2011).

As a result of systematic literature analysis, Isenmann et al. (2020) identified 14 criteria and their corresponding characteristics, which they validated against their practical work experience as university lecturers and professors. These criteria were finally grouped according to the "four causae" proposed by Aristotle (Müller-Merbach 1995) to obtain order and handle the complexity of the ESD topic (Isenmann et al. 2020, p. 5):

- "causa finalis represents goal and purpose of ESD;
- causa materialis represents contents, themes, issues of ESD;

- causa formalis represents form, design, and further layout of ESD;
- causa efficiens represents origin and processes along ESD."

The finally achieved morphological box for ESD provides—combinatorially—more than 70 million opportunities to implement ESD, whereby the authors emphasize the creative momentum which is also induced from seemingly contradictory combinations at first glance.

Therefore, universities may use this morphological box as a creative technique for developing innovative ESD solutions and their unique profile for ESD implementation (Fig. 2).

Additionally, the box can be used to analyze, compare and communicate existing ESD profiles, as Isenmann et al. (2020) exemplarily show by referring to the ESD activities of two German universities (thereunder WBH). Further application fields could be benchmarking and a systematic assembly of ESD databases for knowledge transfer.

2 Specific ESD Characteristics of Distance and Online Learning

Distance and online education covers particular advantages and challenges regarding the above-presented ESD objective of an overall sustainability transformation of educational institutions.

The sustainability-related advantages of distance and online learning can, on the one hand, be roughly described with the attributes of inclusion and accessibility as well as resource conservation (Fig. 3). On the other hand, specific challenges of education for sustainable development in the format of distance and online learning lie in handling the high heterogeneity of the student target group and the conscious design of interaction spaces between teachers and students.

The mentioned ESD characteristics of distance and online learning are further explained in the following sections.

2.1 Opportunities for Inclusion and Accessibility

Location- and time-independent teaching and learning formats are the key characteristic of distance and online education. Whereas in traditional face-to-face formats, students visit courses at the same time and place, they access distance-learning formats in a decentralized and asynchronous manner. They are studying from home or their workplace, for example, and can attend the media-based teaching formats at any time. As a result, students can flexibly and individually design their learning activities and work independently at their own pace. This flexibility provides low-threshold access to educational opportunities for various target groups at different

Causa	Criteria	Characteristics (= realizations)						
Finalis	Operational level	Cross university	University wide	Bridging faculties	Faculty specific	Course of study specific		…
	Type of knowledge	Know-how			Know-why and Know-what-for			…
	Competence	Personal competence	Social competence	Leadership competence	Methodological competence	Professional competence	Gestaltungs-kompetenz	…
		Social competence			Professional competence (skills and knowledge)		Self-reliance	…
	Degree programme	Bachelor	Master		Advanced training / MBA			…
	…							…
Materia-lis	Sustainability dimension	Economy	Ecology		Society	Combinations		…
	Resources	Materials	Energy	Environ. media: air, water, soil	Finance & Money	Space		…
	Sphere of activity	Living	Labor & employment	Leisure	Traffic	Food		…
	…							…
Formalis	Curriculum integration	Obligatory		Compulsory elective		Elective		…
	Credit system	Without certificate (common course achievement)			With Certificate			…
	Course format	Lecture	Seminar	Game & simluation	Project	Excursion		…
	Course methodology	Problem based learning	Project based learning		Research oriented learning	Just-in-time-teaching-learning		…
	Learning type	Presence	Blended Learning		Online			…
	…							…
Efficiens	Teacher	Docent	Group of docents		Team teaching - simultaneous - alternating			…
	Disciplinarity	Monodisciplinarity	Multidisciplinarity		Interdisciplinarity	Transdisciplinarity		…
	…	…						…

Fig. 2 Morphological box for ESD (Isenmann et al. 2020, p. 4)

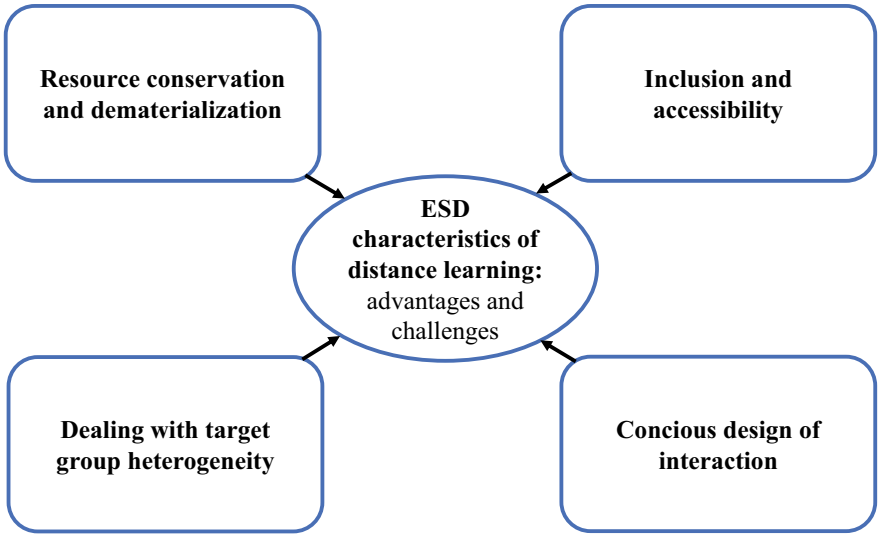

Fig. 3 Advantages and challenges of Education for Sustainable Development (ESD) of distance and online learning and education

stages of their lives and careers. These include students with professional or family work obligations, people with disabilities, or people from regions without reliable access to higher education. Distance and online learning can thus make education more inclusive by removing the participation barriers of face-to-face study, as was particularly evident during the Covid-19 pandemic. Inclusive access to quality education is a crucial Sustainable Development Goal (see SDG 4 and its subgoals; United Nations 2015).

2.2 Resource Conservation and Dematerialization

From the perspective of ecological and economic sustainability, distance and online learning formats are advantageous due to the reduced need for buildings for physical teaching spaces (lecture halls, classrooms) and the elimination of infrastructure and energy requirements for transporting teachers and students to or from the place of teaching. Thus, omitting unnecessary shuttle traffic or only temporarily using residential and supply infrastructures (dormitories, cafeterias, etc.) can positively affect the studies' resource intensity and carbon footprint. Distance and online learning thus enables a dematerialization of the educational offering in many fields.

The required infrastructures can be significantly reduced or shared with other educational institutions (e.g., laboratory and seminar rooms). However, there are also parameters leading to a specific footprint of distance and online education (e.g., the information technology (IT) infrastructure needed for distance and online learning

and the less frequent, but due to the geographical range of distance and online education, more extended travels to the university, as well as the printing and dispatch of teaching materials.

Consequently, a comprehensive life cycle assessment of distance learning depends on different (also behavioral) parameters and must be determined individually, as is the case of face-to-face teaching, too.

2.3 Need to Deal with Target Group Heterogeneity

The inclusive character of distance and online learning courses described above means that students from very different life situations and with varying backgrounds of experience can take up a distance and online learning course: their prior knowledge, skills, and competencies, their goals, and resources available for studying parallelly to family and professional work, are thus very different. Therefore, distance and online learning courses must particularly consider this heterogeneity and ensure that they address all groups in the best possible way and enable them to contribute their extracurricular competencies optimally. Therefore, the high flexibility of learning and work pace, accompanying training for learning and self-competence, and customized additional courses and teaching materials help close any knowledge gaps.

2.4 Need to Shape Interaction Consciously

Since distance and online learning eliminates the need for students and teachers to be in the same place simultaneously, the number of interaction opportunities is initially limited. Personal interaction between teachers and students and between the students themselves must thus be designed and planned more consciously. This brings the opportunity to contact each other less frequently but more intensively and in high-quality exchange formats.

Especially in the teaching context of education for sustainable development, it is necessary to create sufficient room for discourse and experimentation. It must be possible to mirror the learned against own and others' lifeworlds, deal constructively with different points of view, and, finally, reflect on the self-efficacy of the own behavior in personal and professional contexts. Accordingly, sustainability-related competencies cannot be imparted solely through self-learning phases "in the privacy of one's own home" but requires interaction and exchange with others. This requires collective learning spaces that break away from the classic sender-receiver teaching model and enable reflective learning processes on both sides (i.e., among the teaching and learning persons).

3 Examples of ESD in Distance and Online Learning at Wilhelm Büchner Hochschule

3.1 Starting Situation and Basic Principles of ESD Program Development at Willhelm Büchner Hochschule

Wilhelm Büchner Hochschule (WBH), located in Darmstadt, is Germany's largest private distance and online learning university for engineering and technology management. It was founded in 1996 and is part of the Klett Group, one of Europe's leading education providers. The university comprises five departments with over 6.900 enrolled students.

For around five years, sustainability-related content has played an important role in WBH study courses and research programs. Thus, individual modules and nano-degrees such as technology assessment, hydrogen technologies, digital ethics or sustainable business management, and entire degree programs, such as an industrial engineering program "renewable energies" or the master course "energy process engineering", are part of the university's portfolio. These study programs have grown organically and illustrate the importance of sustainable development topics in teaching at the WBH.

The same applies analogously to sustainability research at the university. For example, sustainability-related research fields lie in all five of the university's main research areas (WBH 2018), such as "Digital Health", "Energy Harvesting", "Sustainable Nutrition and Digitalization in the Food Industry", "Transformative Energy System Analysis", "Sustainability Management" and "Sustainability at Distance and Online Learning Universities". Furthermore, exemplary third-party funded projects such as the BMWi-funded research network speedCIGS in the field of polycrystalline solar cell technology and the BMBF project TRIFOLD, which researches technology transfer to developing countries, demonstrate the range of sustainability-related research activities at WBH. They also include internally budgeted research projects, such as PV range extension for electric vehicles and stakeholder integration in sustainability management. Additionally, the university hosted its WBH Science Forum 2019 on "Sustainability at Distance and Online Learning Universities" and established a professorship in sustainability management in 2020.

In 2022, WBH launched two newly designed master curricula explicitly tailored to ESD. These master courses and further ESD practice examples at WBH are presented in this chapter. However, before looking at the concrete teaching formats for ESD in distance and online education, some basic principles for program development in this field will be presented.

The following sections introduce some basic principles guiding the ESD program development for the distance and online learning formats of WBH. They comprise participatory program development, research-based teaching and learning, activating and diversified course packages, and a high transferability of the ESD programs to other courses and departments.

3.1.1 Participatory Program Development

At WBH, new study programs are designed and implemented according to participatory program development. The university systematically involves various committees and experts in program development, which contributes significantly to developing curricula of high academic quality and attractiveness that best meet the personal and professional competence requirements of students and their employers.

Participation is also crucial in developing ESD programs; different perspectives from students and (non-)academic experts must be included to meet the educational requirements necessary for sustainability-related transformation processes and correspond to the target group heterogeneity described above.

This diversity of perspectives is covered by the committees typically involved in program development at WBH, including the University Council, Senate and University Management, the Departmental Council, and an internal Program Steering Committee.

In addition, the program directors are accessing student interviews and other forms of feedback for program development. For example, in the case of the below-presented sustainability master courses, nine in-depth interviews were conducted with (former) students and other experts, each lasting around 45–180 min.

3.1.2 Research-Based Teaching and Learning

Another principle of program development results from the WBH research profile (WBH 2018) and the required link between teaching and research, especially in master's programs.

The interaction between research and teaching has its starting point in the research activities of the respective teachers and study directors. Their research results and experiences can inspire teaching and learning formats, such as case studies, conceptual developments, or analyses. In addition, students can benefit from the methodological experiences of their teachers or instructors in research-based learning formats. At a university of applied sciences, this means, in addition to the sound teaching of theoretical principles and knowledge, first and foremost, imparting application-oriented research skills and scientific problem treatment. Students should be able to identify their own, primarily practice-related research questions independently and work on them according to scientific criteria and methods.

Section 3.1 has already provided an overview of sustainability-related research at WBH. For example, concerning their new sustainability master curricula, research on the topics "Sustainability in Global Value Chains," "Stakeholder Integration in Sustainability Management", and "Multi-actor Collaborations to Achieve Sustainability Goals" (Schwarzkopf et al. 2021; Fischer 2021, 2020; Fischer and Jentsch 2019) provided amongst others an impetus for program development.

Common to these research fields is a holistic perspective on management and technology that broadens the view beyond organizational boundaries, be it to the

local conditions in an industrial zone, the integration of companies into global value creation systems, or, more generally to the changing requirements imposed by standards and laws, jurisdiction, and on the part of other important stakeholder groups, such as (industrial) customers and employees.

3.1.3 Activating and Diversified Course Packages

Asynchronous learning and self-study phases characterize distance and online learning, requiring high motivation and discipline from the students. Consequently, an activating and diversified study program is critical for maintaining learning motivation.

Specially developed study booklets or texts, which convey the course content in a didactically prepared form, are a traditional teaching medium of distance and online learning. They also play a central role at WBH and are flanked by various interaction and support services.

These include access to an online campus as a learning and communication platform, tutorial support for each study guide and module, face-to-face or virtual revision and compact courses, selected compulsory presences (e.g., introductory projects/labs or project workshops), etc.

In the newly launched sustainability study programs, WBH uses an even greater mix of different teaching media and materials bundled in so-called course packages for each module, which transfer the idea of classic "semester apparatus" to online distance learning.

Each course package includes an accompanying (online or printed) booklet linked with different elements, comprising textbooks, scientific journal articles, relevant political documents such as the UN Agenda 2030, the EU Commission's communications on the European Green Deal, or position papers from industry associations and scientific institutions.

The accompanying booklet provides the "didactic roadmap" of each module. In addition, the booklet gives concrete impulses and instructions for working with the course package materials and thus takes the distance and online learning students "by the hand". Therefore, the booklets are designed, on the one hand, to guide the students in a targeted manner. Still, on the other hand, they also "whet their appetite for more" and, for example, encourage them to conduct further research or to browse "right and left" of the core content in a book or historical document.

The accompanying booklets additionally take up the proven didactic elements from the WBH study booklets, including descriptions of learning objectives, summaries, exercises, tasks for self-testing, and submission tasks to get tutorial feedback.

3.1.4 Transferability to Other Courses and Departments

Developing new sustainability curricula at the WBH also aims to anchor sustainability content even more broadly in the general study program of the university. Accordingly, the modules and teaching formats created for the sustainability study programs should not lead to "insular solutions" for ESD teaching. Instead, the program development in this field has a particular service function for other study programs and university departments, similar to other teaching fields with a cross-sectional character, such as mathematical or business fundamentals, which are implemented in diverse courses around the WBH portfolio.

Consequently, suitable modules from sustainability study programs will also become part of other new and already existing study programs (for example, in the course of reaccreditations). Accordingly, internal transferability to different study programs was one key objective when designing the new sustainability curricula. Therefore, corresponding criteria in module development, such as a uniform format with clear qualification goals, self-contained contents, and transparent admission prerequisites, are necessary.

Compared with traditional face-to-face teaching, the asynchronous distance and online teaching formats support the scalability and broad transfer of sustainability modules and teaching formats. Nevertheless, it is necessary to check the fit of each module and teaching format with the respective curriculum before transferring them to other study programs and, if necessary, to modify them for optimal integration.

The course package structure described above offers a high degree of flexibility for requirement-specific adaption. Thus, different qualification goals can be met by adapting the course package elements (e.g., more or less scientific publications, business or political documents). Additionally, the modules can be adjusted through their examination modes (e.g., concerning written exams, sending-in assignments, or oral/video presentations).

3.2 Master Curricula for ESD

In January 2022, WBH launched two entirely newly developed sustainability curricula at the master level for distance and online learning, presented in this section.

Despite the many years of teaching and research experience in sustainability-relevant topics at WBH described above, the offer of study programs explicitly emphasizing the reference to sustainability and bearing it in the title was new for the university. This brings the opportunity to deepen further the university's profile as an educational actor for sustainable development. However, explicitly referring to sustainability also increases public exposure in this regard—the same as is the case for industrial companies when publishing their first sustainability report, for example. In particular, sustainability study programs often appeal to personally highly interested and well-informed students, whose legitimate high expectations should not be disappointed by a superficial "sustainability labeling". Therefore, the two master's study

programs were completely redeveloped to meet these requirements and to obtain a curriculum consistently compatible with sustainability theory and practice.

Additionally to the basic didactic principles presented above, WBH conducts strategic analysis when developing new programs. The strategic analysis helps identify the strengths, weaknesses, opportunities, and threats (SWOT) that can accompany the development of a new program offering, which are made visible in a SWOT matrix. In the case of the sustainability curricula developed, this SWOT methodology had a significant influence on the concrete design of the courses as a techno-economic Master of Science (M.Sc.) format and as a Master of Business Administration (MBA) program. For example, as a technical distance and online learning university, WBH has a high level of expertise in technologically oriented, interdisciplinary study programs on the one hand and many years of experience in offering MBA programs tailored to its target group on the other.

3.2.1 Mater of Science in Sustainability Technologies and Management

The consecutive techno-economic master's program in Sustainability Technologies and Management has a standard study period of three semesters with 30 credits (European Credit Transfer and Accumulation System, ECTS) each. In addition, the core curriculum is supplemented by an optional pre-master program of up to 30 credits, selectable from different certificate programs of WBH.

The overarching qualification goal of the program is to impart sustainability-related competencies at the interface between technological and economic or social science issues.

The three-semester curriculum (Fig. 3) is divided into a block of basic core modules, an area of specialization in sustainability management, a technological field of study, and various modules for scientific application orientation and transfer. The course of study includes asynchronous self-learning phases and synchronous teaching in face-to-face and online events (Fig. 4).

In the sense of student-centered teaching, students have numerous options to choose from and specialize in the content of their studies. For example, students initially select between the three technology fields "Sustainable Energy Technologies", "Sustainable Mobility", and "Digitalization and Sustainability". These fields address the current transformation areas and requirements in various industries and sectors (such as mobility, energy production, and consumption) and have thus highly practical and professional relevance. They are also directly linked with transformation research and practice (WBGU 2011; Manstetten et al. 2021) and with the addressed areas from national and global sustainability policy targets. These include the UN Sustainable Development Goals, the European Green Deal, and numerous other sustainability and climate protection strategies in organizations at municipal or industry-wide levels.

In the specialization area, students choose between the fields of "Sustainability Assessment and Controlling", "Sustainability of Global Value Chains", "Responsible Innovation" and "Sustainability Marketing and Communication". They can thus link

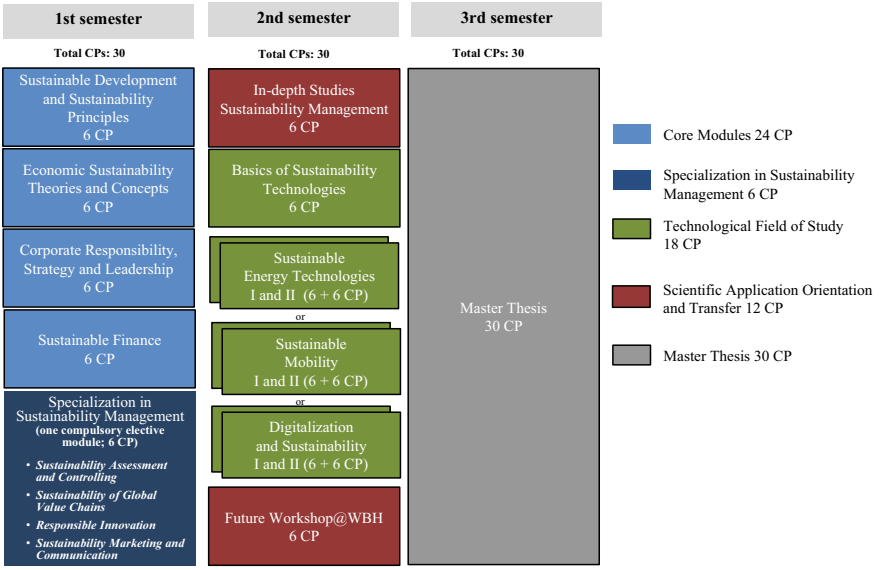

Fig. 4 Curriculum for "M.Sc. Sustainability Technologies and Management" impletmented at Willhelm Büchner Hoschule

to their specific interests and personal development goals. In the modules of scientific application orientation and transfer and the master's thesis, the final aim is to develop and work on self-selected economic and/or technological sustainability problems according to scientific standards. In addition to the core curriculum, students are provided with supplementary teaching media, tutorial support, and compact and revision courses to provide optimal support in preparing for exams starting from different levels of knowledge.

The target group of the study program includes both bachelor's graduates with technical and non-technical subjects and master's graduates who would like to further their education in the field of sustainability transformation. Furthermore, due to the orientation of the program and the cross-sectional importance of sustainability-related knowledge and competencies, target groups in different organizations and functional areas (primary and secondary activities as well as with interfaces to various stakeholder groups) and management levels are addressed. This applies to private sector companies as well as to organizations from the public or civil society sector. Possible corresponding professional fields include sustainability or CSR managers, procurers, product and service developers, sales and marketing staff, controllers, technology managers, organizational and process consultants, and actors from education or consulting for sustainable development.

Students will be able to independently reflect and design products and services, processes, methods and tools, and socio-technical systems against the background of sustainability goals and criteria. They will be able to recognize problems of non-sustainable development and draw conclusions about the ecological, economic, and

social effects of their decisions in private and professional life. In scientific work, students are enabled to acquire knowledge independently and according to scientific standards, recognize and analyze complex interrelationships, design research questions, and select and apply suitable research methods.

3.2.2 Masters of Business Administration (MBA) in Sustainability Management

The MBA program in Sustainability Management offers a generic management education with a specific sustainability focus. It is specifically aimed at students with professional experience who want to acquire sustainability-related transformation knowledge and competencies in all management areas. The target group includes (future) decision-makers and responsible persons in different organizational fields, be it in companies, the public sector, NGOs, or consulting and educational institutions. The program aims to broaden the students' management knowledge and allows them to apply their professional expertise in sustainability case studies and project-based formats. In this way, students acquire the ability to reflect on and use methods and procedures of sustainability management in the sense of holistic management practice and philosophy. A further objective of the study program is to deepen key qualifications such as communication and teamwork skills as well as presentation and moderation skills.

The program's curriculum is designed for a standard study period of two semesters with 30 ECTS credits each (see Fig. 5). In addition, analogous to the program described above, an optional pre-master program is offered.

In the first semester, the course of study comprises four core modules with a thematic focus on the fundamentals of global sustainability principles and goals and the related theoretical concepts in the central management areas. After the core modules, students are working on their so-called "SDG Project", presented in more detail in Sect. 3.3.1.

The second semester starts with the area of specialization, which—just as in the techno-economic master's program described above—allows students to set their focus in the four elective modules "Sustainability Assessment and Controlling", "Sustainability of Global Value Chains", "Responsible Innovation" or "Sustainability Marketing and Communication".

The program ends with an in-depth thesis and the subsequent master's thesis. In both thesis, students independently research management-related issues in sustainability under professional supervision and scientific guidance. Here, the preliminary work from the in-depth thesis can also serve as the basis for the research question of the master's thesis topic if the content and methodology are appropriate. Thus students can engage in a comprehensive and in-depth scientific discussion in their chosen field of research.

Graduates will gain a comprehensive understanding of the social responsibility of companies and organizations and their decisive role as actors of (non-)sustainable

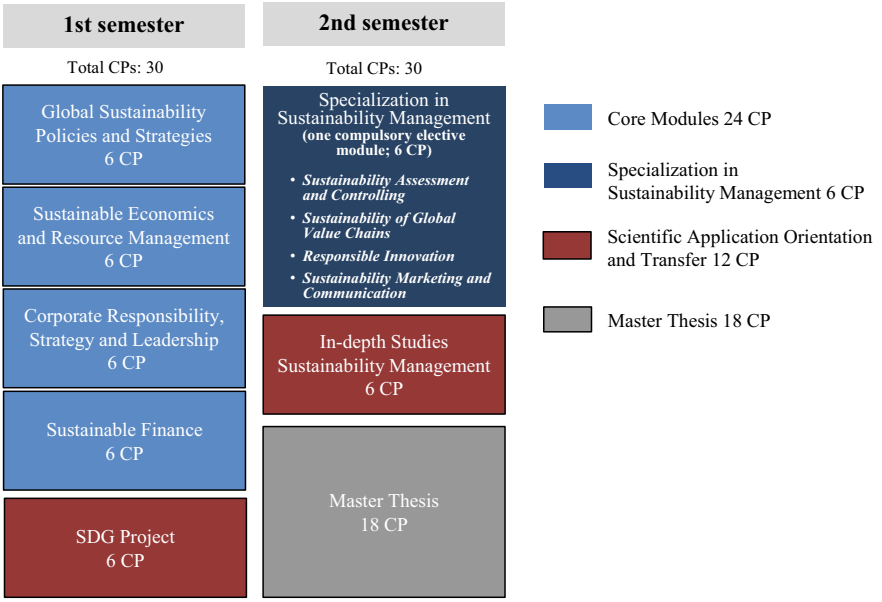

Fig. 5 Curriculum for Masters of Business Administration in Sustainability Management implemented at Willhelm Büchner Hoschule

development. They know the relevance of sustainability as a central economic principle in the management of resources of different types of capital and can use this knowledge and the related management tools to strengthen the competitiveness of their organization permanently. Finally, graduates will be able to recognize and manage potential conflicts of objectives resulting from diverging short- and long-term economic targets or different stakeholder requirements. They will be able to plan, design, and optimize technical and organizational infrastructures, systems, and processes based on sustainability-related design criteria.

3.3 Special Teaching Formats: Blended Learning for ESD

3.3.1 SDG Project

The module "SDG Project" ("SDG" in the sense of the UN Sustainable Development Goals) is a blended learning format anchored in the MBA curriculum, comprising presence phases, remote group work, and individual group coaching. The module builds upon the sustainability knowledge imparted in the upstream core modules.

From a didactic perspective, the module combines various qualification goals. In an initial two-day classroom session, students gain in-depth insights into the emergence and significance of the UN Sustainable Development Goals as a target

framework for global sustainability policy. They develop a comprehensive understanding of interrelations and conflicts between the SDGs and can critically reflect on different implementation approaches and strategies at the global, nation-state, regional and organizational levels.

In addition, students receive an introduction to social and sustainable entrepreneurship, business plan development, and project management, which builds on the content taught earlier in the curriculum.

The central element of the first two-day attendance event is finally the moderated project start, which forms the prelude to a three-month group work phase with usually three to four group participants. This work phase aims to design an SDG implementation project of one's own and to develop a social business plan with a corresponding "pitch deck" in the project team. The students work here—moderated by a supervisor—independently on their business ideas and sustainability solutions, which conveys essential skills, especially concerning the necessary transformation processes and the currently proclaimed "Decade of Action" in implementing the SDGs. Students use (hybrid) project management methods during their group work, drawing on their (possible) professional project experience and developing it further.

The result of the group work is finally presented as a so-called "SDG pitch" at a second presence event and evaluated by a jury. Here, the students present their individual contributions within the whole team's performance and deal with the ideas and results of the other groups critically and constructively. The Sustainable Development Goals provide the overarching framework and the integrative and visionary bracket for each group work and across all project groups.

3.3.2 Future Studies Workshop@WBH

Another blended-learning module is the "Future Studies Workshop@WBH" (German: Zukunftswerkstatt@WBH). It is part of the techno-economic course "Sustainability Technologies and Management" and is located at the end of the second semester in the curriculum there. However, the module is also used in other study programs at the WBH, enabling an exchange between students across different courses.

The Future Studies Workshop@WBH ties in with the contents of the preceding technology modules in the curriculum. Depending on the chosen technology field of study, these are modules in the areas of "Sustainable Energy Technologies", "Sustainable Mobility" or "Digitalization and Sustainability", each combined with a preceding basic module on the role of technologies for sustainability transformation and their critical reflection through technology assessment.

The Future Studies Workshop@WBH follows the principles of research-based service learning. Under the guidance of supervising experts, students develop a future-oriented research question in the fields mentioned above according to their personal preferences and design concrete ways to operationalize it using appropriate research methods. They work self-organized individually or in virtual teams and train their scientific working skills. Professional software tools (e.g., simulation, analysis,

and forecasting tools) or other didactic materials (such as checklists, forms, and roadmaps) are available in the subject area.

Due to the application-oriented format, students build a bridge into practice, show their problem-solving competencies, and their ability to deal scientifically with future topics. Finally, they write a term and present their results in a plenary session with other students and subject experts.

Since the Future Studies Workshop@WBH will also be part of other degree programs, it is planned to hold the presentation session in a university-wide format, embedded in a competition for the best ideas for the future.

In contrast to the "SDG Project", which focuses on developing a sustainability-related business plan in the respective project teams, the Future Studies Workshop@WBH focuses on in-depth scientific work on a specifically derived research question in a future-oriented technology field. Through individual support during the processing phases and the interactive presentation of results, the students get actively involved, and discourse spaces are opened.

3.3.3 "TRANSFORMATOR—Spannendes zur Nachhaltigkeit"

"TRANSFORMATOR—Spannendes zur Nachhaltigkeit"[1] is a quarterly interactive online event series. It addresses current challenges and developments of sustainability transformation in various sectors and action areas in a low-threshold exchange in a virtual seminar room moderated by experts.

The format was developed in a cooperation between Wilhelm Büchner University of Applied Sciences and Kaiserslautern University of Applied Sciences and is part of the program "Smart Qualifiziert: MINTplus–plusMINT[2]" of the Stifterverband für die Deutsche Wissenschaft. In 2022, it is nominated for the German award "Distance Learning Project of the Year".

The primary target groups of the TRANSFORMATOR event series are students and professionals from STEM and non-STEM disciplines to bring together different viewpoints and disciplinary perspectives in the sustainability discourse. In joint discussions between student and non-student participants, external experts, and the moderators, current transformation-related topics are addressed and critically reflected. The aim is to enable participants to form well-founded opinions and develop their contributions to problem-solving in the sense of "sustainability literacy". Thereby, TRANSFORMATOR aims at a holistic view of technology and a systemic understanding of innovation, including behavioral changes, institutional requirements, and culture-specific barriers to innovation.

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[1] In English: "Transformer—exciting facts about sustainability"; the title builds a thematic bridge between sustainability transformation and technology, together with a worldplay in the German language.

[2] "MINT" is the German abbreviation for STEM; "MINTplus" means a further orientation towards inter- and transdisciplinary perspectives, including social sciences and arts.

The choice of topics for the single online events depends primarily on relevant developments in the last quarter and the participants' need for discussion. Thematic reference points are, for example, political initiatives (European Green Deal, energy transition, due diligence in supply chains, etc.), technical developments (such as in AI, e-mobility, circular economy, etc.), or other current topics and events related to sustainability and transformation.

As the TRANSFORMATOR relates to current developments, the participants are encouraged to follow the ongoing discourse in the respective transformation fields. The knowledge, opinions, and attitudes towards transformation processes are not singly conveyed in classical educational formats. Thus, TRANSFORMATOR deliberately links the university as a "place of learning" to other educational contexts in professional and private life, integrating extracurricular skills. During the events, statements from media coverage, popular science publications or position papers, and controversial opinions undergo a joint "fact check" and participants' discussion.

Beyond the quarterly TRANSFORMATOR events, several parallel activities evolved from the exchange in the format culminating in working groups on topics such as analyzing the personal carbon footprint, founding energy cooperatives, and dealing with the "seal jungle" of sustainability labels. Consequently, the TRANSFORMATOR format reaches some additional impact beyond the traditional education from lectures.

4 Discussion, Conclusions, and Outlook

Almost three decades after the first Rio Conference and around 15 years after proclaiming the first World Decade of Education for Sustainable Development in 2005–2014, conveying "sustainability literacy" is still not a natural part of teaching at universities—quite apart from a comprehensive sustainability transformation of the educational landscape. Nevertheless, there is no shortage of goals and declarations of intent, as the cascade of UN and UNESCO programs on education for sustainable development described at the beginning of the chapter vividly illustrates. Thus, there is sufficient system and target knowledge for the sustainability transformation of the education sector ("knowledge of what is and what should be"). Still, the associated transformation knowledge ("knowledge of how to get from the actual to the target state") and the corresponding transformative processes do not seem to be established to a sufficient extent. Unfortunately, it remains questionable whether the recently started new UNESCO action program "ESD 2030" will result in the necessary progress we need in the "Decade of Action" for implementing the Sustainable Development Goals by the year 2030. Similar to previous global sustainability programs (such as Agenda 21 or the Millennium Development Goals), not all goals in the field of ESD seem to be achievable within the announced timeframes. Nevertheless, their global signal effect and the momentum that would not occur without these programs are indisputable.

As we showed in this paper, the specific characteristics of distance and online learning offer advantages but also challenges (Sect. 2) that need to be taken into account concerning the presented vision, objectives, and priority action areas of the recent "ESD 2030" program (Sect. 1.1). As described in this paper, implementing sustainability curricula and ESD teaching formats for distance and online learning is only one crucial first step toward a comprehensive and whole-insitutional sustainability integration in distance and online learning universities. In Sect. 3, we thus presented the development of two sustainability master courses and highlighted some special teaching formats. Due to their modular blended learning design and their mostly asynchronous character, these programs are highly suitable with ESD properties in distance and online learning, which were carved out in this paper (see Fig. 3, Sect. 2). They allow benefiting from the sustainability-related advantages of distance and online learning. At the same time, they address the challenges of target group heterogeneity and the need to design the real-time and personal interaction between students and teachers consciously.

To illustrate and compare the aforementioned programs' profiles, the "morphological box for ESD" which we introduced in Sect. 1.2 can be applied, supplemented by some further characteristics (right column). Doing so, Fig. 6a shows the characteristics of the two master courses "Sustainability Technologies and Management" (M.Sc.) and the MBA program "Sustainability Management" (grey boxes: overlapping characteristics between both courses; green boxes: sole characteristics of the M.Sc. course; yellow boxes: sole characteristics of the MBA program).

Figure 6a illustrates the similarities and differences between the two master courses and shows "blanc spaces" in the box that can be possible subjects for further development. For example, the master programs could be developed to university-wide or even cross-university courses, supplemented by additional bachelor programs, or offered in presence or with more "on-time" online events (as already done in the existing blended formats).

Figure 6b shows the profile of the "TRANSFORMATOR" (see Sect. 3.3.3) as an example of a special ESD teaching format compared to the master courses mentioned above. Here, grey boxes again show overlapping characteristics (between master courses and "TRANSFORMATOR"), and the orange boxes highlight the unique features of the special teaching format.

While the criteria referring to causa finalis (goal and purpose of ESD) and causa materialis (contents, themes and issues) deliver quite similar profiles, causa formalis (form, design and further layout) and causa efficiens (origin and processes) majorly differ between the master courses and the special teaching format "TRANSFORMATOR". These points show the high complementarity between the two different types of ESD teaching ("master curriculum" vs. "special teaching format"). They can again be a starting point for further profile development. Concerning the "beyond curriculum" format of the "TRANSFORMATOR", this could be its integration into the credit system (for student participants) and the asynchronous learning elements of the existing curricula. More generally, an important further step for a systematic ESD integration into distance and online learning could be a comprehensive

Causa	Criteria	Characteristics (= realizations)						Further characteristics
Finalis	Operational level	Cross university	University wide	Bridging faculties	Faculty specific	Course of study specific		…
	Type of knowledge	Know-how			Know-why and Know-what-for			…
	Competence	Personal competence	Social competence	Leadership competence	Methodological competence	Professional competence	Gestaltungs-kompetenz	…
		Social competence			Professional competence (skills and knowledge)		Self-reliance	…
	Degree programme	Bachelor	Master		Advanced training / MBA			Open (academic/sub-academic)
	…							…
Materia-lis	Sustainability dimension	Economy	Ecology		Society	Combinations		…
	Resources	Materials	Energy	Environ. media: air, water, soil	Finance & Money	Space		…
	Sphere of activity	Living	Labor & employment	Leisure	Traffic	Food		…
	…							…
Formalis	Curriculum integration	Obligatory		Compulsory elective		Elective		„Beyond curriculum“
	Credit system	Without certificate (common course achievement)			With Certificate			„Beyond curriculum“
	Course format	Lecture	Seminar	Game & simluation	Project	Excursion		Asynchronous
	Course methodology	Problem based learning	Project based learning		Research oriented learning	Just-in-time-teaching-learning		…
	Learning type	Presence	Blended Learning		Online			Asynchronous
	…							…
Efficiens	Teacher	Docent	Group of docents		Team teaching - simultaneous - alternating			„Co-teaching“ with students and experts
	Disciplinarity	Monodisciplinarity	Multidisciplinarity		Interdisciplinarity	Transdisciplinarity		…
	…	…						…

Fig. 6 **a** Master course profiles in the morphological box for ESD. **b** Special teaching format (“TRANSFORMATOR”) profile in the morphological box for ESD

Causa	Criteria	Characteristics (= realizations)									Further characteristics
Finalis	Operational level	Cross university	University wide	Bridging faculties	Faculty specific		Course of study specific				…
	Type of knowledge	Know-how			Know-why and Know-what-for						…
	Competence	Personal competence	Social competence	Leadership competence	Methodological competence	Professional competence	Gestaltungs-kompetenz				…
		Social competence			Professional competence (skills and knowledge)		Self-reliance				…
	Degree programme	Bachelor	Master		Advanced training / MBA						Open (academic/sub-academic)
	…										…
Materia-lis	Sustainability dimension	Economy	Ecology		Society		Combinations				…
	Resources	Materials	Energy	Environ. media: air, water, soil	Finance & Money		Space				…
	Sphere of activity	Living	Labor & employment	Leisure	Traffic		Food				…
	…										…
Formalis	Curriculum integration	Obligatory			Compulsory elective			Elective			„Beyond curriculum“
	Credit system	Without certificate (common course achievement)			With Certificate						„Beyond curriculum“
	Course format	Lecture	Seminar	Game & simluation	Project		Excursion				Asynchronous
	Course methodology	Problem based learning	Project based learning		Research oriented learning		Just-in-time-teaching-learning				…
	Learning type	Presence	Blended Learning		Online						Asynchronous
	…										…
Efficiens	Teacher	Docent	Group of docents		Team teaching - simultaneous - alternating						„Co-teaching“ with students and experts
	Disciplinarity	Monodisciplinarity	Multidisciplinarity		Interdisciplinarity		Transdisciplinarity				…
	…	…									…

Fig. 6 (continued)

and cross-sectional incorporation of sustainability basics and core contents in all the compulsory curricula of the university's degree programs.

The profile of the WBH as a cross-disciplinary, technology-oriented distance and online learning university offers excellent potential for such an ESD integration—also in conjunction with the other distance and online learning universities of the Klett Group from the fields of social and health sciences. The same applies to the development of ESD offerings along the entire educational chain of sub-academic to academic offerings, which are also represented by the various educational institutions in the Klett Group ("from daycare to university").

The theoretical basics and practical experiences presented in this paper show that ESD in distance and online learning settings provides a huge playing field and potential for educating sustainability experts and leaders of the future. Furthermore, the specific profile of distance and online learning opportunities and the target groups they address make this type of education a valuable educational component for implementing global sustainability goals. Further research into their methodological design and mode of action is thus an essential task for the future.

References

de Haan G (2010) The development of ESD-related competencies in supportive institutional frameworks. Int Rev Educ 56(2):315–328

Fischer K (2020) Sustainability of global value creation and supply chains. In: Thatcher A, Zink KJ, Fischer K (eds) Human factors for sustainability: theoretical perspectives and global applications. CRC Press, Taylor & Francis, pp 233–253

Fischer K (2021) Global value chain sustainability governance: implications for management research and practice. In: Henke M, Kohl H (eds) Sustainability in global value chains—state of the art and interdisciplinary research fields. Kogan Page, London, pp 55–76

Fischer K, Jentsch M (2019) Sustainable supply chain governance—Multinationale Unternehmen als Akteure nicht-staatlicher governance in globalen Lieferketten. In: Wellbrock W, Ludin D (eds) Nachhaltiges Beschaffungsmanagement. SpringerGabler, Wiesbaden, pp 55–74

Grecu V, Ipiña N (2014) The sustainable university—a model for the sustainable organization. Manag Sustain Dev 6(2):15–24

Isenmann R, Landwehr-Zloch S, Zinn S (2020) Morphological box for ESD—landmark for universities implementing education for sustainable development (ESD). Int J Manag Educ 18(2020):1–15

ISO (2010) ISO 26000:2010—guidance on social responsibility. International Organization for Standardization, Geneva

Kolb M, Bungard P (2018) Nachhaltiges Management lehren und lernen: Ein praktischer Ansatz zur Transformation. In: Raueiser M, Kolb M (eds) CSR und Hochschulmanagement: Sustainable Education als neues Paradigma in Forschung und Lehre. SpringerGabler, Berlin, pp 199–211

Landorf H, Doscher S, Rocco T (2008) Education for sustainable human development: towards a definition. Theory Res Educ 6:221–236

Leal Filho W (ed) (2018) Nachhaltigkeit in der Lehre: Eine Herausforderung für Hochschulen. Springer Spektrum, Berlin

Leal Filho W, Raath S, Lazzarini B, Vargas VR, de Souza L, Anholon R, Quelhad QLG, Haddad R, Klavins M, Orlovic VL (2018) The role of transformation in learning and education for sustainability. J Clean Prod 199:286–295

Leal Filho W, Shiel C, Paco A, Mifsud M, Ávila LV, Brandli LL, Molthan-Hill P, Pace P, Azeiteiro LV, Vargas VR, Caeiro S (2019) Sustainable development goals and sustainability teaching at universities: falling behind or getting ahead of the pack? J Clean Prod 232:285–294

Manstetten R, Kuhlmann C, Faber M, Frick M (2021) Grundlagen sozial-ökologischer Transformationen: Gesellschaftsvertrag, Global Governance und die Bedeutung der Zeit. Eine konstruktive Kritik des WBGU-Gutachtens "Welt im Wandel—Gesellschaftsvertrag für eine Große Transformation". ZEW, Berlin

Müller-Christ G, Isenmann R, Dembski N (2009) Nachhaltigkeitsberichterstattung von Universitäten. Strukturelle inhaltliche Überlegungen und ihre internetgestützte Umsetzung. In: Baumgartner R, Biedermann H, Zwainz M (eds) Öko-Effizienz. Konzepte, Anwendungen und Best Practices. München und Mehring, pp 83–100

Müller-Merbach H (1976) The use of morphological techniques for OR-approaches to problems. Oper Res 75:127–139

Müller-Merbach H (1995) Philosophie-splitter für das management. 16 praktische Handreichungen für Führungskräfte. (2nd ed) Bad Homburg, DIE

Nölting B, Dembski N, Pape J, Schmuck P (2018) Wie bildet man Change Agents aus? Lehr-Lern-Konzepte und Erfahrungen am Beispiel des berufsbegleitenden Masterstudiengangs "Strategisches Nachhaltigkeitsmanagement" an der Hochschule für nachhaltige Entwicklung Eberswalde. In: Leal Filho W (ed) Nachhaltigkeit in der Lehre: Eine Herausforderung für Hochschulen. Springer Spektrum, Berlin, pp 89–106

Pizzutilo F, Venezia E (2021) On the maturity of social responsibility and sustainability integration in higher education institutions: descriptive criteria and conceptual framework. Int J Manag Educ 19:100515

Ritchey (2011) Wicked problems—social messes: decision support modelling with morphological analysis. Springer, Berlin

Schwarzkopf J, Fischer K, Müller M (2021) Success factors of voluntary sustainable supply chain management sector initiatives. In: Henke M, Kohl H (eds) Sustainability in global value chains—state of the art and interdisciplinary research fields. Kogan Page, London, pp 225–259

Shulla K, Leal Filho W, Lardjane S, Sommer JH, Borgemeister C (2020) Sustainable development education in the context of the 2030 Agenda for sustainable development. Int J Sustain Dev World Ecol. https://doi.org/10.1080/13504509.2020.1721378

UNESCO (2014) Roadmap for implementing the global action programme on education for sustainable development. UNESCO, Paris

UNESCO (2020) Education for sustainable development: a roadmap. UNESCO, Paris

UNESCO (2021) Berliner Erklärung zur Bildung für nachhaltige Entwicklung. https://www.unesco.de/sites/default/files/2021-05/Berliner%20Erkl%C3%A4rung%20f%C3%BCr%20BNE.pdf. Accessed 25 Apr 2022

United Nations (1992) Report of the United Nations Conference on Environment and Development, Annex I: Rio Declaration on Environment and Development. A/CONF.151/26 (vol I)

United Nations (2002) Resolution adopted by the General Assembly. United Nations Decade of Education for Sustainable Development. A/RES/57/254

United Nations (2015) Transforming our world: the 2030 Agenda for Sustainable Development. A/RES/70/1

Verhoef L, Bossert M (2019) The University campus as living lab for sustainability. A practitioners guide and handbook. Delft University of Technology, Hochschule für Technik Stuttgart

WBGU (2011) Welt im Wandel: Gesellschaftsvertrag für eine Große Transformation. Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen, Berlin

WBH (2018) Forschungsbericht der Wilhelm Büchner Hochschule. www.wb-fernstudium.de. Accessed 25 Apr 2022

Zwicky F (1969) Discovery, invention, research—through the morphological approach. Macmillan, Toronto, Canada

Responsibility Through Action Learning—Building up World Relations and Personal Capacity Through Teaching Formats

Stefan Raich, Anne-Kathrin Lindau, Ina Limmer, and Veronika Schwarz

1 Introduction

German universities today face major and diverse challenges in meeting the current and future expectations of society (Barlett and Chase 2013). On the one hand, students have to meet the requirements of current labour markets, on the other hand, the university itself as an organisation and educational institution should act in accordance with its public mission and as a responsible role model. The concepts of sustainable development and education for sustainable development (ESD) currently represent an approach that universities around the world and especially in Germany are increasingly adopting. In Germany, some universities have already made progress in the process of adopting the whole-institution approach and can serve as a model for other universities on their way to becoming more sustainable. The Catholic University of Eichstätt-Ingolstadt (KU) is an example for a university that has been on the path towards becoming a more sustainable university for twelve years and thus, according to Leal Filho (2009), belongs to the group of universities that have made a long-term commitment to sustainability. In a systemic approach, KU focuses on six fields of action related to sustainability (governance, research, teaching, student

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initiatives and engagement, campus management and operations, transfer) to implement an overall institutional approach. This stringent approach is still too rare in Germany in this scope and complexity (HRK 2017). In response to a joint declaration by the German UNESCO Commission and the German Rectors' Conference (HRK & DUK 2010) and a meeting of the national working group, the then KU university management decided in 2010 to introduce a comprehensive sustainability concept in the sense of a whole-institution approach.

The KU was founded in 1980. It is located in Bavaria approx. 100 km north of Munich. Currently, just under 5000 students are enrolled at the eight faculties of the KU. While the university places its focus on social sciences and the humanities, it also represents a natural sciences component with its Faculty of Mathematics and Geography. Already after the conference in Rio in 1992, KU students started initial efforts to make the university more sustainable (Fig. 1).

Especially in the area of teaching and transfer, KU lecturers use various formats of education for sustainable development to empower students, academics, administrative staff and citizens alike to act sustainably in their respective environments.

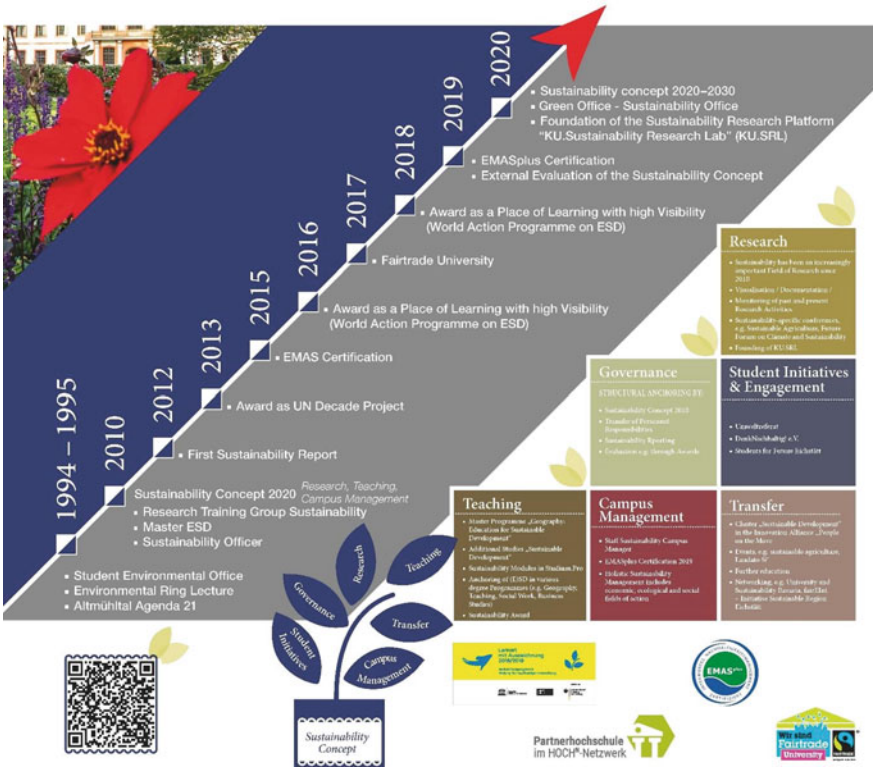

Fig. 1 The Catholic University of Eichstätt-Ingolstadt on its way to a more sustainable university (Lindau and Limmer 2021, illustration: C. Pietsch)

The spectrum of sustainability education formats ranges from seminars, action and Service Learning courses to continuing education and Master's degrees, as well as the area of transfer activities and social engagement. The universities' aim is to systematically develop the potential of those formats to contribute to education for sustainable development and to the organisations overall social responsibility. Part of this task is to develop and shape students' world relations and foster their ability to respond to societal challenges. For this purpose, we see the need for a comprehensive approach to education. This means that we suggest that good education includes students' personal development, value formation, and competence in systemic thinking, as opposed to a purely technical and instrumental concept of education as training without disciplinary self-reflection.

2 Building Resonant World Relations and Taking Responsibility Aim and Methods of the Text

In times of climate change and great global transformation processes (WBGU 2011) in nature and societies, universities have an important role to play in educating students to become responsible individuals who can apply theoretical concepts in a sustainable manner. To achieve this goal, this text explores how theoretical concepts and tools are used, contextualized with other disciplines (interdisciplinary) and practitioners' lifeworlds (transdisciplinary), and then reflected upon from a social ethics perspective.

As social beings, we continually shape our personalities and our existence through the construction and development of world relations (Rosa 2016). We reciprocally react to each other and to things in the world, and in doing so we develop not only ourselves but also our moral standards. Thus, in sustainability and in ESD, we are essentially dealing with a normative guiding principle (what) and its application (how) (Grunwald and Kopfmüller 2006; Kopfmüller 2003, p. 21 ff.; Renn et al. 2009). At the same time, dealing with sustainability requires technical knowledge, such as measuring with indicators, understanding the functioning of ecosystems, carrying capacities or the interaction of sustainability dimensions.

In order to be capable of performing responsible and sustainable actions in society, it is necessary to learn how to link theoretical concepts to social practices in specific contexts. In this contribution, we ask to what extent different education formats at KU contribute to such a comprehensive approach in ESD. The aim of this article is to illustrate the potential of teaching formats at KU to develop students' capability to act responsibly, by examining, how theoretical concepts are contextualised and translated into practices for sustainable action. This article will use four examples of teaching formats at KU to unfold their specific profiles in this respect and analyse how they relate theoretical concepts to specific contexts and practices. For this purpose, we develop three criteria: the role of theoretical concepts, the mode of translating them into different contexts and the role of normative aspects concerning sustainability.

Finally, we highlight the specific educational tools used in the different formats for a potential further usage in other contexts or further research on their effectiveness.

In the next section, we analyse the specific approaches and the mode in which theoretical concepts are reflected and contextualized, with a focus on the education of future leaders that are prepared for making responsible and context sensitive decisions in society. The four examples illustrated in this contribution focus on an Action Learning seminar on social innovation in business studies (3.1), a Service Learning and project seminar on sustainability (3.2), teacher professionalization through Service Learning (3.3) and a transfer project to support a transformative school development process (3.4). Each format addresses a different context in which students are challenged to face both, the functional performance and the social ethical dimension of their actions. In Chap. 4 we summarize the findings and highlight some open questions for further studies.

3 Examples for the Implementation of ESD in Different Teaching Formats

3.1 The Case of an Action Learning Seminar on Social Innovation

Curricula and study programs cannot keep pace with the state of the respective subject and developments in society or in business. This is both a strength and a weakness.

On the one hand, the methods and concepts that flow into curricula are mostly tried and tested and therefore generally relevant in the long term, on the other hand, students sometimes do not get to know the latest approaches, tools and contents. If universities want to educate leaders who are capable of shaping change in society, then the transfer of knowledge into specific contexts seems to be a task for universities, especially in times of great transformation.

In the business world, companies have already recognised the relevance of systematically integrating sustainable business practices and the Sustainable Development Goals (SDG) (Jacobsen et al. 2020). In the case of management education, we know from several studies and observations in the past (Mintzberg 2004; Ghoshal 2005) that the mere focus on theoretical concepts, for example the concepts of homo oeconomicus or the principal-agent theory in MBA education can limit the ability of students to act empathically, to show solidarity and to cooperate. If graduates have not learned to critically reflect and to contextualize theoretical concepts, this can lead to problems when they are in asked to make responsible and context sensitive decisions.

Despite the claim that abstract management concepts like the principal-agent theory or the homo oeconomicus were often considered as analytical models (Wallacher 2003), they found their way into everyone's lifeworld through everyday business practices. Concepts implicitly shaped the behavioural standards of managers

for decades and thus displaced traditional moral guiding criteria of local cultures and ethical norms (Ghoshal 2005) in many countries. It is the economic legitimization of economically 'rational' practices as 'professional' that have displaced other contextual references in societies, such as the orientation on the common good, solidarity or saving resources (ibid.) or role models like the honourable merchant. Even beyond reconnecting to such wise guiding principles, we claim that part of the challenge universities have to face today is, to contextualize and reflect on scientific concepts, also in their social and environmental implications. That means an enlargement of complexity, while scientific models try to reduce it and to re-consider the societal arena, its reality, interests and relations, the "*matters of concern*", how Latour (2004) called it.

Another theory to re-connect different spheres is the theory of resonance in education (Rosa 2016; Rosa and Endres 2016; Beljan 2017). We apply this approach in the following analysis, to describe an Action Learning format from management education at KU and evaluate to what extent this format contributes to a comprehensive idea of ESD with the above mentioned criteria (concepts, contextualization and normative aspects). The first teaching example is a seminar on Social Innovation in KU's Master programme "Entrepreneurship and Innovation (ENTRE)" and is offered every semester. For the goal to describe the format of this course, it seems sufficient to briefly mention the four phases a student goes through, when experiencing resonance, according to the resonance theory.

(1) The student is **affected** or touched by the relation, the experience s/he makes,
(2) s/he **responds emotionally** and is experiencing self-efficacy,
(3) s/he is **transformed**, his/her knowledge, conviction etc. change and
(4) s/he is **not in control** of the process s/he undergoes, being in resonance with others means a certain feeling of unavailability of the process (Rosa 2016).

An Action Learning Seminar on Social Innovation

According to Revans (2011), the format of an Action Learning seminar takes into account existing knowledge and theories ("programmed knowledge") as well as the exploration of the individual case or situation ("questioning insight"). That requires the students to ask questions and interpret the situation. These two aspects seem suitable as a format for practicing action knowledge in this seminar. Action Learning deals with challenging learning processes that involve questioning one's own situation and personal experiences. For Revans, the founder of Action Learning, "praxeology is the science of human action and encompasses three relationships: with self, with others, and with the impersonal world" (Hauser 2012, p. 84).

(1) *Being affected or touched*

In the Action Learning seminar on Social Innovation, the students take on the role of advisors to existing African social impact start-ups (SIST) for example coming from Nigeria, Uganda or Kenia.[1] The social enterprises, all of which have been awarded

[1] https://sistac.world/projects.

by the Bayer Cares Foundation, stand out as companies that strive to find solutions to a social or environmental challenge in their respective countries. The course starts with a three day kick-off workshop for immersion in the cases. Before the Covid-19 pandemic, representatives of the start-ups were invited to Germany, where *students got directly in touch* with them. In the meantime, these meetings take place online. During these workshops, students are curious to get a first-hand insight into a different business culture. The stories told by the socially engaged entrepreneurs and those about the social challenges and serious needs they address, be it the fight against child mortality (SDG 3), breast cancer (SDG 3, 5) or the low income and poverty of farmers (SDG 1, 2, 8, 13), usually *affect and touch the participants directly*. At the same time, the lecturers start their input on management concepts like innovation management, business model canvas, social impact assessment, marketing and communication.

(2) *Responding emotionally and experiencing self-efficacy*

In addition, the students are interested in learning about the different life-worlds in which the start-ups are set. Gosling and Mintzberg (2006, p. 421) claim that "'worldliness' comes from interacting with people who see the world very differently".

> The best thing was the project work with an African start-up, because it is a lot of fun and you can get to know new perspectives, ideas, and backgrounds through the collaboration.[2]

Generally, this first encounter immediately triggers the students' *desire and emotion to help the founders*' social project by providing advice. The lecturers inputs accompany the course and they motivate students to immediately apply the newly acquired concepts on their sample enterprise. It is therefore not about the abstract and mere instrumental application of economic tools, but about developing recommendations and solutions for a challenge in a specific and concrete world context in order to produce impact in the respective societies. Through this conceptualization and its effects, students regularly *feel* that they *contribute to something of relevance* for the success of the venture and the impact on society and by this develop their social competencies (De Haan 2008).

(3) *Transform existing knowledge, conviction and change*

The students arrange regular meetings with the founders throughout the semester and the course via video conference and develop their recommendations in close consultation with the entrepreneur. In this way, they continuously receive an assessment of the feasibility of their advice in the specific cultural and economic context of the implementation and the concrete needs of the target group. After the introduction of a methodology like the stakeholder approach by the lecturer, students also carry out their own analysis to learn about the different perspectives of stakeholders on the product or service of the founder. It is important that the students be not bound to follow the assessments neither of the entrepreneurs nor of the lecturer. Gosling

[2] Course Evaluation Social Innovation I (Winter term 2020/21) on the question: "*What did you find particularly good about this course? Why?*".

and Mintzberg (2006, p. 421) have found a potential tension in the students "*believe they want to learn*", and what we as academics might feel they ought to learn" (ibid., p. 421). We consider exactly this voluntary decision a success factor of education at the Master level, as students have a "strong desire for 'relevance', which is contextually defined and unlikely to be universal to a whole class" (ibid., p. 421). Therefore, we try to allow students not only to gain new experiences or acquire other concepts, but also to *make failure and be transformed* in their (false) assumptions. The same applies for the founders.

(4) *Unavailability of the process while being in resonance with others*

It regularly happens that both sides engage with each other deeply, creating a special exchange that can be described as a resonant learning relationship. The founders listen to the advices and ideas students contribute and students learn from the appraisal of business chances and effects of the entrepreneur. Through this, "management education becomes a process of interactive learning" (Gosling and Mintzberg 2006, p. 425). Compared to other seminars, the energy and motivation of the participants seems to be much higher during the process. In addition, they are committed to delivering something helpful to their partners and experience self-efficacy through the feedback of the founder or even the application of what they recommended.

> What I like most is the practical work with a social start-up. The work is practically relevant and we can achieve something. A first highlight for me was when the company implemented one of our proposals.[3]

Suddenly, their performance in the course does not only concern them alone, but they take responsibility for a common cause for a certain period of time and they are touched by the potential effects of their advice. The *outcome of this process is hardly predictable* before the course, not even for the lecturers. The latter are not directly the addressee of the students efforts but act more in the role of mentors, the provider of feedback. They reflect together with the students on the adequacy of the analysis, the effectiveness and usefulness of the tools and recommendations used.

Evaluation and Learnings

Concerning the question how to educate context sensitive and social responsible managers this course on Social Innovation provides an approach to contextualize and reflect on different levels.

First, the *format* of an Action Learning seminar as a framework already requires an interpretation of the situation and the formulation of open questions from the students. The entitlement to act sustainably in different contexts constantly demands a search and learning process (Grunwald and Kopfmüller 2006, p. 12). Action Learning courses can be a starting point for students to learn how to take wise decisions and reflect situations from different perspectives in real life. After the participants take the role of consultants, the lecturers provide an input of theoretical concepts that are

[3] Course Evaluation Social Innovation I (Winter term 2020/21) on the question: "*What did you find particularly good about this course? Why?*".

interwoven with the advice students give. The learning material and the concepts serve as accessory for the specific learning experience and a context sensitive advice towards the founder.

Second, the Action Learning seminar on Social Innovation is based on a *concept of businesses* that is responsive towards societal needs, in other words enterprises are considered as social organisations that can provide a social service for society. The seminar cooperates with social entrepreneurs who explicitly address a social challenge and try to solve it with an innovative approach, combined with a viable business model. By using those examples, students can realise the idea, that businesses have the potential to promote the common good while being profitable.

Third, the idea, the course conveys is how to bring together the solution of a social goal with market success. The program contextualises this idea in the way that the student-consultants have to reflect about the social good of companies. Lecturers demand a *social impact* analysis with the SROI (Social Return on Investment) approach and a reflection on potential trade-offs with the economic success. By this, the consultant students have to consider both, the economic viability as well as the ethical and social dimension of their recommendations to the entrepreneurs.

Fourth, lecturers prepare students for the analysis of the enterprises with theoretical concepts on disruptive innovation, on stakeholder engagement and models about lean management. While the approach on innovation can be used for a more technical analysis of the partner enterprises, the latter two concepts focus on a responsive relation of the businessman towards society and towards the market. Contextualising theories in seminars through the application of *real cases,* creates situations that challenge students ability to transfer what they have learned to other contexts and to reflect critically on prior assumptions.

Fifth, the course systematically contextualises scientific concepts in relation to systemic and sustainability problems in business education. This encompasses the terms profit maximisation, market, regulation, competition, cooperation or social impact and the question what role they play in the conception of businesses. The course reflects on those concepts from different disciplinary perspectives and by interpreting business actions from *different perspectives* that are trained in multi-stakeholder role-plays representing for example political, economic, environmental and socio-cultural contexts in the course on Social Innovation.

Sixth, the course provides a motivating environment that invites students to immerse themselves in the life world of the partner organisation (African start-ups). Structured and regular interactions with partners proved to have the potential to build up resonant relations. This was beneficial in terms of students' *empathy* towards the companies and for their personal development. The position of the lecturer is alongside the student as an impulse generator, a learning guide and supervisor. Students consider it helpful, that lecturers accompany and reflect with them on the constellation between the students and the partners and their expectations. While students do not direct their actions and contributions towards the lecturer, the latter can observe the students' interaction with the founders and the quality of the interaction and the mutual learning process.

Overview see Appendix A.

3.2 Service Learning as an Element of Education for Sustainable Development—Insight into a Project Seminar

Climate crisis, migration, global injustices, digitalisation, globalisation, loss of biodiversity—the challenge of sustainable development is closely linked to all these (and many other topics). How can students acquire knowledge and competences to grasp sustainability with all its facets, to assess hurdles on the way to a sustainable future, to be able to act responsibly in their living and working environment ("Gestaltungskompetenz", De Haan 2008) in the sense of education for sustainable development)?

Using the example of a project seminar at KU, we show a way how to link the concepts of Service Learning, ESD and Transfer to enable students to acquire the design competences of an ESD. The additional study programme "Sustainable Development" and the associated project seminar described in detail here offers students of the KU the opportunity to deal with future issues in depth during their studies at the KU, to link them with their subject studies and thus to become (co-)designers of sustainable development. It is open to all KU students from the third bachelor's semester onwards as an additional qualification. The module "Sustainable Development—from the Perspective of Different Subjects" is part of the compulsory area of the additional studies and is organised as a lecture series by various professors and academic staff of the KU. This illuminates the subject-specific foundations and challenges of sustainable development from multiple perspectives. In the follow-up project seminar "Sustainable Development 2", students can apply and implement their theoretically acquired knowledge in a project. A broad pool of compulsory elective modules offers a selection of thematic aspects of sustainable development in which students can individually deepen their knowledge: Beekeeping, Sustainable Entrepreneurship and Social Innovations, ESD, Migration and Interculturality, Sustainable Environmental Development or Sustainability in Nutrition. At KU, we offer the 20 ECTS additional study programme since 2019. So far, about two percent of KU students have chosen this additional offer and enrolled in the additional study programme.

The concept of Service Learning or learning through engagement (Reinders 2016) offers a way to intensify the transfer between higher education institutions and society, to link theoretical knowledge with questions and challenges of practice and thus to initiate a dialogue between a wide range of actors. In this way, the students become active in action-oriented and collaborative projects, both to support the partner organisations with real needs (service) and to reflect in the seminar on content and goals, but also on methodological, social and personal competences (learning) (Bringle and Hatcher 2000). Since the design of the projects is related to sustainable development, students can also be encouraged to develop ESD competences such as systems competence, problem-solving competence, tolerance of ambiguity, ability to change perspectives, etc. (UNESCO 2017; Rieckmann 2021).

In the summer semester of 2021, the focus of the project seminar "Sustainable Development" The aim of the project seminar was to address the current needs of associations, initiatives and companies from the Eichstätt-Ingolstadt region and to provide suitable support with the help of the students. In terms of content, the concept of the project was to relate the ideas and needs of the external partners to the UN's 17 Sustainable Development Goals (SDG). At the beginning of the semester, the almost 30 students were able to choose a project and a project group out of more than 35 project ideas with 15 interested partners in the region. In the end, we built ten project groups that wanted to implement projects for sustainable development together with eight external partner organisations over the next eleven weeks. Thematic examples of group work are: The development of waste prevention strategies for the city of Eichstätt, the development of crowdfunding for lifting bags in nursing and elderly care, the optimisation and support in public relations and educational work on ESD topics, measures to protect biodiversity and the initiation of an exchange of experiences on the challenges of sustainable development with people with a refugee background. In addition to the individual work phase with the partner organisations, the project-work seminar supported by the lecturers, discussed and reflected on aspects of sustainable development and Service Learning in depth. The students had the opportunity to bring in their own questions and topics, from which the following additional aspects resulted in the seminars: fields of action of sustainable development, possibilities of a just and socially acceptable sustainable development, social impact assessment, transformation and transformative learning as well as agile project management. The students were also in close, mostly weekly, exchange with the external project partners.

At the end of the semester, the participants presented the project results in the seminar to their fellow students as well as to the external partner organisations. Furthermore, we published the outcomes in the regional newspaper and on social media. That trained the students ability to formulate understandable for the wider public and helped them reflecting to impact their projects had on society. Under normal circumstances outside of a global pandemic, a more extensive appreciation of the project work, for example through a public project fair and presentation of the results, would have been possible. We invited all students and external partners to participate in an evaluation. The following feedback from a partner organisation gives a good insight:

> The level of motivation and commitment of the students was an absolute enrichment for us. The tight timing of the semester was beneficial in the sense that weekly meetings had to take place and goals had to be achieved within a relatively short time. There was little chance that certain tasks would 'fizzle out'. A great collaboration - we are happy to be involved again! The organisation of the cooperation with an external team and the change of perspective showed how important it is to constantly align expectations and take different perspectives.

In conclusion, the participants as well as the partners noted that the collaboration was very beneficial and instructive from all sides, as was the coordination and involvement of the external participants in the seminar at the beginning and end of the semester. However, under the objective of transformative education for sustainable development, there is still potential, to further increase the transformative character

and impact for sustainable development. One possible step would be to develop the project ideas of the partner organisations in a theory-based, critical and reflective way in order to increase the ambition and the learning effect in the individual projects. At the same time, there is a risk of not addressing the concrete needs of the partner organisations.

Overview see Appendix B.

3.3 Teacher Professionalization Through Service Learning Using the Whole School Approach

In the coming years, universities will strive to achieve climate neutrality as an important goal of sustainable development and as an important task for the future (https://www.umweltpakt.bayern.de/energie_klima/fachwissen/374/klimamanagement). Due to climate change and its negative consequences for ecosystems and human societies, urgent action by all actors is necessary (IPPC 2021). In addition to measures to adapt to climate change, ways are being sought in the field of CO_2 reduction that combine climate compatibility and prosperity. Climate neutrality is a central and interlinking issue that touches on different areas in social organisations and concerns technical, political, social and natural science aspects of the present and future (https://ghgprotocol.org/). Closely linked to the issues of climate neutrality are also numerous other questions of the Whole School Approach, which can be differentiated into the fields of action governance, school culture, teaching and campus (Rieckmann 2021). We asked **how to prepare future teachers for both, a school of the future and the global challenges of the Earth**, in order to be able to act as agents of change.

For this purpose, we developed a seminar concept to contribute to professionalization. The complex conflicts of objectives that arise here within social organisations are discussed, using the example of the university system. For this purpose, the diverse activities of the KU in the field of sustainable development will be considered in order to bring ideas of sustainable development from educational institutions into schools (Hemmer and Lindau 2021). This topic is integrated in the seminar with the help of the digital outdoor tool Action bound and, in addition, Greenpeace Schools for Earth initiative, to introduce students to the topic of climate neutrality in educational institutions. This includes a CO_2 climate calculator specially developed for schools by Schools for Earth (https://co2-schulrechner.greenpeace.de/node/1) (Greenpeace e. V. 2021). Table 1 shows the course of the seminar in terms of content and methodology.

In a first seminar, the student teachers get an insight into the necessity of global sustainable development and the concept of ESD for the school context. For this purpose, a lecture followed by a discussion in an experience-based manner, provides basic information to the students. A future workshop on the ideas of the school of the future collected criteria for an ideal school model. At the same time, the student teachers collected existing deficits from the internship experiences. These

Table 1 Seminar schedule on the whole school approach for student teachers in the service learning concept

Session	Content	Methodology
1	Sustainable development and education for sustainable development	Lecture and discussions in plenary and in groups, "Zukunftswerkstatt" (future workshop) on the school of the future
2	The Catholic University of Eichstätt-Ingolstadt on the way to a more sustainable university	Analysis of the university's overall sustainability concept, the sustainability homepage and the sustainability report; exploration of the campus with the help of a "Sustainable Catholic University" Action bound
3	Whole school approach—achieving climate neutrality in schools, service learning concept	Analysis of the whole school approach at schools as well as the CO_2 climate calculator, introduction to project work and the concept of service learning
4	Whole school approach with selected examples	Preparation of the school project through group work
5	Whole school approach with selected examples	Implementation of the school project
6	Evaluation of the school project	Evaluation by means of questionnaires and group discussions

aspects can provide impulses for the project work on the Whole School Approach. In the second seminar, the students deal with the Whole Institution Approach of the Catholic University of Eichstätt-Ingolstadt. For this purpose, they inform themselves about the overall sustainability concept and the sustainability report of the university with the help of input from the lecturer and on the sustainability homepage of the university. They then explore KU with the digital tool Action bound "Sustainability on the Eichstätter Campus" (https://actionbound.com/bound/Greencampusei), in which they visit various places such as the refectory, energy-neutral buildings and the Capuchin Garden as examples of sustainable development. Through the information on the sustainable university, the students get an idea of the concept of the Whole Institution Approach as an institutional approach. The third seminar focussed on addressing the concept of Service Learning by preparing a project work for the schools on the holistic sustainability approach. The aim for the students is, to develop ideas for a project work on the topic of climate neutrality in schools. This approach was supported by the initiative Schools for Earth (Greenpeace e. V. 2021) by providing representatives of the initiative as well as materials for project planning. Subsequently, the students have time in the fourth and fifth sessions to plan concrete projects for the respective studied school types of primary school, middle school, secondary school and grammar school.

The schools have hardly dealt with holistic approaches to sustainable development so far. In the project, the participants implement their ideas together with school classes and bring their competences and expertise as innovative approaches to the

schools in the region. The students explore their schools under sustainability aspects or conduct future workshops. The seventh seminar session, has foreseen the evaluation of the experiences of the project work at the schools with the students at the university. With the help of Service Learning questionnaires based on Furco (1996, 2009), Brok et al. (2021) and Brok and Winklmann (in press), a quantitative evaluation is carried out to measure the effectiveness of the Service Learning approach for the students.

Overview see Appendix C.

3.4 Schools in Region 10 on the Move—University Support for a Transformative School Development Process

The Intergovernmental Panel on Climate Change (IPCC) warns us of the effects of global warming that will cause global environmental and development problems. A shift towards a sustainable society is urgently needed to contain the 2 °C scenario to 1.5 °C (IPCC 2018, 2021). Education plays a central role in this change and it is recognised as a "catalyst for securing a better and more sustainable future for all" (UNESCO 2014b, p. 3). This is exemplified by the "World Programme of Action on Education for Sustainable Development (ESD)" (WAP). The "Roadmap for the Implementation of the WAP ESD" sums up this conviction in the following words:

> We need to change the way we think and act and be clear about how we all depend on each other and how we treat the ecosystems that are our livelihoods. To create a more just, peaceful and sustainable world, we all need more knowledge, skills and unifying values, as well as a greater awareness of the need for such change. This is where education plays a crucial role. Education for Sustainable Development (ESD) is the path to a better future for all - and that path starts here and now. (UNESCO 2014b: 8)

The Education for Sustainable Development 2030 (#ESD2030) programme (UNESCO 2020, 2021), as the successor to the WAP, focuses specifically on "the key role of ESD in achieving the 17 SDG and in the major individual and societal transformation [...] needed to address urgent sustainability challenges" (UNESCO 2021, p. 3). This societal transformation includes, in particular, the transformation of our education system. Andreas Schleicher, the Director of Education at the OECD, summarises this approach concretely by saying:

> The teaching of subject matter is no longer the essential thing today. It's no longer about what we know - Google knows everything. It's about what we can do with our knowledge. Children need space for this in school [...] The most important things are creativity, the ability to find complex solutions, to think laterally, i.e. outside the mainstream. (Schleicher 2019)

To meet these demands, #BNE2030 with its second field of action on learning and teaching environments accordingly focuses its attention on "promoting the Whole Institution Approach to ensure that we learn how we live and live what we learn"

(UNESCO 2021, p. 3). In the sense of the National Action Plan on ESD (BMBF 2017), the World Programme of Action on ESD (UNESCO 2014b), as well as the current programme #BNE2030 (UNESCO 2021), it is urgently necessary not only to implement the relevant content of sustainable development in schools and in the classroom, but also to transform schools into places of learning for sustainable development in the sense of a Whole Institution Approach. The Whole Institution Approach encompasses more than content and teaching, it transforms "educational institutions into places that take on important significance within local contexts and act as part of local educational landscapes" (Seggern 2018, p. 4). In its final report on the WAP, UNESCO formulated four areas that comprise a Whole School Approach to practising ESD holistically. These include Governance Policy & Capacity Building, Community Partnerships & Relationships, Curriculum Teaching & Learning and Facilities School Operation (UNESCO 2014a, p. 89).

For the project "Schulen der Region 10 im Aufbruch" (Schools of the Region 10 on the Move) this was precisely the guiding question **how to transform those traditional learning places**. The project accompanies five pilot schools in their development to become places of responsibility for themselves, for their fellow human beings and for our planet. In this, pupils can acquire the necessary future and creative competences, entirely in the sense of a Whole School Approach.

The pilot schools receive support and guidance within the framework of the project in the form of transformation process support from KU in cooperation with the nationwide initiative "Schule im Aufbruch" (School on the Move). Staff members of the Chair for Geography Education and ESD have been in close contact with "Schule im Aufbruch" for years and now want to support interested schools with their ESD expertise on the further path of school transformation.

KU is a pioneer in the areas of sustainability, ESD and Whole Institution Approach as well as a place of learning with charisma in the national higher education landscape (Hemmer and Lindau 2021). The initiative "Schule im Aufbruch" inspires networks and accompanies schools to become sustainable places of learning in order to create a forward-looking society and a sustainable world (Rasfeld and Breidenbach 2014). The regional network "Schule im Aufbruch Bayern" (School on the Move Bavaria), founded in 2020, forms the basis for firmly anchoring ESD in schools and developing Region 10 into a beacon of a new and transformative school and learning culture.

The transformation support of the pilot schools strengthens KU's Third Mission to act as an engaged and responsible university to contribute innovative and sustainable solutions to the societal challenges of our time. This also sharpens the university profile and their degree of innovation in the areas of research, teaching and campus management. The expansion of existing networks to non-school ESD actors and the implementation of the Whole School Approach is also a contribution to regional development, and strengthens the transfer within the region, as sustainable development is to be understood as a holistic social transformation process, which also has global impacts.

The development of a prototypical transformation process planned in the project also increases the transferability to other schools and thus brings a large number of school communities into contact with the challenges of sustainable development. In

order to fulfil the long-term overall objective of nationwide school transformation in the sense of the Roadmap ESD for 2030 (UNESCO 2020), the aim is also to support other schools after the end of the project with the ESD expertise of the Chair of Geography Education and Education for Sustainable Development.

The close and, above all, permanent support of the pilot schools by KU also enables a learning process for KU in that the experiences from the project can be used for the further development of KU. The implementation of an innovative and transformative learning culture at KU (among other things through new and open forms of teaching and learning and the close link between university and schools) contributes to a further professionalization of the study programmes, which pursue the goal of enabling students for a future multiplier function in the field of ESD.

The project is accompanied by evaluation research, which contributes to applied research, in particular to the design-based research approach. On the one hand, the teaching benefits from the acquired competences of transformation support, and on the other hand, the project serves as a pilot for other regional school transformation initiatives that aim to support the transformation process.

Overview see Appendix D.

4 Conclusion

Translating theoretical concepts into social practices is critical to educating students to act responsibly in society. Universities have an important role in training future leaders to be capable of contextualizing, reflecting and transferring knowledge into action, in teaching systemic thinking and in developing students' personal conduct. In the literature and research on sustainability, the transition from knowledge to action is a widely discussed topic. In asking what academic education can contribute to a comprehensive approach in ESD we found from four teaching formats at KU that different ways of contextualizing concepts have the potential to at least stimulate students towards performing responsible and sustainable practices at different levels. These examples support the claim that action- and Service Learning courses can be appropriate strategies to link theoretical concepts to social practices and by this foster students' ability to take responsible actions. In this endeavour, university courses can benefit from multi-perspective approaches. *First*, this applies for interdisciplinary education. Disciplines as well as scientists have a specific conception of terms and those terms express a certain sphere of meaning. Their usage make up the imagination of the world (Zoglauer 1999, p. 74). In this respect, with a different understanding of terms we can create a different conception of the world. While several new study courses at KU, like Business & Psychology or Sustainability in Business & Economics try to integrate different disciplines, there is still potential to systematically integrating such different disciplinary views in single lectures. *Second*, in Action Learning seminars the perspectives of different stakeholders provide students an insight into new lifeworld's, when they are reflected and contrasted against the

normative framing in the courses, like sustainability or social impact. The collaborative work on positive social effects together with partners open up new horizons of action for students and provides opportunities for experiencing resonance. Those new perspectives of the partner organisations, their knowledge and the interaction with them (transdisciplinary) provide a chance to challenge scientific concepts and train decision-making. In this way, the participants shaped their world relations, fostered their ability to respond to societal challenges personally and by developing sustainable solutions. We found that this is exactly what responsibility is about, giving response to relevant worldly problems. *Third*, the reflection of management actions or sustainability measures are often "many layered and culturally embedded" (Gosling and Mintzberg 2006, p. 422). In order to grasp these multi-layered aspects we see the need to integrate sessions on interculturality and intercultural communication in the future, where applicable.

Courses can also benefit from self-reflection, for example by systematically incorporating assessing the impact on students. Evaluations of the courses also together with the partners, remain a path to continuous improvement, especially for new teaching formats. Although Action- and Service Learning courses can promote the acquisition of transformative knowledge, the learning context at university sometimes prevents lecturers from delve deeper into the projects. Courses regularly face time constraints in developing solutions. Therefore, it is a challenge for lecturers to find a healthy balance between the need to provide effective services for the partner and the achievement of learning objectives within the study programme. There is no universal formula for this. In some cases, it is possible to tailor the size of the task properly within the course. When this is difficult, more time, for example a two-semester course, may be a possible solution; in other cases, students might engage further outside the curriculum. We will further monitor those courses in the future to regularly assess and check our results. Action and Service Learning courses train students' ability to relate to real life situations and increase their self-confidence through the experience of self-efficacy. It seems reasonable to form students who believe of themselves that they can make a difference for sustainability.

Appendix

A. The case of an Action Learning seminar on social innovation (3.1)

Specific question	How can we educate context sensitive and responsible managers and integrate different perspectives on business studies and on societal problems?
Theoretical concepts used	* Action Learning approach * stakeholder approach * disruptive innovation * social impact assessment (SROI)
Contextualisation of concepts	* adapt theoretical concepts to specific contexts * multi-perspective view (transdisciplinary) through the confrontation with different lifeworlds * reflection on the partner relations (relational) * reflection on theories and concepts (interdisciplinary)
Normative-ethical aspect	* reflection on social ethics & social impact assessment * evaluation of contribution to sustainability (SDG)
Specific educational tools	* three day workshop for immersion in the cases * structured exchange during the program * different assignments alongside the consulting process * training on intercultural communication & marketing

B. Service Learning as an Element of Education for Sustainable Development—Insight into a Project Seminar (3.2)

Specific question	How can we link service learning to sustainable development and by this address the development of competences from students as well as the needs of the external partners?
Theoretical concepts used	* "Gestaltungskompetenz" (De Haan 2008) * linking the Service Learning approach with education for sustainable development
Contextualisation of concepts	* multi-perspective view (transdisciplinary) * system thinking * participation in society * confrontation with real world problems
Normative-ethical aspect	* reflection on content, goals and competences an ESD * reflection on the possibilities and limits of civic engagement
Specific educational tools	* Reflection on aspects concerning sustainable development and Service Learning * Self-reliant project management by the students * survey of indicators on the success of the concept of Service Learning * publication of results in local newspaper and meetings

C. Teacher Professionalization through Service Learning using the Whole School Approach (3.3)

Specific question	How to prepare future teachers for both, a school of the future and the global challenges of the Earth and become part of the Whole School Approach?
Theoretical concepts used	* climate neutrality * Whole school approach * Service learning concept * teacher professionalisation
Contextualisation of concepts	* case work * project work * system thinking * Co-operation with local schools and teachers
Normative-ethical aspect	* reflection on content, goals and competences an ESD * reflection on the possibilities and limits of ESD in school
Specific educational tools	* Seminar and project concept * Greenpeace Schools for Earth initiative * Future Workshop as visioning workshop format * Self-reliant project management by the students

D. Schools in Region 10 on the move—University support for a transformative school development process

Specific question	How to transform traditional learning places like schools into places of whole school approach and responsibility?
Theoretical concepts used	* Education for sustainable development * Whole SCHOOL APPROACH * Transformation
contextualisation of concepts	* Whole school approach * Project work * Co-operation with local schools and teachers: * Project: Schulen der Region 10 im Aufbruch
normative-ethical aspect	* reflection on content, goals and competences an ESD * reflection on the possibilities and limits of ESD in school
specific educational tools	* Transformation ideas * standardised transformation process * Evaluation of school transformation

References

Barlett PF, Chase GW (2013) Sustainability in higher education: stories and strategies for transformation. The MIT Press, Cambridge

Beljan J (2017) Schule als Resonanzraum und Entfremdungszone. Eine neue Perspektive auf Bildung. Beltz Juventa, Weinheim.

BMBF (2017) Nationaler Aktionsplan Bildung für nachhaltige Entwicklung. Der deutsche Beitrag zum UNESCO-Weltaktionsprogramm. Selbstverlag, Berlin
Bringle RG, Hatcher JA (2000) Institutionalization of service learning in higher education. J Higher Educ 71:273–290
Brok U, Schlegler M, Sonnberger J, Derkau J, Leitzmann C, Sporer T (2021) Service learning quality criteria and evaluation—a measuring instrument. Contribution the fourth European conference on service-learning in higher education, 16th–17th of September 2021, Bucharest, Romania
Brok U, Winklmann M (in press) Service learning at the Catholic University of Eichstätt-Ingolstadt, Germany. Service-Learning Institutionalization in Catholic Higher Education, a view from its actors. Book contribution to the UNISERVIATE Book Collection
De Haan G (2008) Gestaltungskompetenz als Kompetenzkonzept für Bildung für nachhaltige Entwicklung. In: Bormann I, de Haan G (Hrsg) Kompetenzen der Bildung für nachhaltige Entwicklung. Verlag für Sozialwissenschaften, Wiesbaden, pp 23.44
Furco A (1996) Service-learning: a balanced approach to experiential education. Expanding boundaries: serving and learning. Corporation for National Service, pp 2–6. https://www.shsu.edu/academics/cce/documents/Service_Learning_Balanced_Approach_To_Experimental_Education.pdf. Accessed 18 Jan 2022
Furco A (2009) Die Rolle von Service Learning im Aufbau einer gesellschaftlich engagierten Universität. In: Altenschmidt K, Miller J, Stark W (eds) Raus aus dem Elfenbeinturm? Entwicklungen in Service Learning und bürgerschaftlichem Engagement an deutschen Hochschulen. Beltz, Weinheim, pp 47–59
Ghoshal S (2005) Bad management theories are destroying good management practices. Academy of Management Learning & Education, vol 4, no 1, pp 75–91
Greenpeace e. V. (2021) Schools for earth. Whole school approach. Ganzheitlicher Ansatz zur Schulentwicklung. https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/sfe_handreichung_wsa_210419.pdf. Accessed 18 Jan 2022
Gosling J, Mintzberg H (2006) Management education as if both matter. Sage Publishing, London
Grunwald A, Kopfmüller J (2006) Nachhaltigkeit. Campus Verlag, Frankfurt am Main
Hauser B (2012) Action learning. Workbook mit Praxistipps, Anleitungen und Hintergrundwissen für Trainer, Berater und Facilitators. ManagerSeminare Verlags GmbH, Edition Training aktuell, Bonn
Hemmer I, Lindau A-K (2021) Sustainability concept (Whole-Institution Approach) of the Catholic University of Eichstätt-Ingolstadt (Germany). In: Leal FW, Salvia AL, Brandli L, Azeiteiro U, Pretorius R (eds) Universities, sustainability and society: supporting the implementation of the sustainable development goals. Springer Nature Switzerland, Cham, pp 305–321
HRK – Hochschulrektorenkonferenz (2017) Für eine Kultur der Nachhaltigkeit. Empfehlung der 25. Mitgliederversammlung der HRK am 06. November 2018 in Lüneburg. https://www.hrk.de/fileadmin/redaktion/hrk/02-Dokumente/02-01-Beschluesse/HRK_MV_Empfehlung_Nachhaltigkeit_06112018.pdf. Accessed 18 Jan 2020
HRK & DUK (2010) Erklärung der Hochschulrektorenkonferenz (HRK) und der Deutschen UNESCO-Kommission (DUK) zur Hochschulbildung für nachhaltige Entwicklung. https://www.hrk.de/fileadmin/migrated/content_uploads/Hochschulen_und_Nachhaltigkeit_HRK_DUK.pdf. Accessed 18 Jan 2020
IPCC (2018) Global warming of 1.5°C. https://www.ipcc.ch/sr15/. Accessed 17 Nov 2021
IPPC (2021) Sechster IPCC-Sachstandsbericht (AR6). Beitrag von Arbeitsgruppe I: Naturwissenschaftliche Grundlagen. https://www.de-ipcc.de/media/content/Hauptaussagen_AR6-WGI.pdf. Accessed 05 Mar 2021
Jacobsen SS, Korsgaard S, Günzel-Jensen F (2020) Towards a typology of sustainability practices: a study of the potentials and challenges of sustainable practices at the firm level. Sustainability 2020(12):5166
Kopfmüller J (ed) (2003) Den globalen Wandel gestalten: Forschung und Politik für einen nachhaltigen globalen Wandel. Ed. Sigma, Berlin

Latour B (2004) Why has critique run out of steam? From matters of fact to matters of concern. Crit Inquiry 30(2):225–248. The University of Chicago Press
Lindau A-K, Limmer I (2021) Whole institution approach of the Catholic University of Eichstätt-Ingolstadt—on the way to a more sustainable university. In: International sustainable globe conference 2021. Poster Presentation
Mintzberg H (2004) Managers, not MBAs: a hard look at the soft practice of managing and management development. Berrett-Koehler Publishers
Rasfeld M, Breidenbach S (2014) Schulen im Aufbruch. Eine Anstiftung. 2. Aufl., 155 S., Kösel Verlag, München
Rieckmann M (2021) Service learning für nachhaltige Entwicklung. In: Boos A, van den Eeden M, Viere T (Hrsg) CSR und Hochschullehre (Bd. 26). Springer Berlin Heidelberg, pp 185–198. https://doi.org/10.1007/978-3-662-62679-5_9. Accessed 22 Nov 2021
Reinders H (2016) Service learning—theoretische Überlegungen und empirische Studien zu Lernen durch engagement. Beltz Juventa, Weinheim
Renn O, Jager A, Deuschle J, Weimer-Jehle W (2009) A normative-functional concept of sustainability and its indicators. Int J Glob Environ Issues 9(4):291–317. Inderscience Enterprises Ltd.
Revans RW (2011) ABC of action learning. Routledge, Farnham
Rosa H (2016) Resonanz: eine Soziologie der Weltbeziehung. Suhrkamp, Berlin
Rosa H, Endres W (2016) Resonanz Pädagogik. Beltz Verlag, Weinheim, Wenn es im Klassenzimmer knistert
Schleicher A (2019) Lernen, wie man die richtigen Fragen stellt. www.capital.de/wirtschaft-politik/andreas-schleicher-lernen-wie-man-die-richtigen-fragen-stellt. Accessed 17 Nov 2021
Seggern von J (2018) Executive summary—Die Steuerung und Diffusion von BNE im Bildungsbereich Schule wirkungsvoll stärken. https://www.globaleslernen.de/sites/default/files/files/pages/executive-summaries-_-schule.pdf. Accessed 17 Nov 2021
SISTAC Projects. https://sistac.world/projects. Accessed 10 Mar 2022
UNESCO (2014a) Shaping the future we want. UN Decade of Education for Sustainable Development (2005–2014a) Final report, Paris
UNESCO (2014b) UNESCO-Roadmap zur Umsetzung des Weltaktionsprogramms "Bildung für nachhaltige Entwicklung". Dt. UNESCO-Kommission, Bonn
UNESCO (2017) Education for sustainable development goals: learning objectives. https://www.unesco.de/sites/default/files/2018-08/unesco_education_for_sustainable_development_goals.pdf. Accessed 21 Nov 2021
UNESCO (2020) Education for sustainable development. A roadmap. #ESDfor2030, Paris
UNESCO (2021) Bildung für nachhaltige Entwicklung. Eine Roadmap #BNE2030, Paris, Bonn
Wallacher J (2003) Abschied vom Homo Oeconomicus?: Über die Rationalität unseres wirtschaftlichen Handelns. Stimmen der Zeit (762–772). https://www.herder.de/stz/wiedergelesen/abschied-vom-homo-oeconomicus-ueber-die-rationalitaet-unseres-wirtschaftlichen-handelns/ Accessed 21 Mar 2022
WBGU (2011) World in transition: a social contract for sustainability. WBGU, German Advisory Council on Global Change, Berlin
Zoglauer T (1999) Einführung in die formale Logik für Philosophen. Vandenhoeck und Ruprecht, Göttingen

Guest Speakers: An Opportunity to Create Shared Value?

Kay Emblen-Perry

1 Introduction

Most future business managers and decision makers are educated by universities (United Nations Educational, Scientific and Cultural Organisation 2011). Consequently, it is through learning and teaching that Business Schools can be most influential; developing students with appropriate employment skills and subject knowledge and life skills such as communicating, influencing, and listening (Chalkley 2006; Drayson 2015). Even though Business Schools have responsibility for preparing future leaders, their role is changing. Through the UN Principles of Responsible Management Education (PRME), Business Schools are now considered to be uniquely placed to promote responsible business and enhance contributions to the Sustainable Develop Goals by putting 'public good' at the heart of students' learning and development (The Chartered Institute of Business Schools 2016). Through this, a generation of future leaders who value human and natural capital within a regenerative economy can be created to lead business to be sensitive to the need to limit climate change and facilitate sustainable living (The Chartered Institute of Business Schools 2016).

Despite this changing purpose, Business Schools continue to be criticised for not developing work ready graduates. Up to 80% of graduates lack the generic and specific employment and life skills, and an understanding of the universal values of the Sustainable Development Goals that can contribute to more sustainable, inclusive, and prosperous societies (Chartered Management Institute 2021). Consequently, many graduates who have theoretical skills but no ability to work (Burke 2015), arrive in their workplaces unprepared for real-life work and ill-equipped to handle the complex, multifaceted issues they encounter (Waddock 2007; Kavanagh and Drennan 2008; Rajaratnam and Campbell 2013; Govender 2016; Muller-Heyndyk

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2019; Molinsky and Pisman 2019; Chartered Management Institute 2021). This complexity is growing, driven in part by the widening societal debate about public good and the expectation that businesses will have to demonstrate their contribution to the public good to gain a licence to operate. Consequently, unprepared students are increasingly recruited into 'complex chaos' that is the key feature of real-life work in businesses seeking to become responsible to gain their credibility and legitimacy to trade (Schumann 2019).

Research has long suggested that the incorporation of guest speakers into lectures can contribute significantly to students' required preparation for real-life work as well as academic success (Glenwick and Chabot 1991; McClearly and Weaver 2009; Riebe et al. 2013; Krogstie 2017; Hong et al. 2021). However, such research has generally focused on the student perspective, i.e., the potential for guest speakers to provide value by contributing to student learning and career preparation and concluded that guest speakers are an underutilised resource (Zheng et al. 2018). Whilst some consideration has been given to the potential benefits for tutors (e.g., Riebe et al. 2013; Dalakas 2016; Leor 2015; Merle and Craig 2017), little or no consideration has been given to the value a guest speaker can receive from smart partnering with a Business School. The opportunity for guest speakers and students to both generate and receive value, i.e., shared value has been excluded.

To close this gap, this research adopts a wider perspective on the value of guest speakers. Using business practitioners' reflections on participating in responsible business lectures as a guest speaker, along with students' reflections on their experiences of guest speakers, it explores whether being a guest speaker can positively benefit the individual and/or their organisation as well as the students to create shared value. Responsible business is used as the focus of this research as it is an evolving topic within business management education, and an area of skills shortage and business challenge that may benefit from the real-world learning provided by guest speakers (Riebe et al. 2013; Krogstie 2017).

This study finds that students value the incorporation of guest speakers into lectures, particularly for the different perspectives and new ideas they bring to the classroom. This appears to be valued for both learning and engagement. In addition, the examples of real-world practices and practical insights provided by guest speakers may help students gain greater understanding of the complex chaos of sustainability they are likely to face in their future workplaces. This suggests that guest speakers can bring a better learning experience, one in which students may be encouraged to think more critically about sustainability topics and recognise real-world challenges. From the guest speakers' perspective, guest speaking can support the achievement of personal and corporate CSR objectives and provide new perspectives that would not otherwise be accessible. Speakers can gain access to students who are a pool of knowledge, innovation, and expectations, and may provide creative solutions to challenges being faced.

This paper initially considers the impact guest speakers can have on students, to establish the context for this research, and then explores the value of being a guest speaker from the wider perspective of their personal and organisational benefit. Through this, this paper will contribute to, and develop, two strands of discourse.

Firstly, on how business practitioners and/or their organisation can benefit from engaging with Business Schools as guest speakers, and secondly, on novel approaches to learning and teaching for responsible business that can promote students' knowledge and skills equipping them to survive in the real world after graduation. It will therefore be of interest to educators seeking innovative approaches to education, to those seeking to create shared value through smart partnering with Business Schools, to managers seeking opportunities to develop their CSR objectives and impacts, to future graduate employers who wish to contribute to developing employment skills within their future employees, and to those who simply want a new challenge.

2 Definition of a Guest Speaker

This paper adopts the definition of a guest speaker proposed by Fedoryshyn and Tyson (2003): a person from industry, the public sector, another part of the university, or from another university, who comes to give a guest lecture within the module; the lecture topic is relevant to the module's contents, learning goals and assignments and the module's students are the primary audience.

The motive for participating in lectures as a guest speaker varies between individuals according to their expectations and desired impacts. For example, motives for being a guest speaker range from participating to achieve their personal CSR objectives within their job appraisal, attempting to develop students' responsible business skills or simply wanting to give something back to society. Many only realise the value it can add to them after their lecture. Whatever the motive, each guest speaker will make a difference to each student; they may inspire students to move into a specific career path or be remembered long after students have left the Business School.

3 The Value of Guest Speakers

Although previous research identifies a limited number of educator benefits in utilising guest speakers, the bulk of the benefits received are focused on the value they add to students (for example Glenwick and Chabot 1991; Eveleth and Baker-Eveleth 2009; McClearly and Weaver 2009; Riebe et al. 2013; Krogstie 2017; Zheng et al. 2018; Hong et al. 2021). Despite some challenges being recognised, there is a long-held consensus on the benefits of utilising guest speakers in learning and teaching. These benefits occur in four areas: learning and student outcomes, the educational experience, engagement, and workplace readiness.

This previous research has, however, not explored the value being a guest speaker can offer a business practitioner in terms of value for their business. Some authors recognise generic opportunities from guest speaking which largely relate to personal development, for example, an opportunity to gain experience of public speaking,

network with academics and share their passion for their job (QMUL.ac.uk 2022; Borden 2017). To contribute to understanding the opportunity for shared-value creation through the contribution of guest speakers, which may in turn encourage more sustainability practitioners to exploit smart partnerships, this research explores the specific value of guest speaking from the students', educators, and guest speakers' perspectives.

4 The Value of Guest Speakers for Students

4.1 Value for Students' Learning and Outcomes

Research recognises benefits of using guest speakers to enhance engagement, disseminate practice wisdom, and bring the real world to classroom (Metrejean et al. 2002; Eveleth and Baker-Eveleth 2009; Leor 2015; Li and Guo 2015; Merle and Criag 2017). They can also enrich the curriculum (Riebe et al. 2013) and help students develop positive attitudes to, and find career opportunities, in future professions (Fedoryshyn and Tyson 2003; Kamoun and Selim 2007). By positioning the guest speakers as expert practitioners who bring experience and insight to class to add value to the students' learning, students can be encouraged to engage and co-create knowledge to develop discourse, interest and recognise learning. This can promote academic continuity within the topics under discussion, in an interactive and collaborative environment that adds value to the students' learning journey, and develop students' confidence to become a change agent (Glenwick and Chabot 1991).

Guest speakers' insight can integrate theory and practice with course content which can enrich the curriculum (Riebe et al. 2013) and meaningfully contribute to students' learning (Athavale et al. 2008). Exposing students to multiple viewpoints through the inclusion of guest speakers, including insights into business that cannot be found in the educator's resources, may promote student involvement and critical thinking more effectively than a traditional lecture format (Metrejean et al. 2002; Payne et al. 2003; Robinson and Kakela 2006; Merle and Craig 2017). This reinforcement of course concepts from a different source may open students' minds to differing viewpoints and contemporary issues (Riebe et al. 2013) and enhance relevance for the students, which may add breadth to their learning (Li and Guo 2015).

Engaging a range of guest speakers from different for-profit and not-for-profit organisations and from different countries can encourage students to broaden their global and cultural awareness (Universities UK 2014). By exposing students to a range of different beliefs and a range of business cultures and by giving them the opportunity to challenge other people's views and to develop their own opinions, guest speakers can assist students to fulfil their potential to develop personal values and the needed business skills to become change agents. In addition, engaging in learning through discourse with guest speakers acting as role models who provide

expert content and inspirational teaching to support and guide students' learning in the 'complex chaos' that is responsible business may further develop students' confidence (Schumann 2019). In turn, this can promote self-reliance and self-efficacy, and support students to develop effective communication skills that enable them to a interact with range of different audiences and succeed in the real world (McClearly and Weaver 2009).

4.2 Value for Students' Educational Experience

Guest speakers have long been held to be a valuable pedagogic tool that adds real-life relevance to the curriculum (Jennings et al. 2010; Eveleth and Baker-Eveleth 2009; Riebe et al. 2013; Krogstie 2017). They are generally accepted to bring a better learning experience to a classroom as guest speakers provide an alternative perspective on a topic, offer variety in the teaching approach (Leor 2015), and aim to inspire students through presentations and advice (Study International 2019).

This better learning experience may be a direct benefit from offering variety in the way the class is taught (Leor 2015), because guest speakers can add relevance (Eveleth and Baker-Eveleth 2009) or through meeting students' expectations that guest speakers offer a better learning experience (Merle and Craig 2017). Riebe et al. (2013) link these benefits to the exposure of students to the real world of the workplace which can, in turn, emphasise or reinforce the significance of key employability skills for career success.

4.3 Value for Students' Engagement

Guest speakers are one of the most effective ways to engage students (Merle and Craig 2017; Leor 2015; Li and Guo 2015). Students' engagement is frequently related to the relevance perceived in the topics presented and approaches used by educators, such as 'student-based' sessions, the inclusion of real-world learning and future career opportunities (for example, Riebe et al. 2013; Dalakas 2016; Krogstie 2017). In addition, guest speakers bring variety to the way the class is taught, which may further add relevance to the classroom (Eveleth and Baker-Eveleth 2009; Hemphill and Hemphill 2007; Leor 2015). However, whatever the cause the outcome is beneficial as guest speakers can challenge disengagement, which is a growing problem for Higher Education (Yacek and Jonas 2019).

4.4 Value for Students' Workplace Readiness

Many authors consider that most graduates are not work ready or leave university ill-equipped to succeed in the complex environment of the workplace (Waddock 2007; Kavanagh and Drennan 2008; Rajaratnam and Campbell 2013; Govender 2016; Muller-Heyndyk 2019; Molinsky and Pisman 2019; Schumann 2019). Muller-Heyndyk (2019) consider the lack of graduates' softer skills such as leadership, negotiation, strategic thinking and planning particularly critical which Burke (2015) attributes to a disconnect between what is taught in the classroom and the needs of real-world business. There is also a disconnect between the motivation of students in their university career and the needs of businesses: students frequently take a degree as they see it as a passport to employment (Zepke and Leach 2010) and so become consumed by achieving a first-class degree. Many select modules to progress their preoccupation on grades, and do not recognise that employers want good attitude and ability (Molinsky and Pisman 2019). This makes many graduates hard to employ Burke (2015).

However, the incorporation of guest speakers into learning and teaching may help to develop more accurate workplace understanding and recognition of the value of attitudes, which can contribute significantly to students' expectations of, and preparation for, real-life work (Glenwick and Chabot 1991; McClearly and Weaver 2009; Riebe et al. 2013; Krogstie 2017). Ultimately this can promote students' softer employment skills such as collaboration, negotiation and influencing (Burke 2015). This may be because students can relate to guest speakers who bring the real world of work into the classroom, offer a chance to talk about career opportunities with expert practitioners, and encourage them to be actively engaged in their own learning (Riebe et al. 2013).

As guest speakers act as role models for students, they can encourage them to think more creatively and critically about topics that are part of the real world and likely to be faced in future workplaces (Gibson 2004; Leor 2015). Through this and the guest speakers' provision of practical knowledge and real-world examples, students may recognise the skills required for future career success (Burke 2015), which in turn could help them to develop confidence in their career choice, understand career opportunities or see the value of networking (Metrejean et al. 2002; Riebe et al. 2013; Dalakas 2016; Schumann 2019).

5 The Value of Guest Speakers for Educators

Previous research has identified several benefits for educators from incorporating guest speakers into learning and teaching. This generally focuses on helping educators to achieve the academic goals of the module to developing knowledge through smart partnerships with businesses. The academic goals can be supported through information sharing (Riebe et al. 2013; Merle and Craig 2017) and introducing

students to additional topics not included in the module contents (Leor 2015). Dalakas (2016) takes this further and suggests that through linking class concepts to real-world issues, analysing these further and recommending resolutions, guest speakers may help educators to accomplish specific learning objectives and desired outcomes. This approach may also help to build relationships with businesses (Riebe et al. 2013) and improve educators' knowledge (Leor 2015).

6 The Value of Guest Speaking for Guest Speakers

Studies into the value of guest speakers have generally focused on the student perspectives of value. However, whilst the value from the guest speaker's perspective has had limited investigation, it has been briefly considered as part of wider studies. For example, McKinsey (2018) adopts a smart partnering perspective and suggests volunteering to support lectures can contribute to an organisation's CSR objectives that seek to strengthen the business whilst contributing to society. Borden (2017), however, takes a personal perspective on the value of guest speaking and suggests a value can come from sharing views on the world or a passion for what the speaker does. This research seeks to explore the value of guest speaking for guest speakers further to establish a robust incentive for sustainability practitioners to participate more widely in education.

7 Challenges of Engaging Guest Speakers

Although there is a general recognition that guest speakers can add value to the students' learning experience, there are also challenges that should be considered in exploring the value of guest speakers. These relate both to the logistics of the sessions and to the current Higher Education environment in which students are overly focused on personal module outcomes, i.e., their grades at the expense of learning (Knesek 2022).

Challenges include, firstly, the ability to recruit guest speakers, which is frequently affected by mismatches of the guest's time availability and the scheduled class (Schumann 2019). This challenge is worsened by the ability to obtain support from the guest speakers' employers as operational needs may take priority over the speaking event (Lashley 2011; Sniezek 2005). Secondly, the success of the guest speaker requires the educator to do more than simply inviting the speaker (Lang 2008); a guest speakers' presentation should be structured around the module contents to contribute to the established learning objectives and add breadth to learning (Dalakas 2016; Li and Guo 2015) and/or career advice and networking tips (Hong et al. 2021). Thirdly, the contents and format of the guest speaker's session will influence the benefits perceived by the students (Merle and Craig 2017) as it can frequently appear a speaker-centred passive activity which is less appealing to them (Rodrigues 2004;

Li and Guo 2015; Schumann 2019). Fourthly, the inability of the guest speaker to engage the student audience, or as a minimum hold their attention, will impact the session's value for learning (Schumann 2019). This is particularly challenging for pre-recorded guest speakers' sessions and sessions where students fail to grasp the significance and relevance of the guest speakers' inputs. Taylor et al. (2004) and Li and Guo (2015) suggest these offer little student benefit. Fifthly, tutors can waste time and effort in arranging guest speaker sessions if they simply repeat lecture material (Study International 2019). Sixthly, although students generally find a visit from guest speakers enjoyable, they are not necessarily challenging and their contribution may be unclear so that they may inhibit student engagement (Karns 2005; Dalakas 2016). Finally, without considerable time spent with the guest speaker, the tutor can be unsure of the content and whether it will fit into the module content thus limiting the relevance for students (Schumann 2019). Despite the challenges described above Riebe et al. (2013) suggest that using guest speakers is worth the effort of recruiting them as it meets Higher Education Institutions' aims of engaging with businesses, and it is an effective way of motivating students to recognise the value of learning about workplace skills, which has recently become renamed 'Graduate Attributes'.

8 Emerging Recognition of Opportunities to Enhance the Guest Speaker Experience

The opportunity to enhance the value of guest speakers for students' engagement, involvement in their learning, development of creative thinking and critical analysis, and the development of workplace readiness has been recognised. Generally, this focuses on simple interventions such as interesting and engaging guest speakers presenting themed guest presentations, hands on workshops and small group conversations (Riebe et al. 2013; Leor 2015; Merle and Craig 2017; Zheng et al. 2018).

Consideration of students' perception of relevance appears key to ensuring a successful guest lecture. This can be achieved by recruiting guest speakers from the business sector aligned to the module who provide personal examples and career advice rather than a slide-based lecture (Merle and Craig 2017). The contents of the guest's session should reinforce the course content (Glenwick and Chabot 1991; Lang 2008; Eveleth and Baker-Eveleth 2009; Roush 2013; Zheng et al. 2018), whilst students should be encouraged to reflect on their learning from the guest speaker, their understanding of its applicability to the overall module and their development of employment skills in order to reinforce its relevance and their personal responsibilities for engagement and learning (Taylor et al. 2004; Riebe et al. 2013).

9 Methodology

To explore the value of guest speaking for the guest speaker and the value of a guest speaker for the student two surveys were undertaken during the academic years 2019–2020 and 2020–2021: one with students and the other with the guest speakers. The survey of students was conducted with third year undergraduate Business Management students taking a single semester Environmental, Social and Governance module; the survey of speakers was conducted with the 6 guest speakers contributing to the module. 117 students participated in the survey: 45 in 2019–2020 and 72 in 2020–2021.

A short qualitative online survey asking students 3 questions was used. This asked them to reflect and answer, firstly, "What benefits and challenges do you obtain/experience when you have a guest speaker in class?", secondly, "What value have this module's guest speakers added to your learning?" and thirdly, "If you could have more guest speakers in this module, what would you like them to talk about?" Qualitative responses were requested to ensure the students' voices were heard. These questions were chosen to encourage reflection on their engagement with, and learning opportunities from, the guest speakers. Guest speakers were asked to simply reflect on their experiences of participating in the lectures.

A thematic analysis of the participants' responses was undertaken across each of the three questions asked to identify the key themes emerging from participants' responses. The findings are presented both qualitatively and quantitatively. These are presented as a summary of the top 5 values for learning and engagement and the most preferred preferences for each future guest speakers along with a comparison of the values for learning and engagement (Table 1). The scale of the themes emerging were then calculated for each question as a percentage of the total responses given. These are shown graphically in the findings below (Fig. 1) to offer a comparison of the scope and scale of perceived values within and between each question and between learning and engagement. The findings from this analysis are discussed in relation to previous research and illustrated with students and speakers' reflections.

10 Findings and Discussion

10.1 The Value of Guest Speakers to Students

From the thematic analysis of students' responses, the themes were ranked by number of responses and the top 5 by scale of response were established for learning value and engagement value from the students' perspective. This is shown in Table 1. Table 1 also shows the top 5 preferences for future content to establish the success of current guest speakers' sessions and what could be enhanced for future sessions.

The thematic analysis of students' responses is shown graphically in Fig. 1. Overall, the study suggests students value the different perspectives offered by guest

Table 1 Top 5 students' perspectives of guest speakers

Value for learning	Value for engagement	Preference for future guest speakers' content
Different perspectives provided	Different perspectives provided	Support for course work and assignments provided
Adds a variety for normal lectures/seminars	Real world examples provided	Include speakers' roles/responsibilities and career path
Real world examples provided	Support for course work & assignments provided	Provide different perspectives
Practical insights from an experienced practitioner	Practical insights from an experienced practitioner	Explain speaker's content to lecture topics
Additional knowledge of sustainability provided	Additional knowledge of sustainability provided	Include recommendations on how businesses could improve sustainability practices

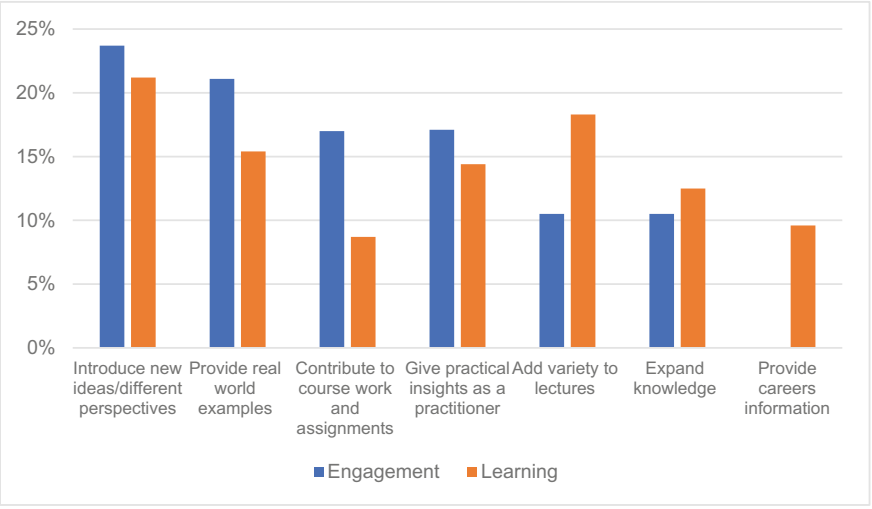

Fig. 1 Students perception of value of guest speakers for engagement and learning using criteria from the thematic analysis of survey responses

speakers, and the new ideas they bring to class, for both learning and engagement. Over 20% of the responses to the first and second questions highlighted students recognised their engagement with guest speakers and their learning from them. For example, students reported:

> I like the different perspectives guest speakers can bring.
>
> It gives another perspective and helps develop a wider understanding.
>
> A different perspective and its always interesting to listen to someone new.

This supports the views of Leor (2015) and Study International (2019) that guest speakers bring a better learning experience as they provide alternative perspective on a topic. This has previously been aligned to the variety of approach that guest speakers can add to lectures (Eveleth and Baker-Eveleth 2009; Leor 2015) and is supported by this study.

The students' responses suggest the real-world examples and practical insights provided by guest speakers are valued but to a lesser degree than the different perspectives. Real world examples appear to be more valuable for engagement than learning (21 vs 15%). Students reflected:

> It brings a real-life example to those theories we learn through the module.
>
> It gives insight into how sustainability links to real world work.
>
> It's good to hear about someone else's experience and how the education material is fitting the real world.
>
> Guest speakers can show real life examples and bring the theories that we are learning into the business world.

This engagement with the real-world examples of sustainability practices provided by guest speakers supports the views of Merle and Craig (2017), Leor (2015) and Li and Guo (2015) who consider guest speakers are one of the most effective ways to engage students. Students reported:

> We can see the applicability in real-life situations.
>
> It is nice having experts on certain topics who can give you their point of view of things and they complement very well to our classes and lectures.
>
> It is really cool to see the theory in action.

The survey findings suggest that some students may be able to use these real-world examples to understand more about sustainability they are likely to face in their future workplaces. For example, students reported,

> It gives insight into how sustainability links to real world work.
>
> It's good to see another person's perspective from the business world and how they try to solve sustainability problems in their day-to-day work.

Whilst students appear to relate the guest speakers to the real world of work, the author recognises they did not take the opportunity to talk about career opportunities as suggested by Riebe et al. (2013). Overall, less than 2% of students responding to the survey reported they valued guest speakers as they provided a more accurate workplace understanding. This opposes the views of Glenwick and Chabot (1991), McClearly and Weaver (2009), Riebe et al (2013) and Krogstie (2017) who advocate adding guest speakers to teaching practice to advance workplace understanding.

From the author's perspective it is pleasing that guest speakers within this study have helped to achieve the learning objectives of the module as suggested by Dalakas (2016). In this study this has emerged through the linking of class concepts to real world issues. Students reported:

> It's good to hear about someone else's experience and how the education material is fitting the real world.

> I enjoy having guest speakers because they often relate the academic learning to the real-world learning.

> I think it's good to see another person's perspective from the business world and how they view certain topics and how they try to solve certain problems etc in their day-to-day work.

However, despite supporting previous research this study challenges the expectations of Riebe et al. (2013), Dalakas (2016) and Krogstie (2017) related to students' engagement with the provision of future career opportunities. This study suggests students place limited value on the inclusion of future career opportunities in guest speakers' sessions, with only 10% of responses to question 2, and none for question 1, indicating students value such information. Whilst this may not support the need to develop graduates with skills to work (Burke 2015; Chartered Management Institute 2021) or an understanding of potential future sustainability roles, the ability of guest speakers to engage students is beneficial as the findings suggest their sessions still challenge disengagement, which is a growing problem for Higher Education (Yacek and Jonas 2019).

A few students suggest the guest speakers engaged in this study could be considered role models who may encourage them to think more critically about sustainability topics as reported by Gibson (2004) and Leor (2015). For example, a students reported,

> It is very informative to hear from experienced individuals, especially if they go into detail and give tips.

As guest speakers in this study all presented their career path and potential career opportunities, the lack of value placed by students on career information is not due to lack of information. However, contributing factors may be a lack of familiarity with business careers and the language used by the guest speakers, limited recognition of the information provided as career based or their key focus on the guest speakers' potential to contribute to their assignment which the participants' reflections suggest is most likely. For example, students reported:

> Guest speakers are only useful if they are relevant for the assignment.

> I only like having guest speakers when they are relevant to the coursework we are doing at the time.

Further research to understand how to overcome students' limited recognition of the workplace advice available and preoccupation with their grades is required, particularly if educators within Business Schools are to address the criticisms of not producing work ready graduates.

Despite the students recognising the value of guest speakers, many of their comments come with a caveat, emphasising their need for guest speakers to deliver personal value which appears for this study to be engagement and a contribution to their assignments. For example, students reported,

> Guest speakers are only interesting if they can relate their work to our assignments.
>
> Sometimes guest speakers can be used to fill a week rather than give any benefit to the students.
>
> As long as the guest is as interesting and engaging as our lecturers it is a welcomed change/inclusion.
>
> I like guest speakers if they are not just coming in to talk about themselves.

These students' responses support the view of Knesek (2022) that students' focus on grades overshadows the desire for knowledge and learning. Consequently, the knowledge provided by guest speakers appears to be considered to offer little value when compared to the different perspectives, real-world examples and practical insights offered that can support assessment success.

Disappointingly, the development of sustainability knowledge appears to have less value for students' perception of learning inputs than different perspectives provided by guest speakers, it does not appear in the 5 key opportunities to develop guest speakers for future interventions shown in Table 1. It may be that students equate a guest speaker's opinion as knowledge and so believe the different perspectives encountered deliver knowledge. Additional work is needed to promote an understanding that information provided does not necessarily give an individual the required knowledge for a successful future.

The ability of guest speakers to add variety to the teaching approach appears to be less important for engagement than learning (11 vs 18%). The limited reflections relating variety in teaching to enhancing engagement appears to be at odds with previous research. Hemphill and Hemphill (2007), Eveleth and Baker-Eveleth (2009) and Leor (2015) suggest students will respond to the variety in teaching as they are provided with a better learning experience. However, this study suggests students do not always value a different approach,

> Some guest speakers … just confuse things.
>
> When the guest speaker spoke … it was difficult to know whether to trust his advice.

In establishing what students would prefer in future guest speakers' sessions (Table 1), a focus on providing inputs and support for coursework and assignments is clearly valued. This unfortunately suggests that students remain driven by self-interest and grades as opposed to knowledge, softer employment skills and attitude which are key expectations of graduate employees. It is noticeable that the only item currently valued for learning and engagement that students want to see in the future is the different perspective provided by guest speakers.

The preference for details of a guest speaker's role, responsibility, and career path offers a quick win in adding value to future guest speakers' sessions. Whilst this was included by all guest speakers presenting over the two years of the study it appears it needs to be more explicitly included and emphasised throughout. Greater explanation of the alignment of the guest speaker to the module topic would also add value for students.

10.2 The Value of Being a Guest Speaker

Consideration of the potential value of being a guest speaker from the guest speakers' perspective has been generally excluded from previous research. To attempt to fill this gap and establish whether business benefits and/or personal value can be achieved by guest speaking, this study collected reflections from guest speakers on their experiences in the classroom. Overall, the sustainability practitioners suggest supporting the students' learning by being a guest speaker is enjoyable, satisfying, and rewarding. For example, a guest speaker recognised:

> It's always a pleasure to work directly with students and I look forward to it. Whilst the business school thinks I might be doing them a favour, it is the exact opposite.

This enjoyment, satisfaction and reward received from being a guest speaker may appear to students as inspiring and relevant and so encourage students to engage with the session (Riebe et al. 2013). This suggests the positive impact of guest speakers may be received by both students and the business practitioner involved.

Guest speakers overwhelmingly recognised that value of hearing the students' opinions on environmental, social and governance within businesses. Guest speakers reflected,

> It is a very valuable opportunity to garner young people's opinions, which are freely given.

> I always go away with a fresh and different 'to do' list.

The students can provide new viewpoints on potential business practices, strategies, and interventions in our increasingly environmentally and socially conscious business environment. This opportunity can deliver value for both sustainability practitioners and students as it can enable the students to feel their voice is heard, which helps to build self-confidence and confidence in the guest speaker (Metrejean et al. 2002), and encourages business practitioners to use the expertise of students to find creative solutions to challenges being faced.

For business practitioners, the students are a pool of knowledge, innovation and expectations representing potential current and future customers, employees, and advocates. By discussing sustainability practices with students, guest speakers can gain new perspectives that would not otherwise been accessible (Keys et al. 2009). This in turn can lead to the adoption of CSR activities and objectives that offer real benefit to society. Guest speakers recognised the value this opportunity:

> Getting feedback from fresh pairs of eyes is invaluable. The insights the students bring invariably make me think and reassess.

> You realize what are the challenges and the opportunities you haven't notice before, you learn from the experience of other people, you adopt some smart practices.

Sustainability practitioners contributing to learning and teaching as guest speakers also recognised the opportunity it offers to inspire students to consider responsible business careers. One guest speaker reported,

> I enjoy providing an insight into sustainable procurement as this area of work is not always obvious from the outside. Hopefully, it will provide a little inspiration to a new generation.

The engagement of students in setting or reviewing sustainable business objectives and public reporting, which are growing areas of CSR, can add value to both the business and students. Objectives can be influenced indirectly through guest speakers' discussions with students or directly by acting as a guest speaker to complete a personal appraisal objective. Whether the guest speakers' input is direct or indirect, the guest speaker's smart partnership can enable an organisation to strengthen its' business responsibility by incorporating students' ideas on improving corporate reputation and attracting, retaining, and motivating employees, which can reduce corporate risk, whilst improving contributions to society (Keys et al. 2009).

Whilst this study supports the previous understanding of the value of guest speakers for students, it has identified a range of opportunities that can benefit the speakers themselves and their organisations which had not previously been considered. Despite the positive values for both the speakers and students, this study also recognises new challenges for the educator to address to ensure this approach to teaching maximises its' potential shared value. The key challenge may be the students' perception of the purpose and relevance of the guest speaker, which is clearly aligned to expectation of personal gain from participating in the session. For example, a student suggested,

> I don't think the guest speaker was specific enough for our module and assignment.

This may affect the benefits available to the guest speakers themselves as their portion of the shared value available comes from student inputs.

11 Summary of Findings and Future Opportunities

This study finds incorporating guest speakers into lectures can add benefits for students and guest speakers; benefits that both students and guest speakers clearly recognise. For students the benefits have emerged in four areas: engagement, learning, educational experience, and workplace readiness. These benefits appear to emerge from the different perspectives and real-world learning provided by sustainability practitioners and particularly from the belief that guest speakers can add information for assignments.

Students' reflections suggest the different perspectives and new ideas that guest speakers bring to the classroom are valued for both learning and engagement. This supports previous studies' findings that guest speakers offer an effective learning experience (Eveleth and Baker-Eveleth 2009; Leor 2015; Study International 2019); one in which students may be encouraged to think more critically about sustainability topics and recognise real-world challenges (Gibson 2004; Leor 2015).

The study also suggests that students find the real-world examples provided by guest speakers engaging and insightful. The value students place on these examples

and insights may in turn help to promote workplace readiness as they emphasise the skills needed for a successful career. This supports the conclusion that guest speakers can contribute to students' preparation for real life work (Glenwick and Chabot 1991; McClearly and Weaver 2009; Riebe et al. 2013; Krogstie 2017; Hong et al. 2021), possibly because guest speakers' personal experiences can help students gain greater understanding of the complex chaos of sustainability they will face in their future workplaces (Schumann 2019).

However, the study also finds students' engagement and learning is framed by their perceptions of relevance. It proposes students' preoccupation with grades drives their perceived relevance of, and interest in, the guest speakers' input, i.e., will it give personal benefit or help with an assignment? Sustainability knowledge per se appears to have less value for students' perception of relevance. This may suggest that knowledge is not understood to be a prerequisite for a successful assignment outcome. This is disappointing as it appears students remain driven by self-interest and grades rather than the knowledge, softer employment skills and attitudes that are graduate employers' key expectations of graduate employees. Nonetheless, this provides an opportunity for educators. By working with the guests to promote relevant content, and with students to align the session to their self-interest, the potential learning experience can be enhanced.

From the guest speaker's viewpoint, the study suggests guest speaking is generally considered an enjoyable, satisfying and rewarding experience through which they can gain personal value as well as value for their organisation. For example, guest speakers can contribute to personal or corporate CSR objectives or obtain new perspectives on sustainable challenges that would not otherwise be accessible. These new perspectives may emerge as speakers have access to students who are a pool of knowledge, innovation, and expectations, and represent the customers, employees and advocates of the future who may provide creative solutions to challenges being faced.

To further understand the benefits of including guest speakers in lectures from the students', educators', and guests' perspectives, and how to overcome the challenges of using them, this study can be extended or replicated elsewhere. The author intends to extend it over the next 2–3 years within the module that is the focus of the current study and to extend it to additional modules. This will enable the current findings to be validated and opportunities to further develop the role of guest speakers as an effective teaching tool to be further explored. Through this it is hoped to identify drivers of generic and specific employment and life skills, that can promote the wider understanding of, and contributions to, the Sustainable Development Goals.

12 Limitations of This Study

This study has been conducted over a two-year period with a limited number of students and guest speakers which prevents conclusive findings from being reported. However, the findings can be used to illustrate the benefits from incorporating guest

speakers into lectures for both students and guest speakers. It is recommended that this is explored further in future research.

In addition, this study presents the findings of a self-reported study, which may be considered to affect its validity. However, despite the long running debate over the use of self-reported data in which its accuracy and appropriateness has been questioned (e.g., Porter 2009; Pascarella et al. 2010) and its reliability and trustworthiness established (e.g., Pohlmann and Beggs 1974; Astin 1977; Pace 1985), there is now a consensus that studies using higher education students' self-reported data are valid. In fact, Pike (2011) goes further and advocates using students' self-reported reflections within research as they can offer specific benefits such as helping to address challenges such as students' relationships with higher education, learning preferences, engagement, and outcomes.

13 Conclusion

This study supports previous research which advocates guest speakers as a beneficial addition to the normal curriculum. It, however, extends the previous concept of benefit by considering whether guest speakers and/or their organisation can share the value available from the speaking session with the students. Reflections from guest speakers and students suggest that shared value can be gained as the speaking session is generally enjoyable, satisfying and rewarding for the speaker which in turn appears to inspire students and drive engagement if it is related to real life and, most importantly, relevant. The guest speakers also highlight the value they gain from the opportunity to understand the viewpoint of the students who represent future customers, employees, and sustainability advocates.

However, the availability of shared value must be treated with caution. Although shared value from guest speaking is accessible to speakers and students, educators need to overcome challenges from logistics and relevance. Without the clear understanding of relevance this study suggests students may not engage and therefore prevent shared value being created.

References

Astin AW (1977) Four critical years: effects of college on beliefs, attitudes, and knowledge. Jossey-Bass, San Francisco

Athavale M, Davis R, Myring M (2008) The integrated business curriculum: an examination of perceptions and practices. J Educ Bus 83:295–301

Borden J (2017) Incorporating guest speakers into the classroom experience. https://www.kuder.com/blog/career-counseling-coaching/incorporating-guest-speakers-into-the-classroom-experience/. Accessed 15 May 2022

Burke C (2015) Culture, capitals, and graduate futures: degrees of class. Routledge, London

Chalkley B (2006) Education for sustainable development: continuation. Geogr High Educ 30(2):235–236
Chartered Institute of Business Schools (2016) Business schools and the public good. https://charteredabs.org/wp-content/uploads/2021/06/Chartered-ABS-Business-Schools-and-the-Public-Good-Final-1.pdf. Accessed 23 May 2022
Chartered Management Institute (2021) Work ready graduates: building employability skills for a hybrid world. https://www.managers.org.uk/wp-content/uploads/2021/09/employability-skills-research_work-ready-graduates.pdf. Accessed 18 May 2022
Dalakas V (2016) Turning guest speakers' visits into active learning opportunities. Atl Mark J 5:93–100
Drayson R (2015) Employer attitudes towards, and skills for, sustainable development. https://www.heacademy.ac.uk/knowledge-hub/student-attitudes-towards-and-skills-sustainable-development-2015. Accessed 24 May 2022
Eveleth D, Baker-Eveleth L (2009) Student dialogue with online guest speakers. Decis Sci J Innov Educ 7(2):417–421
Fedoryshyn M, Tyson T (2003) The impact of practitioner presentations on student attitudes about accounting. J Educ Bus 78(5):273–284
Gibson D (2004) Role models in career development: new directions for theory and research. J Vocat Behav 65(1):134–156
Glenwick D, Chabot D (1991) The undergraduate clinical child psychology course: bringing students to the real world and the real world to students. Teach Psychol 18(1):21–24
Govender I (2016) Evaluating student perceptions on the development management curricula to promote green economy. Environ Econ 7:1–10
Hemphill L, Hemphill H (2007) Evaluating the impact of guest speaker postings in online discussions. Br J Educ Technol 38(2):287–293
Hong J, Parul J, Axinn C (2021) Student perceptions of guest speakers in strategic communications courses. J Public Relat Educ Res 7(1):40–79
Jennings G, Kensbock S, Kachel U (2010) Enhancing 'education about and for sustainability' in a tourism studies enterprise management course: an action research approach. J Teach Trav Tour 10(2):163–191
Kamoun F, Selim S (2007) A framework towards assessing the merits of inviting IT professionals to the classroom. J Technol Educ 6:81–103
Karns G (2005) An update of marketing student perceptions of learning activities: structure, preferences, and effectiveness. J Market Educ 27:163–171
Kavanagh M, Drennan L (2008) What skills and attributes does an accounting graduate need? Evidence from student perceptions and employer expectations. Account Financ 48(2):2–28
Keys T, Malnight T, van der Graaf K (2009) Making the most of corporate social responsibility. https://www.mckinsey.com/featured-insights/leadership/making-the-most-of-corporate-social-responsibility. Accessed 14 May 2022
Knesek G (2022) Why focusing on grades is a barrier to learning. https://hbsp.harvard.edu/inspiring-minds/why-focusing-on-grades-is-a-barrier-to-learning. Accessed 14 May 2022
Krogstie B (2017) Teachers' use of business networks in higher IT education. In: Norsk conference on organizational use of IT (NOKOBIT), vol 25(1)
Lang J (2008) Guest speakers. http://www.chronicle.com/article/Guest-Speakers/45746/. Accessed 28 May 2022
Lashley C (2011) University challenge: sharing some experiences of engaging with industry. Internat J Contemp Hosp 23(1):131–140
Leor K (2015) Guest speakers: a great way to commit to education. J Best Teach Pract 2(2):21–23
Li L, Guo R (2015) A student-centered guest lecturing: a constructivism approach to promote student engagement. JIP 15:1–7
McCleary K, Weaver P (2009) The effective use of guest speakers in the hospitality and tourism curriculum. J Teach Trav Tour 8(4)

McKinsey (2018) Smart partnering' for both business and societal benefit. https://www.mckinsey.com/~/media/McKinsey/Email/Classics/2018/2018-03-CL.html?cid=other-eml-cls-mip-mck-oth-1804. Accessed 27 May 2022
Merle P, Craig C (2017) Be my guest: a survey of mass communication students' perception of guest speakers. J Coll Teach 65(2):41–49
Metrejean C, Pittman J, Zarzeski M (2002) Guest speakers: reflections on the role of accountants in the classroom. J Account Educ 11(4):347–364
Molinsky A, Pisman S (2019) The biggest hurdles recent graduates face entering the workforce. https://hbr.org/2019/04/the-biggest-hurdles-recent-graduates-face-entering-the-workforce. Accessed 22 May 2022
Muller-Heyndyk (2019)
Pace C (1985) The credibility of student self-reports. UCLA Center for the Study of Evaluation, Los Angeles. https://eric.ed.gov/?id=ED266174. Accessed 12 June 2022
Pascarella E, Seifert T, Blaich C (2010) How effective are the NSSE benchmarks in predicting important educational outcomes? Chang Mag High Learn 42(1):16–22
Payne B, Sumter M, Sun I (2003) Bringing the field into the criminal justice classroom: field trips, ride-alongs, and guest speakers. J Crim Justice 14(2):327–344
Pike G (2011) Using college students' self-reported learning outcomes in scholarly research. New Dir Inst Res 41–58
Pohlmann J, Beggs D (1974) A study of the validity of self-reported measures of academic growth. J Educ Meas 11(2):115–119
Porter S (2009) Do college student surveys have any validity? Rev High Educ 35(1):45–76
QMUL.ac.uk (2022) Becoming a guest speaker. https://www.qmul.ac.uk/busman/about/school-leadership/volunteering-with-the-school/guest-speaking/. Accessed 12 May 2022
Rajaratnam K, Campbell A (2013) Enhancing students learning through practical knowledge taught by industry professionals. Int J Econ Res J 12(6):717–724
Riebe L, Sibson R, Roepen D, Meakins K (2013) Impact of industry guest speakers on business students' perceptions of employability skills development. Ind High Educ 7(1):55–66
Robinson C, Kakela P (2006) Creating a space to learn: a classroom of fun, interaction, and trust. Coll Teach 54(1):202–207
Rodrigues C (2004) The importance level of ten teaching/learning techniques as rated by university business students and instructors. J Manag Dev 23(2):169–182
Roush C (2013) The effective use of guest speakers. http://www.aejmc.org/home/2013/03/guest-speakers/. Accessed 15 May 2022
Schumann H (2019) The use of student-copresented virtual guest speakers in entrepreneurial education. J Bus Educ 94(6):418–422
Sniezek T (2005) Avoiding the pitfalls of the invited speaker. Exchanges: the on-line journal of teaching and learning in the CSU. http://www.calstate.edu/itl/exchanges/classroom. Accessed 22 May 2022
Study International (2019) The real-world value of university guest speakers. https://www.studyinternational.com/news/real-world-value-university-guest-speakers/. Accessed 18 May 2022
Taylor S, Humphreys M, Singley R, Hunter G (2004) Business student preferences: exploring the relative importance of web management in course design. J Mark Educ 26:42–49
United Nations Educational, Scientific and Cultural Organisation (2011) Definition of education for sustainable development. http://www.unescobkk.org/fr/education/esd-unit/definition-of-esd/. Accessed 14 May 2022
Universities UK (2014) External speakers in higher education institutions. https://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2013/external-speakers-in-higher-education-institutions.pdf. Accessed 21 May 2022
Waddock S (2007) Leadership integrity in a fractured knowledge world. Acad Manag Learn 6:543–557
Yacek D, Jonas M (2019) Philosophical inquiry in education, the problem of student disengagement: struggle, escapism and Nietzsche's birth of tragedy. PIE 26(1):64–87

Zepke N, Leach L (2010) Improving student engagement: ten proposals for action. Active Learn High Educ 11(3):167–177
Zheng S, Chen Y, Wang X, Hoffmann C, Volkov A (2018) From the source: student centred guest lecturing in a chemical crystallography class. J App Crystallogr 1:909–914

Infusing Design Thinking into Teacher Preparation: Connecting Learners and Stakeholders Through Classroom-Based Discussions About Local Sustainability Concerns

Timothy G. Thomas

1 Introduction

The United Nation's 2030 Agenda for Sustainable Development holds 17 goals which require a global strategy to bolster the global systems upon which all life depends. These urgent goals call for universal action around economics, public health, and stewardship of natural resources. In the end, the 17 Sustainable Development Goals (SDGs) seek improved quality of life for all living things, with diminished poverty and hunger, and improvements for schools and healthcare facilities (United Nations [UN] Department of Economic and Social Affairs 2022).

In order to function as part of a solution to establish sustainable systems for long-term survival of the planet, U.S. teachers preparing to teach in the Kindergarten through twelfth grade years (K-12) must receive revolutionary training. Collegiate Education programs must prepare teachers to administer a range of alternative assessments that invite K-12 students to apply classroom knowledge to social and environmental systems in their locality.

This paper presents a framework through which U.S. educators may create lessons to engage learners with principles of sustainable design through participatory design approaches in K-12 classrooms. A design-thinking approach requires colleges to modify the traditional training that teachers receive through their Education coursework. This design-thinking approach invites learners to examine their surroundings, and as a result, to learn about local sustainability issues. Through lessons rooted in the locality, this framework can nurture a sense of agency among learners who can ultimately take action as informed stakeholders in their communities.

Design thinking is a specific collaborative practice developed in design institutes that situates human problems and human voices at the center of problem-solving.

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This method invites a divergent set of perspectives (Brown and Wyatt 2010) and seeks solutions that are informed by many voices (Chan 2018). Design thinking opens up the design process to home in on resource needs in a locality (Staszowski 2018) and recruits many disciplines to address stakeholders' concerns (IDEO 2012; Miller 2015). One illustration of a design-thinking project implemented in a collegiate classroom is the Huxtable Fellowship at Boston Architectural College (BAC). Through this project, students interviewed residents and studied climate change models to exhibit prototypes for improvements to an existing apartment building site (Peterson 2018).

Educators play a central role in the perceptions that young learners develop regarding their own connections to a place and, by extension, to the health of the people who inhabit the rest of the planet. This paper surveys the literature on participatory design to suggest ways that K-12 educators must involve learners in an inquiry process to apply classroom lessons to occurrences in their locality. In the end, this paper posits an inventory of pedagogical skills that teachers must acquire in their collegiate training. These skills will enable teachers to guide learners through participatory design projects that will display their learning about local resources in their locality.

A design project that illuminates the SDGs in a locality will seem foreign to many educators. The instructional approaches and assessments required for design projects are not within the training that K-12 teachers have customarily received. High-stakes, standardized testing has dictated the majority of teachers' work in the U.S. during the past 35 years. However, these standardized approaches have little to contribute to design thinking in classrooms. For example, teachers might deliver lessons that feature design thinking outside of typical classroom settings. Evaluation of design projects will require steps that are more complicated and multi-disciplinary (Anderson 2018) than the standardized tests to which schools have become accustomed, and an exhibition format such as the atelier (Sect. 4.1) will invite authentic demonstrations by learners to display new understandings they have acquired. Over the course of a project, educators will gauge both the content knowledge and personal growth of individual learners that evolve (Bland and Gareis 2018). Therefore, in order to develop design thinking lessons that study the SDGs in a locality, collegiate teacher training must prepare Education majors with innovative assessment skills (Harris 2021).

2 Literature Review

At the heart of sustainable solutions lies effective, inclusive design. Through participatory design projects situated in a locality to which learners have connection and with which they are familiar, educators can build on learners' attachment to a place and illuminate awareness and action connected to sustainable development. The following review explores the literature on place connection, learner agency, and participatory design.

2.1 Place Connection

Actions that meet the requirements of the SDGs will begin with the individuals who feel connected to the places in which they live, learn, work, and play. This connection influences an individual's time spent in these places (Cundill et al. 2017) and is a strong predictor of the environmental stewardship an individual will exhibit there (Gottwald and Stedman 2020; Hubbard 1993; Newman et al. 2017; Scannell and Gifford 2010a, b; Vaske and Kobrin 2001; Williams and Vaske 2003). The connection that individuals can attach to a place has been shown to affect the quality of decision-making around conservation projects in places that individuals and communities hold as significant (Clayton 2003; Newman et al. 2017; Smith et al. 2012).

Social-ecological systems (SESs) are the set of interdependent relationships that "are mediated through interactions with biophysical and non-human biological units" (Skog et al. 2018, p. 1). Skog et al. studied local food systems in Vermont and found that the following traits at work in SESs made them resilient. The systems:

- were rooted in the local community
- were built on local knowledge and identities
- held cross-sector/multi-stakeholder involvement
- prioritized feedback loops for information and reflection
- promoted collective efforts for engaging a range of stakeholder groups (p. 12).

Researchers noted that the resilience and sustainability of these systems emerged as individuals recognized a shared identity within the system and a common responsibility to care for the system.

2.2 Learner Agency

Outside of school, young learners collect multiple experiences each day, but their academic activity at school does not often include or value their experiences, particularly their experiences in Nature. Schools serve a vital function for developing student agency and a personal connection to a locality (Kumpulainen and Ouakrim-Soivio 2019). However, educators have limited opportunity during which young learners are open to lessons about sustaining the natural resources of a place (Kossack and Bogner 2012). In order for schools to prepare students who adopt practices with SDGs, learners must be presented with the knowledge, awareness, and skills to take action.

Agency is defined as a confidence in action and attitude that young people develop over time and with guidance (Kumpulainen et al. 2014). The occurrences that lead learners to experience agency include learners having opportunities to become recognized for their work, observing that their actions have some impact on the world, and taking action of their own volition (Kajamaa and Kumpulainen 2019; Kumpulainen et al. 2014; Sairanen et al. 2020).

However, as institutions, schools themselves may be ill-equipped to connect classroom lessons to learner's independent experiences in Nature. Lessons focus on the acquisition of new information and rarely draw on learners' personal experiences (Rajala et al. 2013). Even in the elementary Science classroom, learners' experiences in Nature rarely earn a mention (Carrier et al. 2013; Simms 2020; Tugurian and Carrier 2017). Science teachers find it difficult to teach lessons outdoors (Carrier et al. 2013), while learners surrender their personal connections with Nature for an academic experience about Nature comprised of notetaking and "decontextualized facts" (Tugurian and Carrier 2017, p. 149).

Indeed, learners do experience identifiable applications of rich academic content in their lives outside of school. In learners' homes, Moll et al. (1992) identified operational *funds of knowledge*—"historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being" (p. 133). At home children participate actively in daily life. They can help with chores, act as translators, and contribute to household income. In these settings, children are guided by their own interests and questions, a benefit not often present in classrooms. *Participatory pedagogy*, lessons which build on learners' interests, experience, and expertise from their lives outside of school, is an alternative educational approach which educators can employ to increase learners' investment in lessons.

Because increased learning about Nature does not necessarily yield increased pro-environmental behavior from learners (Kollmuss and Agyeman 2002), instruction should be intentionally timed and structured to provide lessons about the SDGs. These lessons can include models of sustainable actions as well as school-based opportunities to promote applications of classroom content into everyday experience. By replacing teacher-centered activities with structured lessons for children's reflection and independent participation, educators guide learners to develop personal agency (Kumpulainen and Ouakrim-Soivio 2019). Involving young learners with hands-on projects promotes positive conservation attitudes (Hirst 2019), and the early formation of a childhood connection to Nature continues to evolve into and through adulthood (Clayton 2003; Kals and Ittner 2003).

2.3 Participatory Design

Participatory design offers a significant fit for K-12 lessons as the natural structure of classwork can be conducive for design thinking. Lessons provide opportunities for give and take among participants and often encourage thoughtful risk-taking—both of these traits will enhance design thinking in lessons that feature the SDGs. Manzini (2014) highlights the significant roles that design and collaboration can play in catalyzing conversations about the management of local resources. He notes that designers can bring together stakeholders from diverse backgrounds to collaborate on solutions for their mutual well-being in a sustainable future. BASE Milano (2021), a creativity think-tank focused on public/private collaborations, dedicated a full day

of its Design Week 2021 to the topic of participatory design. "What is the future of the neighborhoods of our cities?" organizers asked. "Can we think of redesigning a neighborhood dimension through co-planning actions with local inhabitants and actors?" (10 September section, para. 1). Classroom lessons can pursue a similar inquiry and collaboration.

In order to educate an informed citizenry *participatory design* at school can position learners for discussion with community members around locally significant topics. Through a participatory design project, there is a conduit for exchange of ideas between experts and stakeholders, and learners will hear a variety of perspectives. Ehn (2008) outlines two essential traits of participatory design. One is the central place of democracy in participatory designs. The other trait is a valuing of users' "tacit knowledge" to inform designed solutions (p. 3).

For developing sustainability awareness and action in the locality, opportunities at school for collaborative learning (Docherty 2020; Elbakidze et al. 2015) have great potential. *Collaborative learning* is a structure that has proven useful in the field for managing conflicts around natural resource management among multiple stakeholders. Participants in this process use multiple disciplines to collaborate, exert equal effort in completing tasks, show respect for the interests and opinions of others, and empower one another toward finding equitable solutions.

Manzini has emerged as a significant champion for designers to lead social innovation. Manzini (2014) enables many to envision design as a complex yet participative activity, and to view design schools themselves as agents of sustainable change, where the next generation of designers will receive their education (Manzini 2011). Manzini employs the terms "small, open, local, and connected" (p. 8) to describe a contemporary approach to participatory design. Collaboration in design recognizes the need for networks and systems to operate in specific (small, local) contexts, yet also to function on a global (open, connected) scale (Manzini 2010). In thinking about sustainability in everyday design, designers seek new living strategies visible in stakeholder behavior to achieve sustainability (Manzini and Jegou 2003) without reliance on technology to solve dilemmas.

Notably, participatory design is not a typical component of collegiate Education programs. However, as an essential tool to address the SDGs in K-12 settings, design thinking must become an addition to the pedagogy of classrooms. Collegiate Education programs must provide training for K-12 teachers to employ exhibitions as methods to display learners' knowledge, attitudes, and skills around sustainable practices.

3 Framework

Because a participatory design project is so ambitious, an educator should not aspire to conduct every lesson or each textbook chapter with a project in mind. To begin, perhaps a teacher can select one topic for the school year which can receive the "full" participatory design treatment. The teacher can enable learners to accumulate skills

over the course of the year which will prepare them to participate in the full project, applying design-thinking principles in smaller doses in other assignments.

Also, one teacher should not feel compelled to enter the project alone. In fact, a teacher can seek another partner from the grade level, or perhaps teachers from a separate department who can lend their disciplinary skill to the design project. By their very nature, design thinking projects are multidisciplinary. Other invested educators can share their training to read essays, analyze data, or identify samples in the field.

In K-12 settings, there are a variety of entry points into a participatory design project from which teachers can select that incorporate lessons about the SDGs. Teachers and schools can select their initial gateway through which to dive into local issues:

- Content—Moll et al. (1992) encourage teachers to look to students and their families for real-world topics connected to class content. In what ways can teachers guide learners' observations to inquire about classroom topics in their everyday lives?
- Instructional delivery—Educators know that a learner's engagement with an instructional topic make all the difference in the degree to which the learner masters the topic. A participatory design framework requires learners to situate their classroom inquiry in their locality. In what ways can an educator engage learners to apply classroom content in a meaningful way?
- Exhibition—A design project culminates with a display of learners' application of the principles of the classroom content to a real-world setting. Which exhibition techniques are best suited for the information that learners are presenting and for their level of skill in displaying their new expertise? Through what methods can a teacher invite local stakeholders to participate in discussions of classroom applications?
- Evaluation—While a design project can prove engaging for educators and learners alike, once the dust settles, an educator must have a way to determine the degree to which the activity has affected the learner. In what ways can learners demonstrate their acquisition of content knowledge and their growth in awareness and attitudes about the topic?

As highlighted by this list of potential entry points, the proposed framework for design thinking does require some pedagogical duties that are outside of most current collegiate training for teachers.

This author proposes a framework for K-12 design thinking with a local sustainability focus (Table 1). The framework is comprised of five criteria, each intended to promote learner engagement. A regional focus (Criterion 1), a democratic inventory of perspectives (Criterion 2), and a public exhibition of an innovative design that addresses sustainability (Criterion 5) that small groups of learners have created collaboratively (Criterion 4) combine in an educational approach that supports sustainable decision-making (Criterion 3). With all factors in this framework, the process of community interaction around this school project must be managed by

Table 1 Framework for local K-12 design thinking with a sustainability focus

The United Nation's 2030 Agenda for Sustainable Development holds 17 Goals (SDGs) which call for a global strategy to promote the attitudes, awareness, and actions to bolster the global systems upon which all life depends (UN Department of Economic and Social Affairs 2022). This author's framework is comprised of five criteria, each criterion applied from the literature to address classroom engagement
• Criterion 1: Following a territorial ecology approach (Manzini 2013), classroom topics are situated in a local context. Presenting learners with topics set in a local and familiar context invites perspectives from experts and stakeholders attached to the locality
• Criterion 2: Classroom topics have a foundation in the experience of learners in the class, a development outlined in a discussion of participatory pedagogy (Moll et al. 1992)
• Criterion 3: Sustainability is a theme that pervades classroom topics. Skog et al. (2018) write about connections through social-ecological systems which highlight the interdependent relationships that humans share through natural resources. Acknowledging these relationships promotes opportunities for community conversations around shared resources. A discussion of local resource management rooted in both social and ecological systems presents the complexity which these decisions carry in everyday applications
• Criterion 4: The principles for collaborative learning (Elbakidze et al. 2015) govern the interaction of participants. In approaching a design thinking project, participants agree to collaborate, work as equals, and respect one another's opinions and experiences, within a process which prioritizes innovation
• Criterion 5: The learners' experience culminates with an exhibition of their application of classroom content, a performance assessment that displays their mastery of the topics and elicits their reflection on their personal growth over the course of the project (Bland and Gareis 2018; Sizer 1984)

educators in a way that prioritizes both the safety of all participants and the educative experiences of learners.

While the Framework for Local K-12 Design Thinking offers deeper learning about the SDGs for students, it also highlights the shortcomings of collegiate Education training to enable teachers to implement the project.

3.1 Criterion 1—Territorial Ecology

A teacher must be intentional about the content that is selected. A focus on the SDGs benefits from a regional setting for the project, having learners examine the layout of a larger territory to understand how the systems operating in their particular location function within a larger structure (Manzini 2013). Through examining various types of data, an educator's lesson should enable learners to understand the position of community stakeholders and to develop designs in response to the specific, authentic scenario (Melles et al. 2012). Learners' activity in the project should involve hands-on applications of classroom content.

3.2 Criterion 2—Familiar Settings and Experiences

With this design-thinking framework, educators must develop a set of "public relations" skills to connect the classroom with community stakeholders. Moll et al. (1992) highlighted the complexity of everyday life that plays out for learners and their families, a complexity that is often ignored by educators at school. The participatory pedagogy outlined by Moll et al. (1992) contained practices that more clearly connect learners to their locality. As Moll et al. noted, participatory pedagogy overcame an "insularity of classrooms" by providing real-world content inspired by learners' own experiences and opportunities for learners to form research teams about these topics (p. 139). By exploring a familiar setting through the design project, learners can bring an intimacy of the social-ecological systems (Skog et al. 2018) being examined to enhance learning of the SDGs.

3.3 Criterion 3—Sustainable Development

For K-12 settings, the re-envisioning of classroom content from the textbook to local applications is no small shift, especially in schools where it has not been attempted before. However, modified collegiate training for teachers can prepare teachers for localized design discussions about sustainability. A study of local systems will illuminate the 17 SDGs in microcosm to promote discussions about the operations of the earth's systems.

3.4 Criterion 4—Collaborative Learning

While elements of participatory design may feel foreign to a teacher's pedagogical training and practice, classrooms are an ideal setting for discussion of sustainable systems. In order for participatory design practice to be most successful, Ehn (2008) notes the necessity of an established community (such as a teacher's classroom) in which the process can occur. The established and familiar classroom setting provides comfort and safety to enable learners to produce innovative designs.

3.5 Criterion 5: Exhibiting Mastery

Within this framework, educators must prepare lessons that connect classroom content to authentic projects in the locality This authenticity also involves a culminating exhibition, having learners express to an audience what they have learned about their locality during the project. Holding an exhibition that is attended by

local stakeholders makes the classroom structure ideal to house and protect students' insights (Kollmuss and Agyeman 2002; Kumpulainen and Ouakrim-Soivio 2019).

Through the use of an exhibition format such as the atelier model (Sect. 4.1), learners will present their mastery of course content applied to the local scenario. The unique, open-response solutions from students will necessitate a skilled response from a teacher. However, to use design thinking to apply textbook content in lessons about local, sustainable natural-resource use has obstacles in U.S. Education, a teaching corps which has been steeped in over three decades of standardized testing may be hard-pressed to switch to methods of assessment.

3.6 Collecting Evidence from Learners

The collegiate pedagogical training that teachers receive can increase the array of evaluation techniques that teachers are prepared to offer. Design-thinking activities at school can provide a significant step in the development of learners who can enact the SDGs, but preparing skilled teachers to deliver lessons about sustainability will require colleges to revise the Education training that they provide.

As demonstrated by the Huxtable Fellows (Peterson 2018) in a collegiate setting, a K-12 design-thinking project will require sophisticated actions from learners to which teachers must respond. Design projects will require the following actions from learners: applying classroom content to an authentic design project, participating in community interaction to elicit stories of local stakeholders (through interviews, focus groups, and so forth), collecting and analyzing data about a local site, and so forth.

Through the culminating exhibition of the design thinking project, individual learners will display an important blend of evidence gathered over the length of the project. Ultimately, the educators will seek distinct evidence from each group's exhibition that will include information about each learner regarding the following:

- Mastery of course content: The teacher will design a method to discern to what level each learner has mastered subject-area specifics of the coursework being studied at school.
- Understanding the Sustainable Development Goals: The traits of participatory design require an operational awareness of the stakeholders' perspectives and the ecological conditions which affect the site where the project is based. The group's exhibition of a designed solution will display their understanding of the SDGs.
- A personal reflection from learners about their growth: The learners' final statement about their learning should emerge from ongoing reflective writing that they have done in which they express any new understandings that have grown out of their work on the design project.

4 Participatory Design at School

In the end, participatory pedagogy can present individual learners with an opportunity to reflect on their own agency within sustainable systems. The applications of classroom content to life outside of the classroom are plentiful; a classroom topic might illuminate growing seasons or local food sources by studying the shopping habits from learners' homes. Or during a study of natural resource management, a class might examine stormwater abatement in a nearby parking lot.

The following methods have capacity to employ the criteria (See Table 1) designated in the design thinking framework. These classroom projects will call into play the awareness and actions that are rooted in a territorial examination of authentic issues in sustainable development design. The structured classroom time spent in these collaborations will extend from learners' personal experiences and will apply topics from their classwork. Through activity in their design projects, learners will be ready to share their learning through a culminating exhibition.

4.1 The Atelier Exhibition Format

Professional designers present their ideas for public review in a variety of ways. One exhibition model with promise for K-12 settings is the *atelier*, a municipal planning format that has grown out of art and design. Traditionally, the atelier was a method for a principal master in an art studio to supervise collaborations among assistants, apprentices, and students. For a municipality, an atelier is useful to display long-range plans for regional development: it invites a review of a variety of visual and text-based data, and it requires the input of various informed voices. Through consultation with expert stakeholders, Dutch water authorities devised the Climate Atelier Approach (CAA) to shed light on the range of climate change issues, and to invite to the table the patchwork of agencies that oversee separate parts of the municipal water systems. The CAA structure provided an integrated overview of social and natural systems that is neither a top-down assigning of solutions nor a set of decisions which has emerged from the silo of a detached agency (Masselink et al. 2017).

Representatives from a variety of disciplines gather for the CAA visioning process. Together, participants review maps that illustrate the activity of natural and social systems on the landscape. Small interdisciplinary teams each design their thirty-year vision for the municipality. Each team then presents its vision and answers questions. Ultimately, the whole group discusses any insights it has gained. In the end, the goal is not to design the municipality's vision, but to employ a range of perspectives to consider possibilities that could merge into a shared vision (Masselink et al. 2017).

As illustrated by the CAA, an atelier exhibition has great promise for classrooms. This territorial modeling incorporates the collaborative role of community experts (and in learning spaces, students who are applying classroom content to

their local landscapes will function in these roles) to study local information and present a collaborative vision for future design. The whole group views each plan, then discusses together the mutual learning that they have experienced through their shared activity. Through an atelier exhibition appropriate for a particular grade-level, K-12 learners can display their content mastery and their grasp of the SDGs.

4.2 Reflective Writing by Learners

A creative learning project generates lessons that exceed the finished product itself. In classrooms, educators must provide the structure which will guide learners to reflect not only on the quality of their finished product, but on the personal growth that has resulted from the process, as well. Written reflection by each learner is indispensable to chart the degree of their growth. Reflective writing displays for both the educator and the learners themselves the changes that have occurred in learners' thinking over the course of the project.

Intentional reflective writing (similar to a diary or journal entry) must be part of the regular routine of the participatory design project. The teacher should provide writing prompts to extend class discussions, and provide distinct time dedicated to quiet reflective writing. While learners may not have a seismic shift in their learning on any single day, they may recognize trends in their record over the course of the project that will display how their learning has evolved.

As a final "tabulation" of each individual's evolution over the course of the project, the teacher should request a final statement from each learner. Learners will review their collection of journal entries then note in their statement the personal change that has occurred. For the statement, the teacher should provide a small variety of format options with appeal for a particular K-12 group—a letter to a friend or a newspaper article may be appropriate. Options for a video-recorded statement may suffice, as well.

The educator's invitation for learners to reflect on their academic experience may be the first such invitation that the learners have received to understand their connection to the natural world (Salazar et al. 2020). A clearer understanding of their connection with Nature may situate learners to readily transfer their awareness into actions that support implementing the SDGs in their local social-ecological systems.

4.3 A Participatory Design Scenario for Secondary Learners

The literature on public design thinking provides a variety of contemporary case studies which illustrate exhibition methods employed by collegiate and professional designers. The Huxtable Fellowship program provides honors students a focus on civic engagement and public interest design (Peterson 2018). A project set in East Boston sought to re-design an apartment block inhabited by forty thousand residents

and threatened by coastal flooding. Fellowship students instituted a participatory design approach by engaging residential stakeholders through a number of means. Fellowship students collected data by visiting homes and hearing the stories, cares, and concerns of residents. For the residents at the site, students presented information graphically and in multiple languages to explain climate change and potential impacts of future flooding. Students shared their findings with stakeholders through several community meetings, generated consensus, and guided the group to identify next steps in taking action.

Ultimately, the Fellowship learners re-interpreted scientific content about coastal flooding to apply it to the East Boston context. By means of their research on the ground, their exhibitions represented the voices of residents and applied their classroom content to real-world scenarios for sustainability decision-making. The East Boston project displays elements of participatory design which can be modified for learning in K-12 settings as appropriate.

For the sake of illustration, this manuscript proposes a design challenge for high school students similar to the one performed by the Huxtable Fellows (Peterson 2018). An Earth Science class in Virginia could employ this project to situate their classroom content along the Chesapeake Bay. During this project, students will be applying specifics from the state's content standards (Virginia Dept. of Education 2018) to examine a variety of data (interviews with residents, tidal patterns, projections for sea-level rise, and so forth). The lesson will illuminate information from the state standards including knowledge of engineering practices and principles of weather and climate functions. Students' exhibitions would apply this content to the specifics of the Chesapeake Bay setting. At the close of the project, teachers will assess learners' acquisition of course content and the SDG principles displayed in the exhibition, as well as personal growth that the learner can report.

5 Concluding Remarks

In order for teachers to present the SDGs to learners in a meaningful way, teacher training institutions must revise the set of skills with which they prepare teachers. This paper identifies a set pedagogical skills that collegiate Education programs must provide in order to equip teachers to elevate learners' agency to connect them to their locality through participatory design projects. The framework for design thinking described above elucidates two significant roles that classrooms can play to amplify the SDGs for learners: both affirming the experiences of learners in the natural world outside of school, and in developing awareness and practices for learners that they will use in their future decision-making as stewards of sustainably designed localities.

Design-thinking projects will raise students' learning beyond test scores. Design thinking in K-12 classrooms will promote research questions that inquire about the types of classroom engagement which finds purchase in the actions of adults who become active in systems of community sustainability. Future research may also ask about which pedagogical approaches best connect classroom learning to actions that

support the SDGs. Localities that engage with design thinking projects can chart the frequency of effective conservation actions and any change in the activity of local stakeholders in the wake of design-thinking exhibitions.

Collegiate programs for K-12 teacher preparation are indispensable links in a chain to prepare learners for sustainable actions in their communities. However, collegiate Education programs must prepare teachers who can guide learners through a framework of participatory design to a deeper understanding of the Sustainable Development Goals. The challenge is considerable to equip teachers to incorporate design thinking, a demanding format of instruction and evaluation that is "multifaceted and complex" (Anderson 2018, p. 204). For an investment in citizens who are prepared to sustain the systems that support planetary health, the pathway to fortify K-12 student design thinking will be an essential one to explore.

References

Anderson NM (2018) Evaluating student learning: engaging experience to create agents of change. In: Abendroth LM, Bell B (eds) Public interest design education guidebook: curricula, strategies, and SEED academic case studies. Routledge, pp 202–205. https://doi.org/10.4324/9781315627458

BASE Milano (2021) Public program_design week 2021. https://base.milano.it/events/public-program-designweek-2021/. Accessed 26 Mar 2022

Bland LM, Gareis CR (2018) Performance assessments: a review of definitions, quality characteristics, and outcomes associated with their use in K-12 schools. Teach Educ J 11:52–69

Brown T, Wyatt J (2010) Design thinking for social innovation. Dev Outreach 12(1):29–43. https://ojs.unbc.ca/index.php/design/article/viewFile/1272/1089

Carrier SJ, Tugurian LP, Thomson MM (2013) Elementary science indoors and out: teachers, time, and testing. Res Sci Educ 43(5):2059–2083. https://doi.org/10.1007/s11165-012-9347-5

Chan D (2018) Addressing air pollution impacts on senior citizens in Beijing, China: the international urbanization seminar. In: Abendroth LM, Bell B (eds) Public interest design education guidebook: Curricula, strategies, and SEED academic case studies. Routledge, pp 147–153. https://doi.org/10.4324/9781315627458

Clayton S (2003) Environmental identity: a conceptual and an operational definition. In: Clayton S, Opotow S (eds) Identity and the natural environment: the psychological significance of nature. The MIT Press, pp 45–65

Cundill G, Bezerra JC, De Vos A, Ntingana N (2017) Beyond benefit sharing: place attachment and the importance of access to protected areas for surrounding communities. Ecosyst Serv 28:140–148. https://doi.org/10.1016/j.ecoser.2017.03.011

Docherty M (2020) Collaborative learning: the group is greater than the sum of its parts. In: Auer M, Tsiatsos T (eds) The challenges of the digital transformation in education. ICL 2018. Advances in intelligent systems and computing, vol 916. Springer, Cham, pp 26–33. https://doi.org/10.1007/978-3-030-11932-4_3

Ehn P (2008) Participation in design things. In: Proceedings participatory design conference 2008. ACM

Elbakidze M, Dawson L, Andersson K, Axelsson R, Angelstam P, Stjernquist I, Teitelbaum S, Schlyter P, Thellbro C (2015) Is spatial planning a collaborative learning process? A case study from a rural–urban gradient in Sweden. Land Use Policy 48:270–285. https://doi.org/10.1016/j.landusepol.2015.05.001

Gottwald S, Stedman RC (2020) Preserving ones meaningful place or not? Understanding environmental stewardship behaviour in river landscapes. Landsc Urban Plan 198. https://doi.org/10.1016/j.landurbplan.2020.103778
Harris MA (2021) Growing among trees: a 12-month process evaluation of school based outdoor learning interventions. J Adventure Educ Outdoor Learn 1–12. https://doi.org/10.1080/14729679.2021.2001758
Hirst N (2019) Education for sustainability within early childhood studies: collaboration and inquiry through projects with children, Education 3-13 47(2):233–246. https://doi.org/10.1080/03004279.2018.1430843
Hubbard P (1993) The value of conservation: a critical review of behavioural research. Town Plan Rev 64(4):359
IDEO (2012) Design thinking for educators. IDEO LLC. http://designthinkingforeducators.com/
Kajamaa A, Kumpulainen K (2019) Agency in the making: analyzing students' transformative agency in a school-based makerspace. Mind Cult Act 26(3):266–281. https://doi.org/10.1080/10749039.2019.1647547
Kals E, Ittner H (2003) Children's environmental identity: indicators and behavioral impacts. In: Clayton S, Opotow S (eds) Identity and the natural environment: the psychological significance of nature. The MIT Press, pp 135–157
Kollmuss A, Agyeman J (2002) Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environ Educ Res 8(3):239–260. https://doi.org/10.1080/13504620220145401
Kossack A, Bogner FX (2012) How does a one-day environmental education programme support individual connectedness with nature? J Biol Educ 46(3):180–187. https://doi.org/10.1080/00219266.2011.634016
Kumpulainen K, Lipponen L, Hilppö J, Mikkola A (2014) Building on the positive in children's lives: a co-participatory study on the social construction of children's sense of agency. Early Child Dev Care 184(2):211–229. https://doi.org/10.1080/03004430.2013.778253
Kumpulainen K, Ouakrim-Soivio N (2019) "My treasure box": pedagogical documentation, digital portfolios and children's agency in Finnish early years education. In: Eckhoff A (ed) Participatory research with young children. Educating the young child (Advances in theory and research, implications for practice), vol 17. Springer, Cham, pp 105–123. https://doi.org/10.1007/978-3-030-19365-2_7
Manzini E (2010) Small, local, open, and connected: design for social innovation and sustainability. J Des Strat Chang Des 1:8–11
Manzini E (2011) Design schools as agents of (sustainable) change. In: 1st International symposium CUMULUS//DRS for design education researchers. http://www.designresearchsociety.org/docs-procs/paris11
Manzini E (2013) Resilient systems and cosmopolitan localism—the emerging scenario of the small, local, open and connected space. Econ Suffic 70:70–81
Manzini E (2014) Making things happen: social innovation and design. Des Issues 30(1):57–66. https://doi.org/10.1162/DESI_a_00248
Manzini E, Jegou F (2003) Sustainable everyday. Des Philos Pap 1(4). https://search.proquest.com/docview/993126914?accountid=11667
Masselink L, Goosen H, Grond V, Vellinga P, Leemans R (2017) Climate change in cities: an Atelier approach for municipal action. Solutions 8(1):54–65. https://thesolutionsjournal.com/article/climate-change-cities-atelier-approach-municipal-action/
Melles G, Howard Z, Thompson-Whiteside S (2012) Teaching design thinking: expanding horizons in design education. Procedia Soc Behav Sci 31:162–166. https://doi.org/10.1016/j.sbspro.2011.12.035
Miller PN (2015) Is 'design thinking' the new liberal arts? The Chronicle of Higher Education. http://chronicle.com/article/Is-Design-Thinking-the-New/228779
Moll LC, Amanti C, Neff D, Gonzalez N (1992) Funds of knowledge for teaching: using a qualitative approach to connect homes and classrooms. Theory Pract 31:132–141

Newman G, Chandler M, Clyde M, McGreavy B, Haklay M, Ballard H, Gray S, Scarpino R, Hauptfeld R, Mellor D, Gallo J (2017) Leveraging the power of place in citizen science for effective conservation decision making. Biol Conserv 208:55–64. https://doi.org/10.1016/j.biocon.2016.07.019

Peterson B (2018) Advancing resiliency: the Huxtable fellowship in civic engagement and service learning. In: Abendroth LM, Bell B (eds) Public interest design education guidebook: Curricula, strategies, and SEED academic case studies. Routledge, pp 171–178. https://doi.org/10.4324/9781315627458

Rajala A, Hilppö J, Lipponen L, Kumpulainen K (2013) Expanding the chronotopes of schooling for the promotion of students' agency. In: Erstad O, Sefton-Green J (eds) Identity, community, and learning lives in the digital age. Cambridge University Press, pp 107–125

Sairanen H, Kumpulainen K, Kajamaa A (2020) An investigation into children's agency: children's initiatives and practitioners' responses in Finnish early childhood education. Early Child Dev Care 192(1):112–123. https://doi.org/10.1080/03004430.2020.1739030

Salazar G, Kunkle K, Monroe MC (2020) Practitioner guide to assessing connection to nature. North American Association for Environmental Education. https://cdn.naaee.org/sites/default/files/assessing_connection_to_nature.7.23.20.pdf

Scannell L, Gifford R (2010a) Defining place attachment: a tripartite organizing framework. J Environ Psychol 30(1):1–10. https://doi.org/10.1016/j.jenvp.2009.09.006

Scannell L, Gifford R (2010b) The relations between natural and civic place attachment and pro-environmental behavior. J Environ Psychol 30(3):289–297. https://doi.org/10.1016/j.jenvp.2010.01.010

Simms W (2020) Bringing environmental identity research into the classroom context: examining the theoretical foundations influencing its current use in the literature. Stud Sci Educ 56(1):35–76. https://doi.org/10.1080/03057267.2020.1736379

Sizer TR (1984) Horace's compromise: the dilemma of the American high school. Houghton Mifflin

Skog KL, Eriksen SE, Brekken CA, Francis C (2018) Building resilience in social-ecological food systems in Vermont. Sustainability 10(12):1–16. https://doi.org/10.3390/su10124813

Smith JW, Siderelis C, Moore RL, Anderson DH (2012) The effects of place meanings and social capital on desired forest management outcomes: a stated preference experiment. Landsc Urban Plan 106(2):207–218. https://doi.org/10.1016/j.landurbplan.2012.03.009

Staszowski E (2018) Inclusive iteration: participation as method in design theory and practice. In: Abendroth LM, Bell B (eds) Public interest design education guidebook: curricula, strategies, and SEED academic case studies. Routledge, pp 179–181. https://doi.org/10.4324/9781315627458

Tugurian LP, Carrier SJ (2017) Children's environmental identity and the elementary science classroom. J Environ Educ 48(3):143–153. https://doi.org/10.1080/00958964.2016.1191415

United Nations Department of Economic and Social Affairs (2022). The 17 goals. https://sdgs.un.org/goals

Vaske JJ, Kobrin KC (2001) Place attachment and environmentally responsible behavior. J Environ Educ 32(4):16–21. https://doi.org/10.1080/00958960109598658

Virginia Department of Education (2018) Science standards of learning for Virginia public schools: earth science. https://www.doe.virginia.gov/testing/sol/standards_docs/science/2018/standards/stds_earth_science.docx

Williams DR, Vaske JJ (2003) The measurement of place attachment: validity and generalizability of a psychometric approach. For Sci 49(6):830–840. https://doi.org/10.1093/forestscience/49.6.830

"Innovation and Sustainability"—A Virtual German-American Student Exchange Project

Andrea Heilmann, Nancy Philippart, and Juliane Lessmann

1 Introduction

Working internationally and virtually has become the norm for most professions. To be well prepared for future jobs, students need to acquire necessary global competencies that include intercultural awareness, cultural intelligence (CQ), the ability to communicate in English (including how to communicate with non-native speakers) and proficient use of digital collaboration tools to be effective in this cross-cultural virtual context. Developing these competencies in a traditional university setting requires creativity and rethinking how to teach. Students require an authentic experience working cross-culturally with their peers on a real global challenge that will allow them to gain and share knowledge while at the same time developing their cultural intelligence.

Sustainability, with its three intersecting pillars of environmental protection, economic development and social equity is one example of a complex challenge impacting the entire world. The complexity and multidisciplinary nature of sustainability makes the subject difficult to incorporate into Bachelor and Master degree programs. In particular, the application of sustainable management within the curriculum of universities of applied sciences is challenging since the topic is multidisciplinary and not easily taught by a single department.

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Problem-solving, especially through the application of technological solutions, has been a cornerstone of engineering and applied sciences education. More recently, engineering curricula are emphasizing the need for innovation and creativity to better prepare engineering and applied science students for twenty-first century challenges. The UCL Center for Engineering Education highlights in its 2018 report that engineers are now "creating, innovating, designing and using technologies, working together in teams, being in a variety of settings and working across disciplinary and cultural borders. Our twenty-first century challenges will require inter/multidisciplinary [educational] approaches that are at the intersection of science, the humanities and the arts." (UCL 2018). One recommendation is to offer engineering students access to problem solving and project-based learning with an emphasis on social impact.

This intersection of sustainable development, innovation and global social impact was the foundation for the new virtual exchange course jointly offered to engineers and applied science students at Harz University of Applied Sciences in Wernigerode, Germany and Wayne State University in Detroit, Michigan, USA. The need for sustainable development is a driver of innovation, yet the United Nations Sustainable Development Goals (SDGs) have typically not been incorporated into our innovation processes or project-based learning. Likewise, students have little opportunity to work on big social impact challenges with peers from elsewhere in the world where they can develop cultural intelligence (CQ) and leverage each other's unique cultural perspectives. This course and the joint project address these shortfalls by giving students the opportunity to work virtually and cross-culturally on a significant sustainability challenge.

In this paper we will

- Describe the innovation and sustainability project as well as the theoretical and methodological background of cultural intelligence and the innovation process incorporated in the assignment
- Share the course learning objectives and outcomes to demonstrate how these contribute to the preparation of engineers as future leaders and problem solvers in the field of sustainability
- Share lessons learned and best practices so other universities can engage in similar cross-cultural virtual exchanges.

The methodology and accompanying theory for two fundamental principles of the project, cultural intelligence and innovation management are described in subsequent chapters.

2 Cultural Intelligence

CQ, an individual's capability to function effectively in culturally diverse situations, is a relatively new form of intelligence introduced by Early and Ang (2003) in an effort to make sense of ideological clashes and cultural conflicts occurring worldwide post

9/11 (Ang et al. 2011). Globalization, transportation and technology have increased the ability of people to interact cross-culturally. However, despite Friedman's (2005) assertion that a flat world connected via technology would enable the fast, seamless flow of ideas, information, business and money, cultural differences that create misunderstandings and conflict frequently impede this flow. This led Harvard Professor Pankaj Ghemawat (2007) to counter that differences still matter. Businesses that treat the world as one flat seamless market without considering specific cultural, political and economic differences, will fail. It is within this context that cultural intelligence was proposed as a means for understanding why "some people, but not others, can easily and effectively adapt their views and behaviours cross-culturally" (Van Dyne et al. 2012).

Cultural intelligence is informed by Sterberg's (1997) multiple facets of intelligence framework. Focusing on a specific domain, that is, one's ability to cope with diversity and function in intercultural settings, Ang et al. (2011, p. 5) assert that CQ is a distinct form of intelligence, arguing that "since norms for social interaction vary from culture to culture, it is unlikely that cognitive intelligence, emotional intelligence or social intelligence will translate automatically into effective cross-cultural adjustment, interaction and effectiveness".

CQ is a four-dimensional construct that includes both cognitive and metacognitive skills to help one conceptualize and understand how to function in a new culture as well as to gain culture specific knowledge, motivation to want to engage with a new culture, and capabilities to engage in adaptive behaviors. It is not specific to a particular cultural context—rather it reflects an ability to perceive and manage one's emotions so as to successfully interact in culturally diverse situations (Earley and Ang 2003). Cultural intelligence leads to competence in responding effectively to people of all cultures, languages, races, classes, ethnic backgrounds, religions and other diversity attributes in ways that recognize, affirm and value their dignity (Earley and Ang 2003). Like other forms of intelligence, it can be learned and developed over time through experience, education and training (Ang et al. 2011). The CQ construct, as well as the scale to assess it, was defined, developed and validated by Ang et al. (2007). Since that time considerable empirical research has been conducted showing that authentic global experiences can increase an individual's cultural intelligence (Ang et al. 2011; Crawford-Mathis 2009; Crowne 2007; Shannon and Begley 2008; Tay et al. 2008). Multi-cultural team experience (Shokef and Erez 2008) was found to increase CQ over time and even non-work study and travel experiences can be predictors of increased CQ (Crowne 2008; Tarique and Takeuchi 2008). Research suggests that CQ can predict various outcomes of work performance—better decision making and negotiating cross-culturally (Imai and Gelfand 2010), overcoming difficulties with diversity and using this diversity as a strength (Moynihan et al. 2006) and enhancing team trust when members are culturally different (Rockstuhl and Ng 2008). Groves and Feyerherm (2011) discovered that team leader CQ predicts team performance. Finally, studies show that CQ enhances the effect of transformational leadership on organizational innovation (Elenkov and Manev 2009) and that CQ is a better predictor of leadership effectiveness in cross-cultural contexts than emotional intelligence (EQ) (Rockstuhl et al. 2009).

An objective of this virtual exchange course was to give students an authentic global work experience that simulated how most of them will work at some point in their careers—on diverse teams with people from different parts of the world who they may never meet in person, using technology to collaborate virtually across multiple time zones, yet with the expectation that the team will effectively complete a specific set of deliverables. Success in this context requires team members to develop and practice their cultural intelligence and virtual leadership skills.

3 Inclusion of Sustainability Within the Innovation Process

Another important aim of the course project was to incorporate the consideration of sustainability criteria, especially the SDGs, in the innovation process. The innovation process describes the path of translating new and/or existing knowledge into marketable solutions to identified problems (LEAD 2021). It is an organizational method that divides the uncertainties within an innovation project into clearly subdivided steps and decision points to drive development forward efficiently, while at the same time avoiding potential risks (Innolytics). The innovation process comprises four different phases[1] in which different methods of technology monitoring and technology foresight are applied. Technology monitoring or technology foresight includes the observation, assessment and selection of suitable technologies and innovations. When assessing technologies, their relevance for sustainable development in all areas should also be evaluated.

According to Spath et al. (2010), there are four integrated phases of the Technology Monitoring process. (See Fig. 1.)

In the first phase, the problem of practice is specifically stated and the relevant information is compiled with reference to the respective company or technology field, for example:

- existing competencies and technological possibilities,
- current and future required functionalities of existing applications (e.g. of products, processes or services),
- capital goods and assets associated with technology or fields of application (e.g. special, production facilities) and
- technological, social, economic or ecological trends that influence the use of technology in the relevant area of application.

The need for sustainability, guided by the SDGs, can easily be incorporated in this first phase.

In the second phase, information on relevant fields of technology and application is collected. Formal and informal sources of information are referenced. Sustainability aspects are also considered in this phase.

[1] https://www.lead-innovation.com/english-blog/the-4-phases-of-innovation.

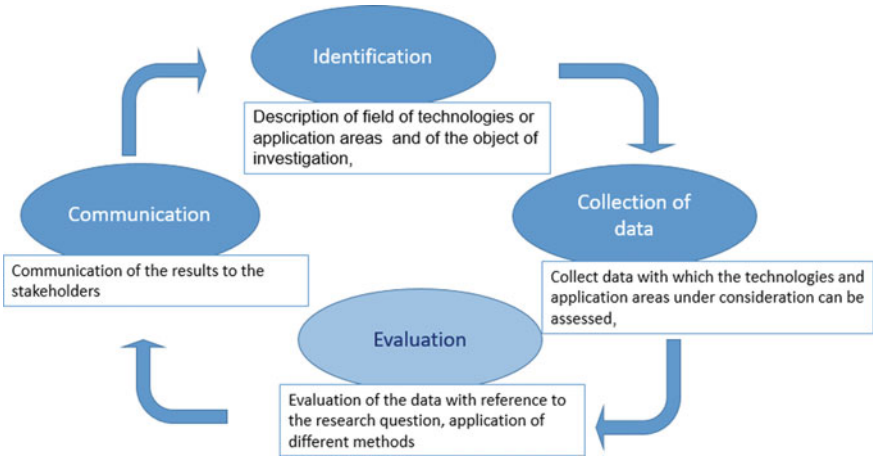


Fig. 1 Technology monitoring process

It is not until the third phase, evaluation, that technology monitoring differs depending on the particular issue. Different methods can be used to analyze the data collected. Cuhls (2008, pp. 12–14) cites twelve possible groups of methods for technology foresight in international comparison. Examples include creativity procedures, expert interviews, simulations or statistical procedures.

Spath et al. (2010) has reduced the complexity and selected five different methods for technology monitoring for evaluation. The methods differ according to the objectives, the consideration within the innovation process and the opportunity to consider sustainability aspects (See Table 1).

Scenario analysis is a method that can enhance the innovation process in several phases from idea generation to market launch, adapting the analysis to the progress of the project. Of the methods compared, this one is well suited for taking sustainability aspects into account. Spath et al. (2010) has simplified the methodologies of prior researchers of scenario analysis Van der Heijden (1996), Schoemaker (1995), Reibnitz (1992) and Kosow (2007) to a four-phase process that was used as a framework for the student virtual exchange project.

Phase 1: Scenario environment analysis
Phase 2: Create characteristics
Phase 3: Creation/Derivation of scenarios
Phase 4: Communication

The SDGs can be considered, especially in the first step, scenario environment analysis, in which external influences on the development are compiled. PESTEL analysis, a structured tool that analyzes the Political, Economic, Social, Technological, Environmental and Legal impacts can be collectively used to assess whether this scenario is sustainable. For example, a political commitment may lead to the

Table 1 Overview of methods for technology monitoring

	Scenario analysis	Technology radar	Technology potential analysis	Technology assessment	Systematical literature review
Objectives	Future scenarios are worked out to show possible development directions for the company in the future	Supports technology users in identifying technologies to meet a specific requirement profile for the current or future products, services or processes of the company	Supports developer in product and service development on the basis of certain technologies, especially in the identification of attractive technology applications and the associated markets	Supports technology users with the detailed analysis of a technology field, in order to be able to find the (best) technology to derive medium-term decisions	Provides a comprehensive overview of the corresponding technology. With the help of semantic—text analysis methods large amounts of information can be evaluated and made available to experts for further analysis
Assessment of sustainability	++	+	+	+	+
	Long-term, strategic technology planning	Operative technology planning, application known	Operative technology planning, application unknown	Operative technology planning technology field known	Long-term, strategic technology planning

introduction of new legal regulations or subsidies. All aspects of sustainable development can be taken into account in the PESTEL analysis. PESTEL categories and some examples are shown in Table 2. While the PESTEL criteria are uniform for one technology field (social impact area), they may vary in different contexts (countries) which should be considered within the innovation process.

Table 2 Example PESTEL analysis

Political	Economical	Social	Technology	Environmental	Legal
Political stability	Access to credit	Employment options, education	Infrastructure	Climate chance	Legal framework (Act)
Property rights and the rule of law corruption	Funds, subsides	Quality of life	Competitive technologies	Resource availability	Ownership inside ground

The external influencing factors from the PESTEL analysis can then be applied to various scenarios described in Phase 3 and the results of analysis communicated in Phase 4.

Analysis of the methods during the course development showed scenario analysis and PESTEL analysis to be the most appropriate methods for the virtual exchange project; however, time constraints limited the extent to which students could apply these methodologies. For the project design, students developed only one possible future scenario, then focused their efforts on conducting a robust PESTEL analysis and using the SDGs to recommend innovations in three different country contexts to achieve this sustainable future.

4 Virtual Collaboration—Innovation and Sustainability Project

4.1 Learning Objectives

This semester long project was purposefully designed to enable students to connect and apply their learning to the real world. Teams of students were challenged to create a scenario in a social impact area (field of technology) of their choosing like energy, education or transportation that could be sustainable in the future and understand the nuances of how sustainability could be achieved in three different regions of the world.

Project learning objectives were to:

1. allow students to increase awareness of their own cultural values, further develop their cultural intelligence and practice their intercultural competencies while working virtually and cross-culturally
2. engage students in inquiry-based learning, tackling a real-world social impact problem that is personally meaningful to them, while learning about the Sustainable Development Goals and their application
3. apply methods to assess sustainable innovation on both global and regional levels while recognizing that global challenges may have different solutions in different contexts
4. communicate project results and reflect on their own learning experiences

4.2 Project Design and Milestones

Figure 2 illustrates the conceptual design of the student project and is the result of two years of development and piloting with three international student groups. The project design has changed and improved over time.

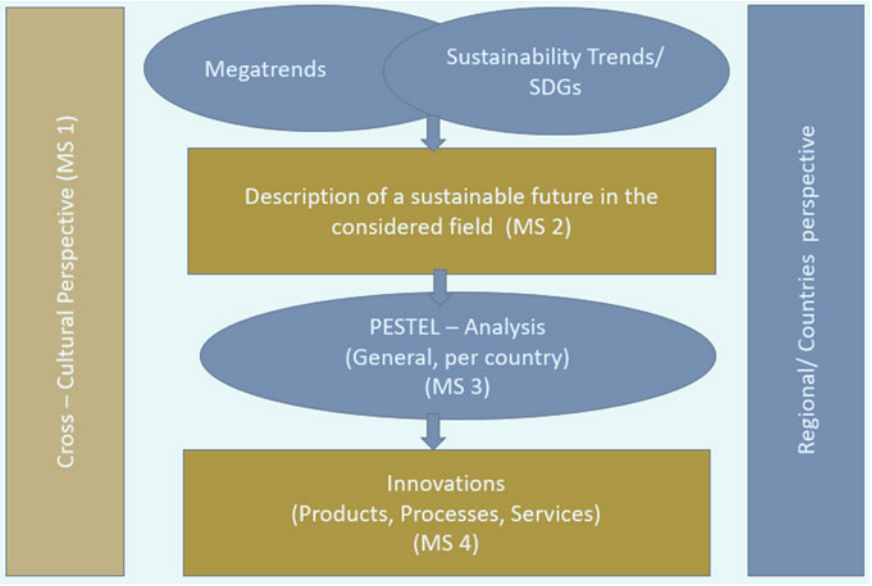


Fig. 2 Project design "innovation and sustainability"

The recommended logistics of the project are as follows. Students are assigned to four-person teams (ideally two from each university) with a faculty member designated as a resource. In the pilot, Harz and Wayne State students were assigned to teams by the instructors, replicating the workplace where employees rarely get to choose their teammates. Most teams were four persons with two students from each university, with a few three-person teams because of total number of students. Harz students were primarily German, Wayne State students primarily American but each university did have some international students. Each team was assigned a faculty member from either Harz or Wayne State as a resource. This structure ensured that each team could leverage both cross-cultural and regional perspectives in their work.

Each team then chooses a significant global impact area (technology field of innovation) and three different countries from three different continents as the context for analyzing this social impact challenge. Their assignment is to analyze, envision and innovate a sustainable future in these three different countries. The project is comprised of five milestones also shown in Fig. 2:

1. CQ self-assessment and discussion
2. Description of a sustainable future for a social challenge (see Table 3) and selection of three different countries
3. Presentation of PESTEL analysis considering the situation in different countries
4. Description of relevant innovations for sustainability
5. Reflection paper or reflection discussion (Lessons learned)

Table 3 Proposed project timeline

Phases/Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Intro intercultural competencies		M1												
2 Provide knowledge														
3 Collaborative work				M2				M3					M4	
4 Lessons learned														M5

The project has two foundational elements: enabling students to experience cross-cultural perspectives and a project-based approach to working on a real-world problem. Once teams are formed, but before project work starts, teambuilding exercises to build relationships and increase cross-cultural awareness should be organized. Students should complete a cultural intelligence and values self-assessment using the tool developed by Ang et al. (2007)[2] prior to the first joint class so they can better understand how their own values might differ from others and impact team dynamics. (Milestone 1).

In the Harz—Wayne State virtual exchange, knowledge required for the project was conveyed through joint online lectures, as well as pre-recorded lectures made available to students during the semester. Topics were: "Sustainability and Sustainable Development Goals", "Working Virtually and Cross-Culturally and Cultural Intelligence", and "Methods of Scenario and PESTEL Analysis".

The global impact areas students chose to investigate were broad and included questions like:

(a) What will sustainable mobility in the future look like?
(b) What will sustainable education in the future look like?
(c) What will sustainable water supply in the future look like?

Given the breadth of these questions, students had to define the scope of their research (shown as Milestone 2 in Fig. 2). For the example, sustainable mobility, the team could decide whether to focus on transport of goods or people, transport over long or short distances or urban or rural transport. Students then consulted literature on Megatrends[3] and considered how their topic was impacted by these trends and the SDGs.[4] Additionally, teams chose three countries on three different continents to investigate. In the Harz-Wayne State pilot, not unexpectedly, most teams chose Germany and US as two of their three countries given their familiarity with their own countries of origin; if a team had an international student, typically that country was also chosen but otherwise there was great variety in the African or Asian countries chosen. Topics and countries were shared with the instructors to prevent overlaps, but interestingly each team chose a unique challenge with a unique set of countries. The scope of the research as well as the chosen regions are discussed in the first presentation (Milestone 2).

[2] *Now commercially available through the Cultural Intelligence Institute (https://culturalq.com/).

[3] www.zukunftsinstitut.de/dossier/megatrends/.

[4] https://sdgs.un.org/goals.

Fig. 3 PESTEL analysis for sustainable long-distance transportation

Once students complete Milestone 2 and receive feedback from both classmates and instructors, they are ready to work on the next step. As discussed previously in Chap. 2, students will use a PESTEL analysis for assessments as this approach encourages taking a holistic systems view of their impact challenge. Students will investigate the Political, Economic, Social, Technological, Environmental and Legal factors impacting their chosen question. They will also identify which PESTEL factors are most important for each country and discuss their criteria and rationale for prioritization. Each team makes a short presentation midway through the semester on the results of their PESTEL analysis (Milestone 3). This allows instructors to ensure that students are on the right track with analysis and enables student teams to learn from each other.

Figure 3 illustrates the results of the PESTEL analysis for the example of sustainable mobility for long-distance public transportation.

The next phase of the assignment will likely be the most challenging for students based on experience from the Harz-Wayne State pilot. Using the learnings from Milestones 2 and 3, each team recommends innovations they believe will be required to meet a sustainable future in the specific field of technology for each of their three chosen countries. Figure 4 illustrates the impact of the prioritization of external factors for the example of long-distance public transportation. To improve stakeholders' participation and utility, the team suggested a smart information system for users to navigate and connect via various forms of public transportation.

Students, particularly those in engineering and technology programs are frequently reluctant to propose ideas that are unproven. Most students in the Harz-Wayne State pilot had difficulty envisioning innovations required for a sustainable future twenty years from now. As a result, most of the 'innovations' recommended were not very innovative and were typically off-the-shelf solutions. To help students

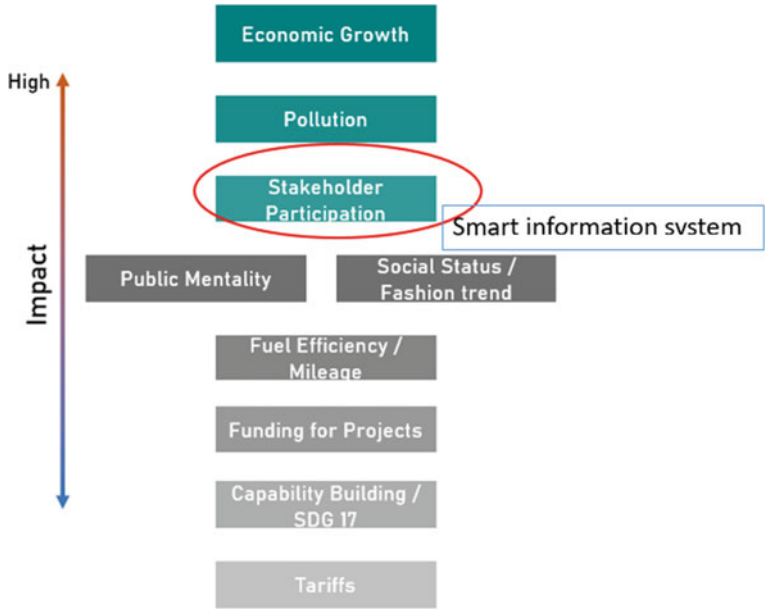


Fig. 4 PESTEL Prioritization and Innovation

think more creatively, it is recommended that time be allocated in the project at Milestone 4 to practice technology foresight methods like brainstorming, storyboarding, mind mapping, five whys analysis, etc. Students will need to be guided through these exercises since they are not extensively used in engineering education.

Student feedback on the class content and project are extremely important in refining and continuously improving the course. Students from both universities were required to write a reflection paper or to participate in a reflection interview (Milestone 5). This was intentionally left broad so students could comment on not only the sustainability and innovation content of the course, but learnings from the project, insights on working virtually and cross-culturally, key takeaways that shaped or reshaped their understanding of sustainability, innovation, their own cultural intelligence or any other concepts or learnings that were especially meaningful to them. Specific results are discussed in the next chapter.

5 Results and Findings

Student reflections were used to understand whether course learning objectives were met and how the content, project, team formation and preparation could be improved. Reflections primarily focused on intercultural collaboration and sustainability and were provided via interview, survey and reflection paper. (Milestone 5).

5.1 General Evaluation of the Virtual Exchange Program

An online survey was provided to all Harz and Wayne State students who participated in the course. Results from the summer semester are summarized in Fig. 5. Responses show that between two thirds and three quarters of students learned more about cultural differences and similarities between German and Americans, increased their knowledge about sustainability while improving their cross-cultural, technological and communication skills. However, data shows that this was not universal for all students so going forward it is important to put interventions in place so that all students have a positive learning experience. Additional insights were obtained from student's reflection interviews and papers.

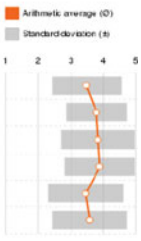
Students were asked to comment on the duration of the virtual exchange project. As shown in Fig. 6, half of the students surveyed considered the time to be too short.

The first pilot course took only 8 weeks which was deemed too short for teambuilding and virtual cross-cultural collaboration. Because of the compressed schedule, students did not take the time to build relationships, discuss differences in their cultural values and establish norms before rushing to begin the actual tasks of the assignment. Likewise, time was not available to work with students on technology foresight methods. The Gantt chart in Table 3 shows a recommended timeline of 14 weeks for the five project milestones. A duration of 10 weeks may also be possible but limits the amount of time students have in getting to know each other, learning how to work effectively together and practicing creative technology foresight methods.

Q1) Did you gain knowledge and skills during your participation in the Virtual Exchange+ project additional to the subject related content? N=38

1) I know more about the differences and similarities between German-American education.
2) I know more about the cultural differences and similarities between Germans and Americans.
3) I improved my cross-cultural-working skills.
4) I gained additional knowlegde due to the course content.
5) I improved my technological skills.
6) I improved my communication skills.

	strongly disagree (1)		disagree (2)		neither agree nor disagree (3)		agree (4)		strongly agree (5)		cannot answer (0)		
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	Ø	±
1)	2x	5,26	5x	13,16	8x	21,05	18x	47,37	5x	13,16	-	3,50	1,06
2)	-	-	5x	13,16	6x	15,79	19x	50,00	8x	21,05	-	3,79	0,93
3)	2x	5,26	4x	10,53	3x	7,89	17x	44,74	11x	28,95	1x	3,84	1,14
4)	1x	2,63	4x	10,53	6x	15,79	14x	36,84	13x	34,21	-	3,89	1,09
5)	2x	5,26	7x	18,42	7x	18,42	15x	39,47	7x	18,42	-	3,47	1,16
6)	2x	5,26	7x	18,42	3x	7,89	19x	50,00	7x	18,42	-	3,58	1,15



Quelle: Eigene Erhebungen (2021) | Source: Own Survey Results (2021)

Fig. 5 Survey results

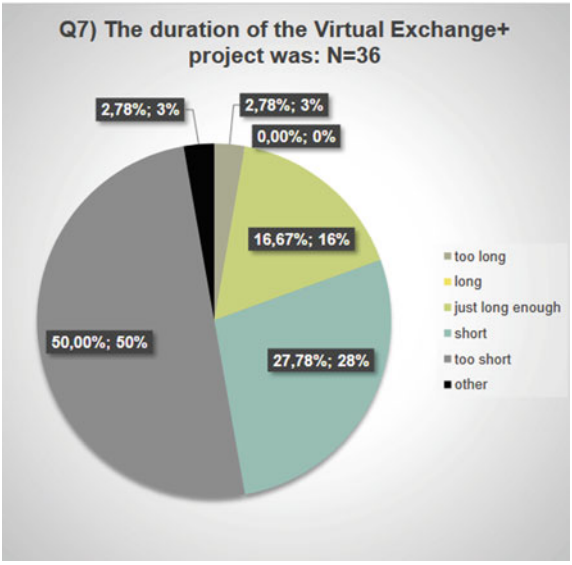


Fig. 6 Duration of the virtual exchange project

5.2 Cultural Intelligence and Intercultural Collaboration

Survey results as well as comments from students' reflections show that the course increased their awareness of their own cultural values and helped increase their CQ. Several students also acknowledged that their intercultural competencies and ability to work effectively on a cross-cultural team improved over the semester. An American student commented that now that he had worked with students from Germany, he is more interested in visiting the country, suggesting an increase in the motivational component of CQ. For many students, this virtual exchange was the first time they had worked with people on a different continent and several commented that they learned they needed to change their approach. Again, this suggests growth in CQ in the metacognitive components of strategy and action.

Another real challenge students faced was navigating the six hour time zone difference between Detroit and Wernigerode. Most German and American students had jobs in addition to school and family responsibilities. A requirement of the course was to participate in four joint Saturday classes so students planned for this in advance, but teams still regularly needed to meet outside of class. Students reflected that managing the time zone difference was challenging; there were instances when all team members could not participate. This helped teams learn to define roles and responsibilities, delegate tasks, ensure team communication and manage work integration. Given that most students will encounter time zone differences when working professionally, learning to work through this challenge is an important cross-cultural collaboration competency.

5.3 Sustainability

The educational backgrounds of the students involved in the exchange were similar. Nevertheless, their experiences, knowledge and awareness of sustainability were very different. Sustainability and Sustainable Development Goals are topics within the Master program in Germany. Moreover, the awareness of sustainability topics within German society has significantly increased throughout the last decade. Although American engineering students can elect to take a course in sustainability, it is not embedded in all curricula, nor is it as apparent in American society. Sustainability was an "eye-opener" for many American students, not only because of the course content but because of interacting with their German peers. Seeing firsthand the priority German students put on sustainability caused American students to examine their own behavior. Said one student, "I started looking at different aspects of my day-to-day life differently, trying to be more efficient and sustainable when it came to things, such as gas consumption, and the use of non-renewable energy." American students realized that the implementation of sustainability in day-to-day-life is "not cost prohibitive and even small steps can lead to positive impacts on the environment". Another American student concluded that the topic of sustainability can be integrated in his/her career as a future engineer. Overall, the feedback of the American students showed that not only did their knowledge of sustainability and the UN SDGs increase, but they recognized they had responsibilities as individuals and future engineers to work towards a more sustainable future. Alternatively,

German students realized that sustainability has not yet been well recognized or accepted in other countries further demonstrating the importance of these types of professional collaborations.

5.4 Methods

Students were able to create a scenario in a social impact area of their choosing that could be sustainable in the future in three different countries of the world and then conduct a PESTEL analysis to prioritize those factors that were most impactful. Teams had little difficulty executing these phases of the problem. Where students struggled was in identifying innovations to achieve this sustainable future. To help students think more creatively, it is recommended that time be allocated in the project at Milestone 4 for guided instruction to allow students to practice technology foresight methods like brainstorming, storyboarding, mind mapping, five whys analysis, etc.

5.5 Communication

A barrier teams had to overcome was communication. For some American students, it was their first time to regularly interact with non-native English speakers; as students observed their non-native English-speaking teammates communicate, it made them appreciate and respect the challenges these students faced. Students had no difficulty finding and using collaboration tools to communicate and execute their projects; tools like Google Docs, Zoom and WhatsApp were commonly chosen for collaboration. Student reflections proved to be an invaluable source of information and insight on attainment of the course learning objectives.

5.6 Limitations of Work

The described innovation and sustainability project was a collaboration between engineering and applied technology students at Wayne State University and Harz University of Applied Sciences. Students with no technical training may still benefit from a project such as this but may require additional background information and prerequisite knowledge about sustainability, problem-solving and innovation process to effectively complete the assignment. The diversity of students was limited by those attending the two participating universities; inclusion of additional universities would lead to additional cross-cultural perspectives and greater international diversity. Finally, the project was continuously improved over multiple semesters. The version described in this paper was tested only once and may continue to undergo improvements over subsequent semesters.

6 Conclusions

The Sustainability and Innovation project was conceived to strengthen the virtual cross-cultural collaboration of students from different universities while exposing them to the importance of the SDGs as the drivers of sustainable development. Students were able to choose a meaningful social impact area and using the innovation process develop scenarios of a sustainable future in different regions of the world. Specifically, the following objectives were achieved through the project design and implementation:

1. Students increased awareness of their own cultural values and further developed their cultural intelligence. The project gave students an authentic real-world learning experience that enabled them to practice and improve both their cross-cultural and virtual collaboration skills, critical for global engineers.

2. Students increased their knowledge of the Sustainable Development Goals, but more importantly, learned the importance of applying these goals to drive innovation for sustainable development in a social impact area (field of technology) that was meaningful to them.
3. Students learned and applied research backed methods to assess sustainable innovation both globally and regionally. These included scenario analysis to envision a sustainable future in their chosen field of technology, PESTEL analysis to identify and assess critical external factors and the ability to identify different development paths for their chosen regions of the world. Students do need help in future with technology foresight methods to think more creatively about the identification of innovation required for the project.
4. All students completed the project and successfully communicated their findings. The survey taken at the end of the semester as well as oral and written reflections showed that students increased their knowledge of sustainability while at the same time learning about their own cultural values, increasing their cultural intelligence and further developing their cross-cultural and virtual collaboration skills.

A key lesson learned from the evaluation is that additional time needs to be included in the project schedule for virtual and intercultural cooperation. This time is especially important for team building as well as allowing more time to focus on the innovation phase of the project.

The project can be implemented by students from various fields of study. However, it is particularly suitable for familiarizing technically trained students with the topic of sustainability in an international context. These cross-cultural project-based assignments are important contributors to the effective preparation of our future engineers, technologists and innovators.

References

Ang S, Van Dyne L, Koh C, Yee Ng K, Templer KJ, Tay C, Chandraseker NA, Cultural Intelligence (2007) Its measurement and effects on cultural judgment and decision making, cultural adaption and task performance. Manag Organ Rev 3, 335–371

Ang S, Van Dyne L, Tan ML (2011) Cultural intelligence. In: Sternberg R, Kaufman SB (eds) Cambridge handbook on intelligence. Cambridge University Press, pp 582–602

Crawford-Mathis KA (2009) Longitudinal study of cultural intelligence and self-monitoring personality. Paper presented at the academy of management meeting, Chicago, IL

Crowne K (2007) The relationship among social intelligence, emotional intelligence, cultural intelligence and cultural exposure. Doctoral Dissertation, Temple University

Crowne K (2008) What leads to cultural intelligence? Bus Horiz 51:391–399

Cuhls K (2008) Methoden der Technikvorausschau—eine internationale Übersicht, Fraunhofer IRB Verlag, Stuttgart

Earley P, Ang S (2003) Cultural intelligence: individual interactions across cultures. Stanford University Press, Stanford, CA

Elenkov DS, Manev IM (2009) Senior expatriate leadership's effects on innovation and the role of cultural intelligence. J World Bus 44:357–369

Freidman T (2005) The world is flat. Farrar, Straus & Giroux, New York, NY
Ghemawat P (2007) Redefining global strategy. Harvard Business School Press, Boston, MA
Groves KS, Feyerherm AE (2011) Leader cultural intelligence in context: testing the moderating effects of team cultural diversity on leader and team performance. Group Org Manag 36:535–566
Heijden Kvd (1996) Scenarios. The art of strategic conversation. John Wiley & Sons, Chichester, England and New York, (S. 7)
Imai L, Gelfand MJ (2010) The culturally intelligent negotiator: the impact of cultural intelligence (CQ) on negotiation sequences and outcomes. Organ Behav Decis Process 112:83–98
Kosow H, Robert Gaßner R (2007) Methods of future and scenario analysis: overview, assessment, and selection criteria. DIE research project "development policy: questions for the future" (Studies/Deutsches Institut für Entwicklungspolitik; 39), Bonn.
Mietzner D, Reger G (2005) Advantages and disadvantages of scenario approaches for strategic foresight. Int J Technol Intell Plann 1(2):220/239
Moynihan LM, Peterson RS, Earley PC (2006) Cultural intelligence and the multinational team experience: does the experience of working in a mutlinational team improve cultural intelligence? In Chen YR (ed) Research on managing groups and teams. Emerald Group, pp 299–323
Reibnitz U (1992) Szenario-Technik. Instrumente für die unternehmerische und persönliche Erfolgsplanung. Gabler Verlag, Wiesbaden
Rockstuhl T, Ng KY (2008) The effects of cultural intelligence on interpersonal trust in multicultural teams. In: Ang S, Van Dyne L (eds) Handbook of cultural intelligence: theory, measurement and applications. M.E. Sharpe, New York, NY, pp 206–220
Rockstuhl T, Ng KY, Seiler S, Ang S, Annen H (2009) Emotional intelligence and cultural intelligence in global leadership effectiveness. In: Paper presented at 24th annual conference of the society for industrial & organizational psychology meeting, New Orleans
Shannon LM, Begley TM (2008) Antecedents of the four factor model of cultural intelligence. In: Ang S, Van Dyne L (eds) Handbook of cultural intelligence: theory, measurement and applications. M.E. Sharpe, New York, NY, pp 41–55
Shokef E, Erez M (2008) Cultural intelligence and global identity in multicultural teams. In: Ang S, Van Dyne L (eds) Handbook of cultural intelligence: theory, measurement and applications. M.E. Sharpe, New York, NY, pp 177–191
Schoemaker PJH (1995) Scenario planning—a tool for strategic thinking. Sloan Manag (36):25/40
Spath D (eds), Schimpf S, Lang-Kroetz C (2010) Technologiemonitoring. Fraunhofer Verlag Fraunhofer-Informationszentrum Raum und Bau, Stuttgart
Sternberg RJ (1997) Successful intelligence: how practical and creative intelligence determine success in life. Plume, New York, NY
Tarique I, Takeuchi R (2008) Developing cultural intelligence: the role of international nonwork experiences. In: Ang S, Van Dyne L (eds) Handbook of cultural intelligence: theory, measurement and applications. M.E. Sharpe, New York, NY, pp 56–70
Tay C, Westman M, Chia A (2008) Antecedents and consequences of cultural intelligence among short term business travelers. In: Ang S, Van Dyne L (eds) Handbook of cultural intelligence: theory, measurement and applications. M.E. Sharpe, New York, NY, pp 126–144
UCL (2018). Innovation in engineering education. Inspiring & preparing our engineers for the 21st Century in UCL report 2018, London, pp 12–13
Van Dyne L, Ang S, Ng K, Rockstuhl T, Tan M, Koh C (2012) Sub-dimensions of the four factor model of cultural intelligence: expanding the conceptualization and measurement of cultural intelligence. Soc Pers Psychol Compass 6(4):295–313

Student Knowledge and Perceptions of a Green Campus

Lauren Schrock, Lydia Giannini, Beth Choate, and Matthew Bethurem

1 Introduction

The United Nations Environment Programme reports in October, 2021 that over 1,000 universities throughout the world have committed to "reach net-zero emissions by 2050 and transform their impact on nature" (UNEP 2021). Many institutions demonstrate their commitment to sustainability through the signing of declarations, charters, and partnerships that state the institution will engage with sustainability initiatives and focus these efforts in areas such as "education, research, campus operations, community outreach, and assessment and reporting" (Lozano et al. 2013, 2015). Additional initiatives toward sustainability that are happening across campuses include energy efficiency and management, minimizing water consumption, and affordable public transport in an effort to make a positive difference in a college or university's carbon footprint (Lozano et al. 2015). Cai and Shafiee-Jood (2017) report that renewable energy labs, green infrastructure, a Campus Sustainability Innovation Fund, stormwater management wetland demonstration project, and student funds for research exist at some of the most prestigious green campuses within the US. Additionally, many schools have committed to the goal of carbon neutrality which has been achieved by reducing their C footprint and supporting methods of carbon sequestration (Jain et al. 2017).

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A wide variety of sustainability initiatives have proven to be useful at reducing waste, saving money, and greatly decreasing the impact of institutions of higher education on the environment. However, research suggests that sustainability efforts have not been integrated seamlessly across all operations of institutions of higher education (Lozano et al., 2015). Venkataraman (2009) states, "Embracing ESD at all levels of education and assessing programs and efforts to establish best practices… are crucial to producing citizens that embrace sustainable development as a guiding principle of their lives." Many campuses offer sustainability courses as well as Environmental Science and Sustainability majors that incorporate issues of campus sustainability; however, beyond these programs and departments sustainability efforts often remain unknown to the campus community (McMillin and Dyball 2009). Institutions of higher education must seek ways to ensure that their sustainability efforts are known and understood by the student body. Only then will the efforts to create sustainable campuses translate into developing citizens of the world that prioritize sustainability.

Allegheny College is a small undergraduate, liberal arts school located in Meadville, Pennsylvania. Allegheny was the eighth college in the U.S. and first college in PA to reach carbon neutrality ("Allegheny…" 2020; Holthouse 2020). Additionally, it is home to the nationally ranked Environmental Science and Sustainability department ("Top Environmental Science Schools" n.d.). The college has undertaken large-scale initiatives, such as retrofitting buildings to make them more energy efficient, purchasing 100% renewable energy, installing geothermal heating and cooling in multiple buildings across campus, along with a suite of additional efforts (Sustainability n.d.). Across campus you will find students using "green boxes", our reusable to-go food containers, refilling water bottles at one of the 2-dozen plus bottle refills stations and composting their food scraps, utensils, napkins and cups in the dining halls. Student residence halls participate in an annual energy challenge and the savings generated through this program are used to fund more sustainability efforts (Sustainability n.d.). The campus garden produces 2000 pounds of organic produce each year that is served to the students and faculty through the campus dining halls and catering (Sustainability n.d.). While on campus, most students are engaging with initiatives that reduce their environmental footprint on a daily basis (Bethurem et al. 2021); however, we remain unsure if students understand the importance of these initiatives.

Ensuring that a green campus is acting as an educational tool for all students is important as we seek to create leaders in making environmental change. The overarching question of this research is to determine if as an institution of higher education we are effectively communicating the importance and environmental impact of our sustainability initiatives in a way that results in the creation of sustainable citizens. Our research begins to address this question by seeking to determine if students are aware of Allegheny's sustainability efforts and understand their benefits to the environment.

2 Methods

Over a 5-week period from October 16th to November 20th, 2019, we conducted a survey examining students' knowledge and understanding of campus sustainability efforts. The survey was distributed to undergraduate students over the age of 18 at Allegheny College. Students participated in the survey voluntarily and were incentivized with the chance to win a 25-dollar visa gift card. Students were made aware of the survey through a daily online announcement board (myAllegheny), through public tabling conducted over two hours on three different days, via instructors of ESS classes, by instructors of first year seminars, and by building coordinators who emailed it to the majors in their department.

The survey was designed by two Environmental Science professors and two of their students. It consisted of 11 questions total, 2 of which were designed to filter out students who were not eligible and 3 of which were demographic questions. The questions were presented in a variety of formats, including Likert scale, "select all that apply", and short answer questions. The survey asked questions about Allegheny's current sustainability efforts, asking students to identify which efforts were in use, identify the effort that they felt is most important, and explain how that effort benefited the environment. Students were also asked whether they had thoughts for additional sustainability efforts that could be effective on campus.

Students were presented with a list of 14 sustainability initiatives and asked to select which initiative Allegheny participates in. For the analysis, these initiatives were classified as visible initiatives, less visible initiatives, and incorrect initiatives. "Water refill stations," "solar panels," "composting facility," and "reusable and compostable food containers" were categorized as visible initiatives. Visible initiatives are those that students engage with regularly and see on a day to day basis. "Geo-thermal heating," "low flow shower heads," "porous pavers in parking lots," "rain gardens," "locally sourced food," "energy efficient lighting," and "purchase 100% renewable energy" were categorized as less visible initiatives. Less visible initiatives are those that students do not engage with daily and are less likely to know they exist (geo-thermal and energy efficient lighting) or their function (porous pavers and rain gardens). There were three initiatives that the college does not do on our campus, "animals as lawnmowers," "incinerate trash for energy," and "own low carbon vehicles".

2.1 Data Analysis

For all questions, the percentage of individuals that selected each response was calculated. For questions that allowed respondents to select more than one answer, multiple answers per individual were tallied as separate responses and recorded. Responses to open-ended questions were coded to identify recurring themes. Quantitative data

were then generated from open-ended questions by tabulating the number of occurrences of each of those themes in the responses. A one-way ANOVA was conducted to determine if sustainability ranking varied significantly by class year, and a Student's *t*-test was conducted to determine if sustainability ranking varied significantly by major.

3 Results

Approximately 23% of the student population (N = 440) participated in the survey. Sixty seven percent of participants identified as female, 30% identified as male, 1% identified as nonbinary, and 2% did not include their gender. In the fall of 2019, the student body was comprised of 56% females, 44% males, and 0.5% students identifying as non-binary. The percentage of student respondents within each class year are first year 26%, second year 20%, third year 25%, fourth year 29% and fifth year 0.5%. The distribution of students across each class on campus: first year 31%, second year 23%, third year 21%, fourth year 22%, and fifth year 3%.

Environmental Science and Sustainability (ESS) majors were the most common respondents, accounting for 26% of all responses, despite making up 14% of total campus population. Other common majors include Biology (10.6%), Economics (8.9%), Global Health Studies (8.7%), and Psychology (8.2%). With the exception of Global Health Studies, these majors were among the most popular majors on campus at the time of the survey. All responses from majors outside of these five were combined into a sixth category of major, "other," making up 38% of responses. Eighty five percent of the current majors offered to students were represented in the survey responses.

For the first question, respondents were asked to rank Allegheny's sustainability on a scale from 1 to 5 (1 being "not at all sustainable" and 5 being "very sustainable"). The average ranking was a 3.8 (SE $\pm$ 0.03), and the most common response was a 4/5 (57%). No student ranked the college a 1 with regards to sustainability. First year students ranked Allegheny's sustainability highest ($\bar{x} = 4.0$; SE $\pm$ 0.06), while second year students had an average ranking of $\bar{x} = 3.8$; SE $\pm$ 0.08. Third year students had the lowest average ranking ($\bar{x} = 3.6$; SE $\pm$ 0.07) and fourth year students had an average ranking of $\bar{x} = 3.7$; SE $\pm$ 0.06. A one-way Analysis of Variance test revealed that there is significant variation between class year and ranking, with first year students ranking Allegheny's sustainability significantly higher than third and fourth year students ($P = 0.0012$). ESS students ranked the college at 3.9 while Economics, Global Health Studies, and Biology majors ranked the college at 3.7. Psychology majors ranked the college a 3.5 and the "other" category of majors ranked Allegheny as a 3.8. A student's *t*-test indicated that ESS majors did not rank the college's sustainability significantly higher than all other majors.

In an open-ended question, students were asked to identify the most important sustainability effort made by Allegheny College. The most frequent responses referred to visible sustainability efforts, including reusable take out boxes (37%)

and composting (20%). Other responses included recycling (6%), carbon neutrality (6%), LEED certified buildings (5%), solar panels (4%), and unknown (5%). The most common response for ESS majors was also reusable take out boxes (24% of ESS majors) and composting (21%), while 19% of ESS student respondents identified Carbon neutrality as the most important sustainability measure. Only 1% of all other majors identified Carbon neutrality for this question. Only ESS majors identified reusable dining utensils in the dining hall, informational signage, and environmental clubs as the most important sustainability measures (Each of these responses was only mentioned once.).

In the next open-ended question, students were asked to indicate the benefit of that sustainability effort to the college. The most common response to this question was to reduce waste in general (20%) (Fig. 1). Other responses related to limiting physical waste of all kinds with answers including reducing dining/food waste (12%), limiting plastic (11%), reducing single use plastic (7%), and less landfill waste (6%) (Fig. 1). Other responses included working towards reducing fossil fuels (7%), achieving Carbon neutrality (6%), and spreading awareness (5%) (Fig. 1). There were a large number of responses to this question coded as N/A due to incoherent or off topic responses (6%) (Fig. 1). Additionally, the responses "prevents runoff", "boosts student enjoyment", "convenience", and "looks good for admissions" were mentioned once each. ESS majors showed the most diversity in responses with answers covering 26 different codes. The common responses for ESS majors mirrored the common responses of the entire study, with the addition of "prevents climate change."

An additional open-ended question asked specifically how the most important sustainability effort identified benefits the environment. Responses were similar to those for the question above despite the altered language. The most common responses were "limit landfill waste" (19%) or a general "reduce waste" (19%). Many of the most common responses to this question involved Allegheny limiting outputs, including waste, carbon and other fossil fuels, and pollution in general. Compared to the previous question, fewer responses were coded N/A for being confusing (3%). Some students indicated that we return to their answer to the last question "what is the benefit of this effort?" for their response (1%). The most common responses among ESS majors were "reduce fossil fuels" and "less landfill waste".

The next question in the survey provided students with a list of sustainability initiatives and asked students to identify all of the initiatives that the college actually participates in. This question had 14 total options with 11 true initiatives and 3 decoys. Out of all 14 initiatives, the decoys were chosen the least frequently. Three percent of respondents selected "animals as lawnmowers," 5% of respondents selected "incinerate trash for energy," and 7% selected "own low carbon vehicles" (Fig. 2). Of the 11 true initiatives, "porous pavers in parking lots" (23.7%) and "purchase 100% renewable energy" (20.1%) were selected the least frequently (Fig. 2). The most commonly identified initiatives were water refill stations (93.5%) and reusable and compostable food containers (92.3%) (Fig. 2). Approximately 50% of respondents correctly identified geothermal heating as one of Allegheny's sustainability initiatives (Fig. 2). On average, the initiatives labeled as visible were identified more

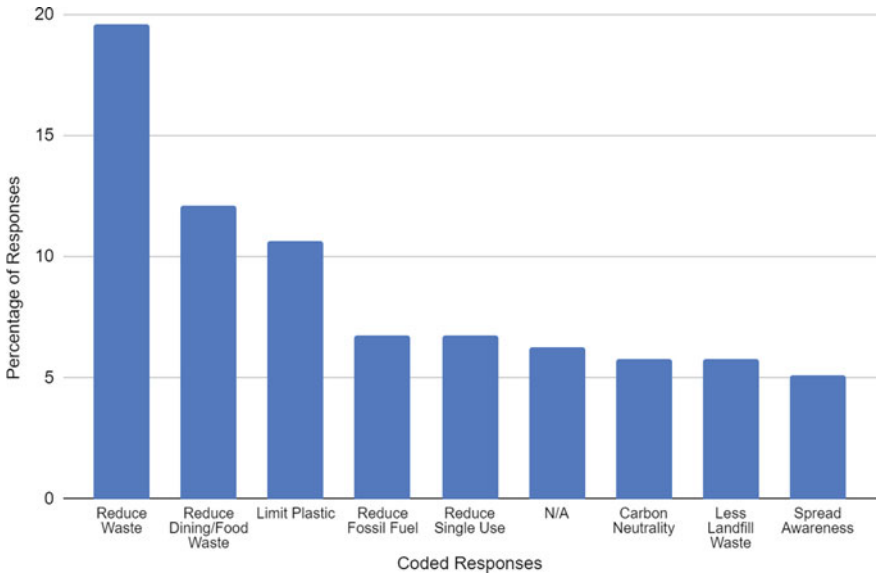

Fig. 1 The most common answer codes when students were asked to indicate the benefit of the most important sustainability effort to the college that they identified in the previous question

frequently than less visible initiatives. Locally sourced food, the third most common selection, was determined to be a less visible initiative, but was correctly identified in 82% of responses (Fig. 2). Geothermal heating was only correctly identified as one of Allegheny's initiatives in 50% of responses (Fig. 2).

Out of 414 total responses, only 13 students were completely correct. Ten of the 13 correct responses came from ESS majors. Third year students had the most correct responses (6), followed by fourth year students (5), and then by second year students (2). No first year students submitted a completely correct response.

The final question asked students what efforts they felt the college should be making towards sustainability. Nineteen percent of student responses were categorized as "Unknown" since many did not answer the question or responded N/A. The second most common answer was that Allegheny needs to have more renewable energy (9%). Over half of the students that responded to the question (55.07%) listed a sustainability effort that is already happening at the college, or suggested that the college needs to increase their commitment to efforts already being done at the college, such as obtaining more renewable energy (10%), more solar panels (7%), or reaching carbon neutrality (4%). Seven percent of responses recommended that we implement "Animals as lawnmowers", one of the decoy initiatives in the "select all that apply" question at the beginning of the survey. Three percent of students answered that we should focus on improving all current initiatives.

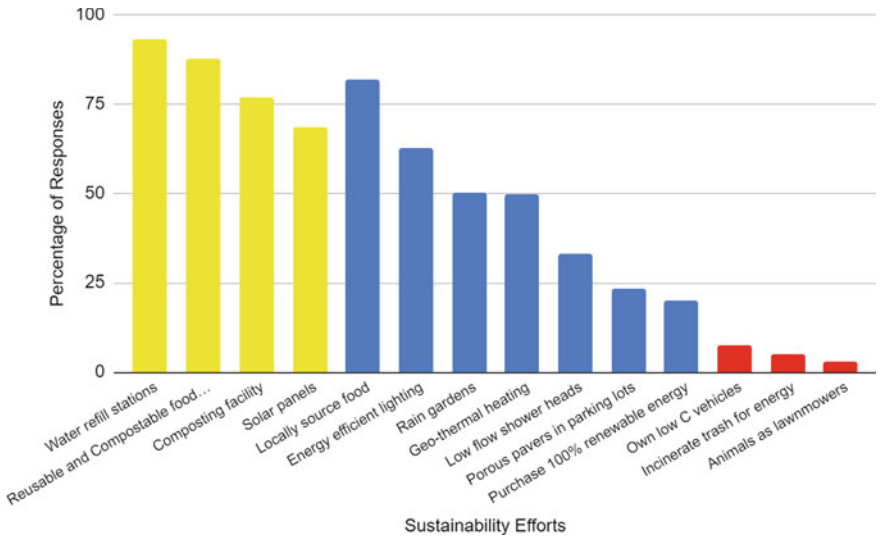

Fig. 2 This figure displays the percentage that each option was selected from a list of 14 sustainability initiatives provided. Students were asked to select all initiatives the college participates in with some initiatives being decoys, initiatives that the college does not do. The yellow initiatives are coded as visible, the blue are coded as less visible, and the red are decoys, initiatives that the college does not do

4 Discussion

Wang et al. (2013) points out that the "impacts" of sustainable campuses on students is not well known, something we must understand to further guide the preparation for students to accomplish the sustainable development goals set out by the United Nations. The results of this survey demonstrate that Allegheny College students are aware of certain sustainability efforts and their impact on the environment. However, they know far more about the sustainability efforts that they are exposed to or use on a daily basis than they do about what many would argue are the most impactful i.e. Carbon neutrality and geothermal heating and cooling.

This survey indicated not only a knowledge of campus initiatives among students, but also which students possessed a majority of that knowledge. A large number of student respondents were Environmental Science and Sustainability (ESS) majors. While this may be considered a limitation of the study, the authors were able to draw conclusions about ESS majors. Two factors likely contributed to the large number of ESS respondents. One is that this survey was marketed as a sustainability survey. Since Allegheny is a small campus, it is easy to identify which department is distributing a survey and for respondents to identify that survey with the focus of that department. Additionally, professors within the ESS department aided in distribution of the survey through their classes and some offered extra credit to students for completing the survey. This method may have unintentionally attracted a

larger proportion of ESS students than students in other popular majors. One positive outcome of this trend is that we had a large enough population of ESS students to compare their knowledge of sustainability to students on campus that are not studying sustainability as a requirement of their major.

All students ranked the college's sustainability above average. Students majoring in ESS gave the college the highest ranking, likely due to increased knowledge about campus sustainability measures being discussed in courses. Previous studies have also shown that students who take courses in environmental studies are more environmentally aware (Smith-Sebasto 1995). Additionally, these students are also more likely to seek out information about the college's sustainability practices due to their interest in the field (Lewington 2020). A positive correlation was also found between first year students and higher sustainability rankings. This is potentially due to the fact that Allegheny's sustainability efforts are so heavily advertised to incoming academic classes with admissions offering a "Green Tour" to interested prospective students.

When students were asked about the most important sustainability effort on campus, the most common responses were the green box program, composting, and water bottle refill stations. Uncoincidentally these initiatives are also the ones that are the most visible. Students from every major were able to identify at least one of these programs. Common responses by ESS majors were evenly split between green boxes, composting, and reduced carbon emissions/ESS students responded with a broader range of responses, many of which would be considered "less visible". Some of the least mentioned initiatives were the LEED certified buildings, geothermal heating, and wind energy. It was surprising that only 6 respondents mentioned the energy challenge. This is a month-long event that encourages dormitories to compete for the greatest reduction in energy usage for the month of October (Boulton et al. 2017).

The next two questions asked "what is the benefit of this effort?" and "how does this effort benefit the environment?" One limitation of the study was the large amount of overlap between the answers to these two questions. The original intent of the question "what is the benefit of this effort?" was to collect answers about the benefit of these efforts to the college, but not from an environmental view point. We anticipated the majority of the answers to focus on college operations and business, but instead received a majority of responses regarding sustainability. The emphasis of the following question, "how does this effort benefit the environment?" was the question that was designed to draw answers about environment-related benefits. Instead, both questions drew similar responses, with the most popular answer for both questions was "reduce waste (general)," accounting for 20 and 19% of the responses respectively.

When asked to identify sustainability efforts from a list, results indicate that students are more likely to correctly identify sustainability efforts that are visible to them, such as solar panels, or efforts that they frequently use, such as water refill stations or the composting facility. Certain sustainability efforts, such as geothermal heating, were only mentioned in half of the responses. Locally sourced food was classified as a "less visible initiative" but was correctly identified by a large number of respondents. This is likely the result of a very visible college garden on the campus.

While the Carr-den does provide a small percentage of food to the dining halls, this response was meant to indicate that the college's dining provider makes every effort to source food from within a 100 mile radius of the college (Sustainability n.d.).

ESS students seemed more knowledgeable about a variety of sustainability efforts, as well as their benefit to the environment. Fisher and McAdams (2015) found that coursework in higher education plays a major role in how students view sustainability; however, studies have also shown a strong connection between emotion and behavior, suggesting that creating environmental emotion in students would make them more likely to be sustainable citizens when given the option (Carmi et al. 2015). Perhaps students who chose to major in ESS come to college with strong emotions toward environmentalism and the question becomes how to evoke that in students within other majors.

This study is an important first step to understanding the role of campus sustainability in creating sustainable citizens. Universities are no longer assessed for their provision of education alone, but are also regarded for their commitment to move society forward (Nejati and Netaji 2013). As the importance of sustainability practices evolve in society, so should they in a university. Despite the fact that many of our students are aware of our sustainability efforts, the authors question if their engagement with those efforts is the result of being on a college campus that makes it extremely convenient to be environmentally friendly. Studies such as Thondhlana and Hlatshwayo (2018) and Bethurem et al. (2021) identify that students are more likely to participate in pro-environmental behavior if it is convenient to do so. The question now becomes how do sustainable institutions ensure that they are serving as learning laboratories for students to become sustainable citizens and leaders.

5 Conclusion

In order for institutions of higher learning to create the sustainability leaders of the future, they must consider how to use sustainable campuses as living laboratories. Through a survey, it was determined that Allegheny College students are aware of the sustainability efforts with which they interact on a daily basis; however, the less visible efforts such as Carbon neutrality and purchasing renewable energy are less well known. ESS students seem to be more aware of sustainability likely due to discussions within their courses, yet the aim should be to reach students majoring in all disciplines. The college must find ways to better communicate their own sustainability and ensure that all students understand the importance of efforts such as greenhouse gas and waste reduction on their future. All students graduating from Allegheny College should be prepared to become environmental change agents.

References

Allegheny College becomes first college in Pennsylvania, Eighth in nation to achieve carbon neutrality. Allegheny College News Center. April 14, 2020

Bethurem M, Choate B, Bramwell S (2021) Stop piling on: assessing efforts to reduce single-use water bottles at Allegheny College. Sustainability 13(16):8864

Boulton K, Pallant E, Bradshaw-Wilson C, Choate B, Carbone I (2017) Energy challenges: isolating results due to behavior change. Int J Sustain High Educ 18(1):116–128

Cai X, Shafiee-Jood M (2017) Review of campus sustainability programs: opportunities for education and research. Institute for Sustainability, Energy, and Environment University of Illinois at Urbana-Champaign. https://sustainability.illinois.edu/wp-content/uploads/2018/02/Review-of-CS-programs.pdf

Carmi N, Arnon S, Orion N (2015) Transforming environmental knowledge into behavior: the mediating role of environmental emotions. J Environ Educ 46:183–201. https://doi.org/10.1080/00958964.2015.1028517

Fisher PB, McAdams E (2015) Gaps in sustainability education. Int J Sustain High Educ 16(4):407–423. https://doi.org/10.1108/IJSHE-08-2013-0106

Holthouse S (2020) Allegheny receives award for being first PA college, 8th in nation to achieve carbon neutrality. The Campus

Jain S, Agarwal A, Jani V, Singhal S, Sharma P, Jalan R (2017) Assessment of carbon neutrality and sustainability in educational campuses (CaNSEC): a general framework. Ecol Ind 76:131–143. https://doi.org/10.1016/j.ecolind.2017.01.012

Lewington J (2020) In a climate-anxious world, these colleges are training students to fight back. https://www.macleans.ca/education/college/in-a-climate-anxious-world-these-colleges-are-training-students-to-fight-back/. Accessed 29 Sep 2020

Lozano R, Lukman R, Lozano FJ, Huisingh D, Lambrechts W (2013) Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. J Clean Prod 48:10–19. https://doi.org/10.1016/j.jclepro.2011.10.006

Lozano R, Ceulemans K, Alonso-Almeida M, Huisingh D, Lozano FJ, Waas T, Lambrechts W, Lukman R, Hugé J (2015) A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey. J Clean Prod 108(A):1–18. https://doi.org/10.1016/j.jclepro.2014.09.048

McMillin J, Dyball R (2009) Developing a whole-of-university approach to educating for sustainability: linking curriculum, research and sustainable campus operations. J Educ Sustain Dev 3:55–64. https://doi.org/10.1177/097340820900300113

Nejati M, Nejati M (2013) Assessment of sustainable university factors from the perspective of university students. J Clean Prod 48:101–107. https://doi.org/10.1016/j.jclepro.2012.09.006

Smith-Sebasto NJ (1995) The effects of an environmental studies course on selected variables related to environmentally responsible behavior. J Environ Educ 26(4):30–34. https://doi.org/10.1080/00958964.1995.9941449

Sustainability (n.d.) Allegheny College Website. https://sites.allegheny.edu/sustainability/. Accessed 2 Nov 2021

Thondhlana G, Hlatshwayo TN (2018) Pro-environmental behaviour in student residences at Rhodes University, South Africa. Sustainability 10(8):2746. https://doi.org/10.3390/su10082746

Top Environmental Science Schools (n.d.) EnvironmentalScience.org. https://www.environmentalscience.org/top-schools. Accessed 2 Nov 2021

UNEP (2021) Over 1,000 universities and colleges make net-zero pledges as new nature initiative is unveiled. https://www.unep.org/news-and-stories/press-release/over-1000-universities-and-colleges-make-net-zero-pledges-new-nature. Accessed 28 Jan 2022

Venkataraman B (2009) Education for sustainable development. Environ Sci Policy Sustain Dev 51(2):8–10. https://doi.org/10.3200/ENVT.51.2.08-10

Wang Y, Shi H, Sun M, Huisingh D, Hansson L, Wang R (2013) Moving toward an ecologically sound society? Starting from green universities and environmental higher education. J Clean Prod 61:1–5

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Using Out-Of-Class ESD Experiences to Link the Outside World with Young People's Lives

Fiona Vella Ciangura and Mark Christopher Mifsud

1 Introduction

The concept of Education for Sustainable Development (ESD) arose from the need to address growing global environmental challenges. The Tbilisi + 35 Intergovernmental Conference on Environmental Education acknowledged that "ESD is now internationally recognized as a fundamental education strategy to prepare citizens with the values and principles of sustainable development, the knowledge of sustainability issues, and the skills and motivation to apply this knowledge to their own actions" (UNESCO, UNEP and the government of Georgia, 2012 as cited in UNESCO 2014).

Owing to its complexity, ESD cannot be simply taught as a stand-alone subject, but must be incorporated throughout the educational system, curricula, policies as well as in formal, informal and non-formal learning. It is important that students are given different experiential, participatory and collaborative opportunities to link SD principles to their lives, thus making them real, personal, and memorable (Leicht et al. 2018). To have a meaningful education about and for sustainable development, students should be provided with varied opportunities in which to link Sustainable Development (SD) to their everyday lives, interests and experiences (Leicht et al. 2018). One possible way to do so is by allowing them to spend time in the natural environment whilst carrying out various activities.

This research is about the potential of using out-of-class activities during school time to promote ESD. Specific focus is laid on informal gardening activities which

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are carried out during break and free time. It covers a niche which tries to link recreation, environmental protection, and awareness, together with personal and social development. This follows the idea that ESD is a type of education that is based not only on acquiring new knowledge, but also on gaining the right attitudes/values and skills in which students become empowered in their own learning, become critical thinkers, collaborate in teams and participate in decision-making (Cheang et al. 2017). This study is also inspired by Sir David Attenborough's statement, "No one will protect what they don't care about; and no one will care about what they have never experienced" (Williams 2013).

This aspect of learning about and through the outdoors is also much relevant (re spending most of their time indoors (de la Vega and Toscano 2018). Nature connectedness is now considered a fundamental link to pro-environmental behaviour and extending student participation in such outdoor activities has proven to be considerably more effective (Braun and Dierkes 2017). Moreover, understanding what type of learning happens when students are absorbed in outdoor activities is interesting and can shed light on different ways that can engage and empower students by presenting ESD in a more practical and relevant way. Unfortunately, instilling in students the values, knowledge, and skills that ESD entails is not so straightforward, and does not seem to be something that can be achieved by traditional pedagogies.

This research, thus, strives to understand:

- the learning path students take, whilst participating in out-of-class activities and how this mirrors Education for Sustainable Development;
- how out of class activities develop students' cognitive, affective, interpersonal/social and physical/behaviour domain; and,
- the effectiveness of retrospective interviews, observations and concept maps to monitor and promote students' education for sustainable development.

All this will guide researchers into taking informative and practical decisions about how to better incorporate ESD activities in schools. An engaging, holistic and transformative education in ESD will have a long-term effect on the future of our communities. Today's students are tomorrow's leaders and decision makers. It is thus highly important that all opportunities to fully integrate ESD in today's school life are utilised. This will be key to promote pro-environmental knowledge, values and skills by raising awareness, foster empowerment and commitment towards protecting the environment in the hope of having a more sustainable literate society.

2 Literature Review

Global challenges are great and escalating, thus the call for uniting and working towards reaching a balance between the environmental, societal, and economic systems. Educators have to understand the relevant ways in which education address such issues. As Irina Bokova, Director-General of UNESCO (UNESCO 2016) remarked, education has a responsibility to be in gear with twenty-first century

challenges and aspirations and equip citizens with the right skills, knowledge, and attitudes to face these struggles. Educators and policy makers have to realise that education and behavioural changes are not necessarily directly linked (Mifsud 2012). Education based on knowledge learning, and with little emphasis on 'values education,' is insufficient to meet the challenges of catering for a better future. Education has to change to meet today's challenges. There must be a shift from traditional, information-transfer teaching to competency-based, transformative learning (Sterling 2001). Students are to be given opportunities to be able to embrace risk, to understand ambiguity, to be committed, to develop critical thinking and to appraise the sense of leadership (Bendell et al. 2017).

One possible way of doing so is by taking students out of the classroom and involving them in taking care of a natural space, so as to offer opportunities for students to learn about their surroundings, appreciate it and link it to bigger, more complex realities. Literature shows the benefits this can have. Ozer (2007) compiled several studies that highlight the value of school gardens as learning laboratories, with high aesthetic value, places where to grow and consume fresh produce and promote a healthy lifestyle. Fisher-Maltese et al. (2018) also believe that school gardens positively influence nutritional habits (Nanney et al. 2006) and exercise (Dillon et al. 2006). According to Higgins and Loynes (1997) outdoor education is considered to be a pedagogy promoting recreation, awareness, environmental protection and personal and social development. Literature, also shows how school gardens can be an effective example of Powerful Learning Environments, by fostering an extensive range of environmental, social, recreational, health and public educational benefits to sustain the well-being of the local community (Cheang et al. 2017). As James and Williams (2017, p. 59) explain, "Scaffolding the learning from the classroom to the field and then back to the classroom results in memorable, comprehensive, and long-term learning".

Voluminous literature shows the importance of incorporating SD in education, with particular reference to teacher training and mainstream education, as well as illustrating various challenges and opportunities that may arise (Briguglio and Pace 2004; Dewhurst and Pendergast 2011; Zowada et al. 2020; Springett and Kearins 2001; Summers and Kruger 2003). To have meaningful transformative education, educators need to incorporate a holistic approach to link SD principles to students' lives especially through experiential, participatory and collaborative ways, thus making them real, personal, and memorable (Leicht et al. 2018). Educators should find ways how to move away from teaching about SD and strive to promote ESD.

Students must not only learn about the environment, economic and social dimensions of SD but need to have practical ways on how to engage with them. However, in today's society children and young people are spending less time outdoors (Clark and Cassar 2013; Mifsud and Chisholm 2018) and are leading increasingly urban, sedentary, and technologically driven lives away from the outdoors (Curry and Brown 2010). Some scholars say that there is an increased nature-deficit disorder, that is linked to rises in obesity, attention disorders, and depression (Louv 2005). Moreover, Lindemann-Matthies and Bose (2008) advise that to increase biodiversity education

and conservation, people have to reconnect to nature, promote more in-depth knowledge of biodiversity, and encourage people to take environmentally-friendly actions. Studies also confirm that nature connectedness counts as a crucial predictor of pro-environmental behaviour, and that extended student participation in such outdoor activities are the significantly more effective (Braun and Dierkes 2017). Thus, one might ponder, how can formal education on its own be sufficient to empower students in owning and managing their environment, if they are becoming disengaged from their natural surrounding environment? It is in this light that the study undertaken by the author seeks to go beyond formal education and tries to unfold the learning that happens when students are offered the opportunity to participate in informal out-of-class activities within the schooling system. This scenario offers students a chance to act without curriculum restrictions, interact with nature, learn about it and take responsibility of their actions whilst working as a team.

This research is meant to develop further understanding of how out–of-class gardening experiences can foster ESD. It focuses on the potential of using activities carried out in break and free time, as this offers a scenario without curriculum restrictions and it is freely available to all students, irrespective of academic achievement and subject choice. The study is generally based on Rickinson et al. (2004) metanalysis work that examined 150 pieces of research on outdoor learning, similar to local literature, and which shows how outdoor learning can have a cognitive, affective, interpersonal and physical impact, which in turn can help students grow personally and according to ESD principles, and hopefully move on from the Awareness, Empowerment and Commitment stages as explained by Cooper (2004) as explained in Table 1.

Learning by doing, as originally proposed by Dewey (1916), is a widely accepted learning concept. People remember things they did and actively worked upon, more than things that were told to them, especially if they are emotionally engaged. Thus, it is our role as educators, to give youth varied experiences that will engage them and promote commitment to working according to ESD principles. There is no one-size-fits-all solution, and researchers, as well as educators, should always strive to understand best practices, unfold challenges and work towards having quality education.

3 Methodology

The aim of this qualitative case study is to get a deeper understanding of the learning journey that students in one school experience whilst participating in voluntary out-of-class gardening activities. Various methods are used to understand if this learning can extend beyond Environmental Education (EE) and develop students' cognitive, affective, interpersonal-social and physical-behaviour domain as suggested by Rickinson et al. (2004) and how this further mirrors Education for Sustainable Development. This case study will serve to shed empirical light on the aforementioned theoretical concepts or principles.

Table 1 The impact of outdoor learning on students

Cognitive impacts
• **Concerning knowledge, understanding and other academic outcomes**
• Literature shows that positive outdoor teaching and learning approaches are important conduits towards understanding of sustainability (Higgins 1997; Higgins and Kirk 2001; Irwin 2008; Prince 2016). Fisher-Maltese et al. (2018) also believe that school gardens positively influence academic achievement (Blair 2009; Klemmer et al. 2005)
Affective impacts
• **Encompassing attitudes, values, beliefs, and self-perceptions**
• Working in school gardens positively effects environmental attitudes (Fisher-Maltese 2016), skills, self-esteem and self-confidence (Ruiz-Gallardo et al. 2013)
Interpersonal-social impacts
• **Including communication skills, leadership, and teamwork**
• According to Twiss et al. (2003) school gardens provide a new setting for interactions among members of the school community and potentially promote the social networks, sense of connectedness, and skills
Physical-behavioural impacts
• **Relating to physical fitness, physical skills, personal behaviours, and social actions**
• Other studies also show how gardening programmes can improve behavioural attitudes (Ruiz-Gallardo et al. 2013)

Note Table explaining cognitive, affective, interpersonal- social and physical—behavioural impacts outdoor education has on students. Adapted from "A review of research on outdoor learning." (p. 16), by M. Rickinson et al. (2004), National Foundation for Educational Research and King's College London

This research is a single case study, as it covers trends over an elongated period of time of one group in one secondary state school and is done following a developmental course of interest (Yin 2018). As Yin (2018) explains, case studies are useful in answering questions of 'how' and 'why' and providing a dynamic and in-depth analysis of a subject that can be a program, individual, organisation, institution of event and help us determine context characteristics that will help with its understanding (Sanders 1981).

Tackling ESD through out-of-class activities is one way of achieving transformative education that is needed to have ESD. The Concept map, ESD in local schools (Fig. 1) shows the different ways ESD can be implemented in schools. As shown in the concept map, ESD can be carried out in all subjects (Sund and Gericke 2020), both in class and in an outdoor setting.

During this study, the author followed an interactive model of research design. This, as explained by Maxwell (2012), has an interconnected and flexible structure based on five concepts that are: goals, conceptual framework, research questions, methods, and validity (Fig. 2). These concepts are closely but flexibly linked. They are also linked to postmodernism which rejects the idea of using research to find the universal, single truth. At times they are also linked to 'bricolage' that is a more spontaneous and improvised use of the resources at hand (Maxwell 2012).

This qualitative case study was designed to identify and examine one gardening club at a state-secondary school in Malta. Here, students' participation is voluntary and takes place mostly during lunch-breaks and when they have a free period. Their

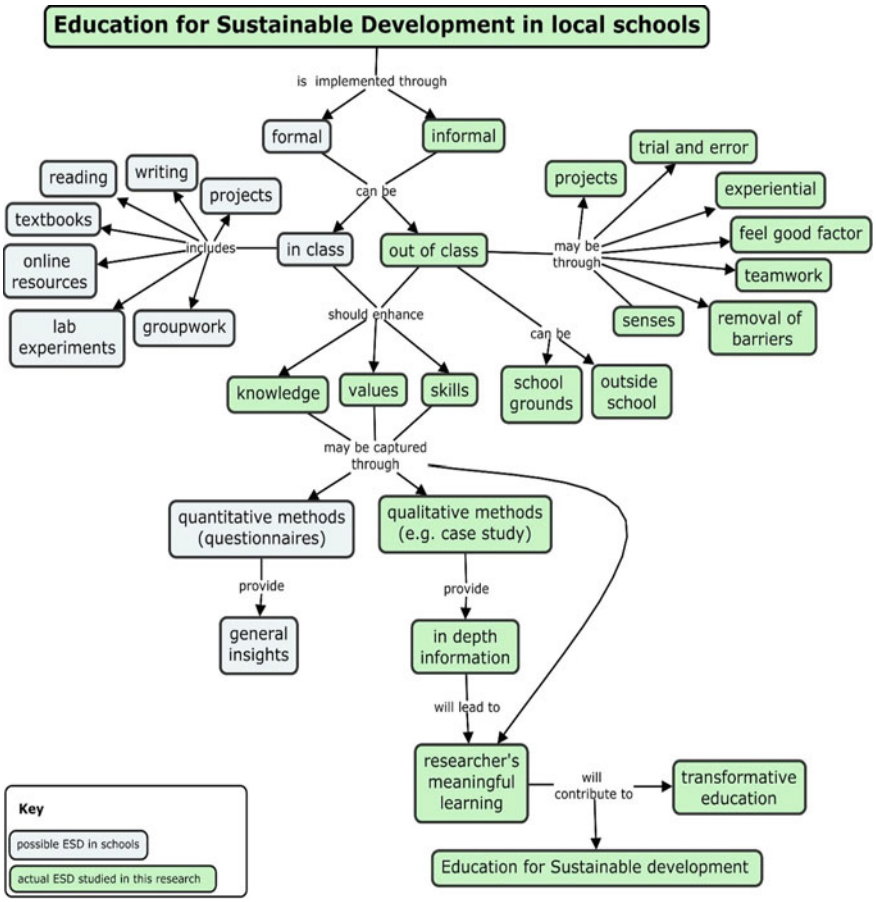

Fig. 1 Concept map illustrating how ESD can be incorporated in schools

work includes embellishing and maintaining the school garden that is an extension of the school grounds, making it more accessible and working towards growing crops. The garden has an area of about 2,000 m^2 and is adjacent to a valley from one side and fields from another. It is kept closed for safety reasons during school time and opened during breaks and/or for lessons, always under adult supervision. They are free to carry out activities to inform and involve other students in the school. Activities that they participate in include:

- continuous planning,
- holding meetings with various stakeholders,
- drawing action plans,
- hands–on work,
- teamwork,
- garden cleaning,

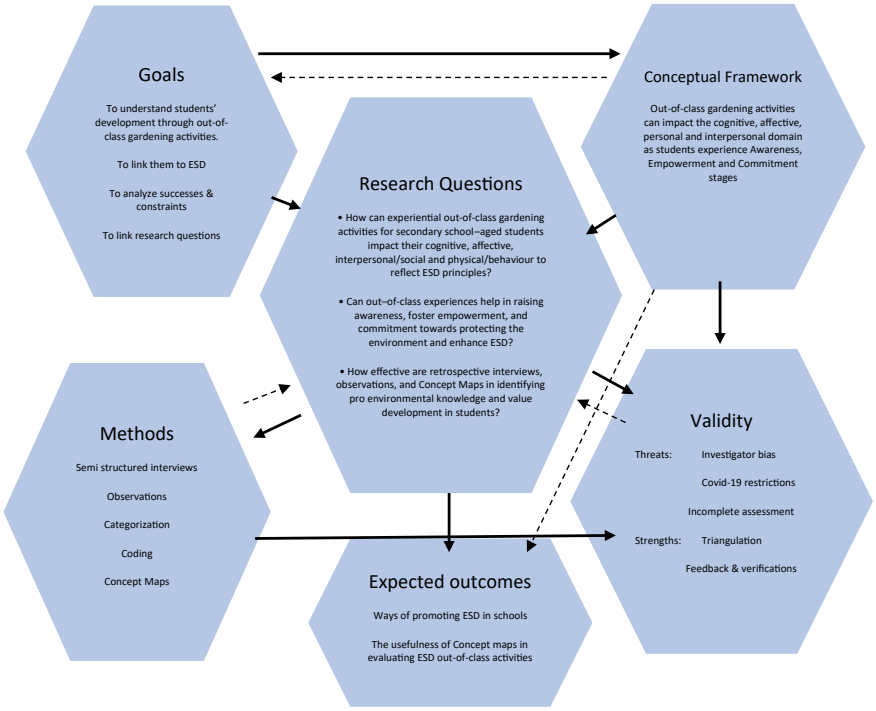

Fig. 2 Interactive model of research design. *Note* Diagram illustrating this study according to an interactive model research design as adapted from J. A. Maxwell (2012)

- planting crops,
- pruning trees,
- irrigating crops,
- planting trees,
- fixing rubble walls,
- setting up wind breakers,
- making the garden more accessible.

They also link their work to national/international programmes, including Eco Schools and LEAF (Learning about Forests), run by FEE (Foundation for Environmental Education 2019) and occasionally participate in out-of-school activities like outings to agribusiness labs and fieldworks to natural areas including Natura 2000 sites.

3.1 Sampling

To get a holistic study, purposeful sampling is needed in a case study. Patton explains that purposeful sampling is desirable to get information-rich cases which are essential for the purpose of the study (Patton 2015).

All the students taking part in the out-of-class gardening activities were invited to participate, however the sample choice was based on two criteria:

- Students have taken part in out-of-class gardening activities for more than one year, and
- Parents/guardians were willing to participate in the interview.

This was done to tap into information rich interviewees. The total number of students who regularly participate in these activities is 18, but only 6 had the mentioned requirements and accepted to participate. This automatically led to the selected 6 respondents, 2 girls and 4 boys. Such number, albeit seemingly small, lends itself very well to an in-depth qualitative case-study analysis.

3.2 The Research Tools

One of the unique strengths of a qualitative case study is the ability to deal with a full variety of evidence, including documents, artefacts, interviews, and observations (Merriam 1998). To achieve a holistic study, the researchers used a variety of tools to gather different data strands to make the research as valid and as reliable as possible. Data collected includes:

(a) interviews with the participating students,
(b) interviews with the students' parents/guardians,
(c) interview with the Head of School,
(d) photos and personal comments collected during observation sessions,
(e) Concept Maps to illustrate main findings, to help students evaluate their experience and to facilitate analysis.

The semi-structured interviews were organised in five different thematic sections, namely: background, cognitive, affective, interpersonal/social and physical/behavioural implications as based on A Review of Research on Outdoor Learning (Rickinson et al. 2004, p. 16):

(a) *Background*—age, years involved in activity, previous similar work, hobbies,
(b) *Cognitive impacts*—concerning knowledge, understanding and other academic outcomes,
(c) *Affective impacts*—encompassing attitudes, values, beliefs and self-perceptions,
(d) *Interpersonal/social impacts*—including communication skills, leadership and teamwork,

(e) *Physical/behavioural impacts*—relating to physical fitness, physical skills, personal behaviours and social actions.

Through these interviews, the students were guided into reflecting on their learning path by using the Retrospective Analysis Technique which is part of the Critical Incident Technique (CIT). CIT is when people assign meanings to their experiences. It is when a researcher collects the significances people attach to events and analyse the emergent patterns (Hughes 2007). The results were then tabulated, analysed, and depicted through Concept Maps to better visualise their pre and post developmental changes. Each face-to-face interview took approximately 60 min and was held online at a date and time suggested by the participant.

Short, semi-structured interviews with the parents of the selected students were carried out online for triangulation purposes, so as to get a different perspective of the learning curve of these students because as Yin (2018) argues, interviewing people with different perspectives can be a valuable approach. The questions of the interviews mirrored those of the students and focused mainly on identifying any missing information that the students were not able to give. The interviews included general background questions, the parents' initial/ongoing worries of having their child participating in out-of-class activities and the potential changes they saw in their child.

The Head of School (HOS) was interviewed to further validate the study. This short, semi-structured interview included questions about his ESD understanding and feedback on the students' work done in the garden.

Observations, were also focused on noting Cognitive, Affective, Interpersonal/social and Physical/behavioural impacts, to keep in line with the interviews, four observations were carried out prior the interviews, and were staggered with one observation per week, for four consecutive weeks. Specific behaviours observed included verbal and physical behaviours which indicate the way kids interact, speak, make decisions, and do actual hands-on work. The researcher noted examples of different behaviours, for example, the amount of commitment, peer-to peer encouragement, motivation, hands –on work, decisions taken, etc. Interaction between participating students and non-participating peers was also considered. These observations were annotated, and qualitative notes were added to describe how the behaviour was exhibited.

3.3 Qualitative Data Analysis

In this research, the qualitative data was analysed through a thematic coding system that permitted the author to gather non-biased holistic results. This requires meticulous interaction with data and asking analytical questions (Flick 2014). To reduce errors, transcripts of each interview were read and reread, and deeply analysed, together with observation data. Analysis of data was done using a four-step approach: preparation, exploration, specification, and integration (PESI) (Rashid et al. 2019).

Once interviews were transcribed and tabulated, information was represented as a Concept Map with the use of CMapTools™. This is a free online software developed by the Institute for Human & Machine Cognition (IHMC) in Florida, USA which facilitates the construction of these maps. Concepts are represented in nodes and their relationships to other concepts are specified by the links between them. The purpose of this study goes beyond using Concept Maps as an assessment tool and to give numerical data to results. Concept Maps are here used to get a holistic picture of each participant's responses and were analysed along with Kinchin et al.'s (2000) ideas; namely Spoke, Chain and Net structures.

Two concept maps were generated from each student's interview. The first depicts the student's original stance before joining the gardening group and the second shows, according to the students' interview replies, how this evolved in time. Once the Concept Maps were designed, the students were invited to check them out and verify them. Respondents' validation is in fact one way to reduce results bias (Noble and Smith 2015), whilst helping students think critically about their personal and intellectual development, and if needed, add some points they might have forgotten to mention during the interview. Once the Concept Maps were finalised, they were checked by a locally recognised expert in the area.

4 Results

This study showed, through the use of concept maps, verbatim transcripts, photos and authors' observations, the learning journey of six students that participated in voluntary out-of-class gardening activities for more than two years.

Table 2 shows an overview of the participating students who are all Maltese nationals. Pseudonyms are used for students and their parents who participated in this study.

Results of the study are presented in two main parts;

Part A gives a brief introduction on each student followed by two Concept Maps of each student. These show the participant's stand before and after participating voluntarily in out-of-class activities As an example, Concept Maps in Figs. 3 and 4 illustrate Janice's stance before and after participating in out-of-class activities respectively.

Part B includes the themes, sub-themes and categories that emerged from the interviews through the coding process. Quotes of respondents and photos taken during observation are incorporated to capture some aspect of the student's worlds.

It is interesting to point out that outcomes vary depending on previous knowledge they had and upon which new knowledge is scaffolded.

Actively working in the garden and participating in out-of-class activities gave the students new experiences where they could tap on previous knowledge and experiment on new skills. Simon explains how he gets to do things he never had the opportunity to do before and thus learning by doing, whilst building his self-confidence.

Table 2 Characteristics of case study participants

Student	Name	Age	No. of scholastic years participating	Preferred learning style	Self-perceived attainment level	Hobbies	Related previous outdoor experiences	Name of parent participating in study
1	Simon	15	3	Hands-on	Level 6–7	• Swimming • Fishing • Farming with grandpa	• Walks in nature • Helping grandpa in fields • Gardening with Eco Schools in middle school	Sonia
2	Jacob	16	3	Hands-on	Level 6–7	• Cooking • Feasts • Farming with family	• Working the fields with father, grandpa and all the family • Gardening with Eco Schools in middle school	Grace
3	Mark	15	2.5	Hands-on	Level 6–7	• Feast and Parish Church • Aeroplanes	• Walks in nature with family	Emilia
4	Janice	15	2.5	Hands-on	Level 7–8	• Drama	• Farming in family's fields • Gardening with Eco Schools in primary school;	Vicky
5	Leon	16	2.5	Deskwork	Level 7–8	• Piano • Watching TV	• Gardening at home • Walks in nature	Nathalie
6	Isabelle	15	2	Deskwork	Level 7–8	• Reading • Cooking	• Helps in family's fields • Walks in nature	Maria

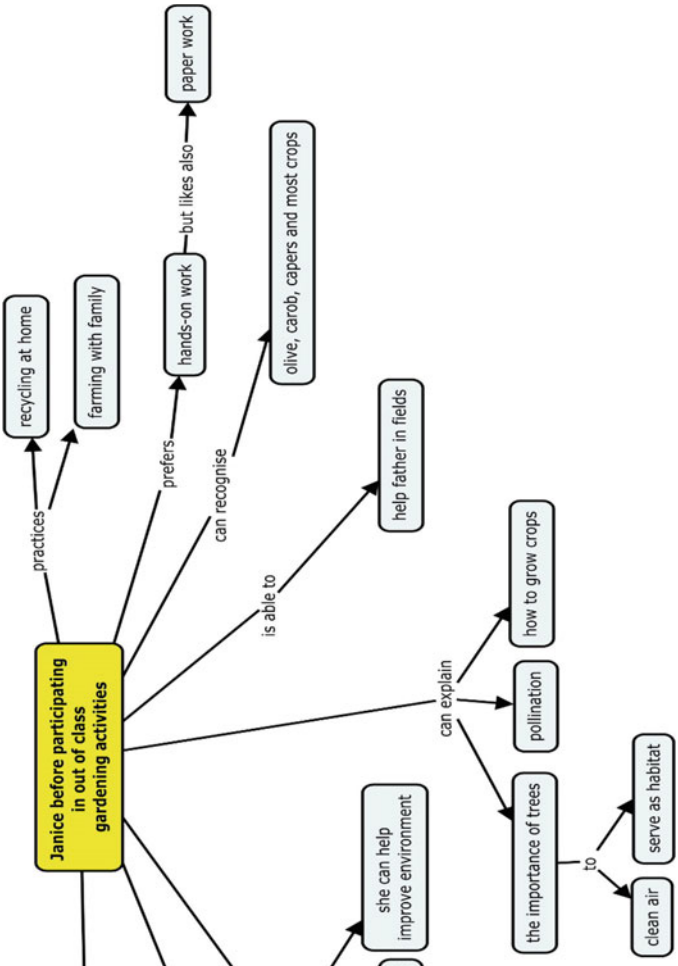

Fig. 3 Concept Map of Janice before participating in out-of-class gardening activities

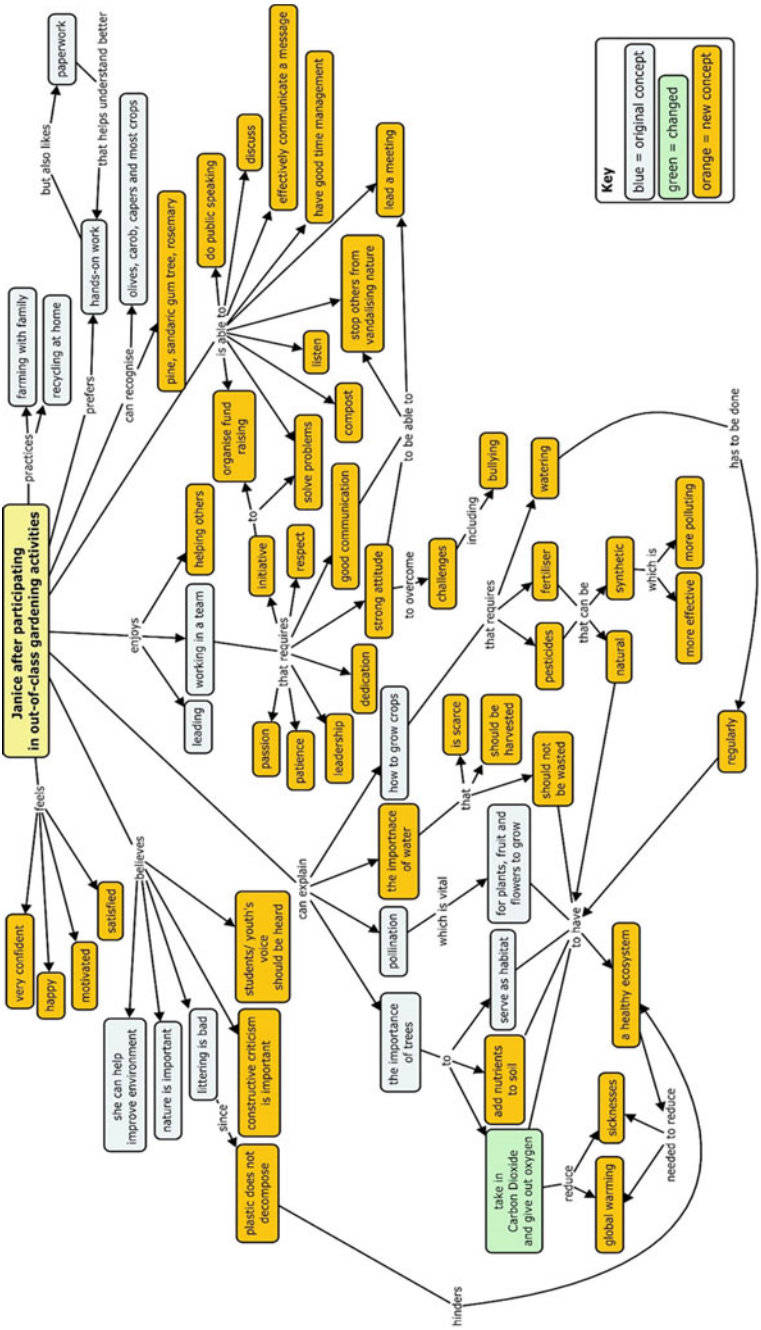

Fig. 4 Concept Map of Janice after participating in out-of-class gardening activities

> Usually when I'm with grandpa, he does certain things like fixing the water pump and irrigation. Now that I was alone at times, I had to do stuff that grandpa usually does, I had to step up to the situation and do it. I felt very proud. (Simon, 3rd May, 2021)

Mark's mum, Emilia, reflected on how out-of-class gardening activities helped her introvert son, make new friends. She also explained how it also helped him focus more.

These activities also improved personal skills, as Isabelle explained, "*when you share ideas with others, you learn to tolerate other people, you understand that people are not the same, they have different backgrounds… it's like without realising it you learn to be more sensitive to others*" (Isabelle, 25th April, 2021).

The study with this group of students showed how much learning can happen during voluntary gardening and related out-of-class activities. Learning happens mostly through hands-on activities, active participation, teamwork and is heightened through various senses. There was an overall increase in every domain, be it cognitive, technical, personal, and interpersonal, mental and physical as indicated in the following table (Table 3).

The students' major challenges include time and monetary constraints, together with challenging behaviour from other peers. A focal point in this study is the value of place this garden has had on these students. The extreme commitment of the students and the lively teamwork going on are the fundamental pillar of learning to happen. The Head of School (HOS) sees this commitment to taking care of their garden and the way they managed to work as a team as two big achievements. He stated that "*a big success was the fact that they were taking responsibility for something. I think that they can carry this responsibility with them to other schools they will be attending or in the workplace that they will be in*" (HOS, 25th June, 2021).

The future aims they finally talked about, both for themselves and for the school garden sheds light into how deeply they believe in their work. Working in the school garden evolved from a simple gardening hobby to a bigger, more important part of their educational experience. Such experience has to be supported and guided from committed adults who present innovative ways to promote ESD through such activities. What the students did, felt, heard, worked for, failed in, and achieved in the garden seems to have deeply impacted their personal beliefs and attitudes. Moreover, the knowledge, beliefs and attitudes that evolved throughout this experience reflect ESD principles.

The students participating in this study became so committed towards working together to take care of the school garden that it became an integral part of their educational experience. The fact that they dedicated 2 ½–3 years to this activity nurtured a wide range of environmental, personal, social, recreational, health and educational benefits that are in line with what Cheang et al. (2017) described as being a Powerful Learning Environment. In turn, this increased their awareness, fostered empowerment, and commitment towards protecting the environment. Moreover, promoting their work at a school level and linking such school-based projects to other international programmes, such as Eco Schools and LEAF proved to increase the students' sense of pride in their work and further enhanced their self-esteem. It also opened new

Table 3 Summary of how out-of-class gardening activities impacted students' personal development

Cognitive impacts
• All students' second concept map had a considerable number of increased concepts and prepositions interlinking these ideas, showing that learning has taken place and that out-of-class activities have had a significant impact on them
• Students gained knowledge related to activities they participated in
• Students learnt facts about the natural ecosystem
• Increased their understanding of the importance of trees and soil and value of nature
• They linked this knowledge to global issues
• Acquired technical skills regards gardening, growing crops and garden maintenance
• Learning happens through direct experience, aided by peer-to-peer teaching and supported by adult teacher-mentor
• Snowball effect—The more time they spent working in garden, the more committed they became, the more they learnt
• Ripple effect—they sought different ways to try and reach to other students to make them appreciate nature more
Personal-affective-impacts
• Students increased their self-esteem and confidence
• There was a positive correlation between the feel-good factor they were getting in the garden and their enthusiasm to come to school
• Increase in values such as, determination, love of nature, willingness to help and patience
• An opportunity to work on time management skills
Students feel physically and mentally recharged when spending time in the garden
Interpersonal-social impacts
• Working in a team with a shared goal helped the students improve their interpersonal, transverse skills which include:
• empathy
• leadership
• altruism
• tolerance
• perseverance
• communication skills
• problem solving
• ethical behaviour
• giving and accepting criticism

opportunities and widened the platform where students could interact and showcase their work and deepen their learning.

Concept Maps, constructed upon the interviews and verified by the participants, proved to be an important strategy in this qualitative inquiry (see Fig. 5). These were useful when simplifying intricate concepts, mapping each student's learning journey and facilitating the analysis and understanding of their meaning, as well as the connections that arose across concepts. Moreover, when the students verified their Concept Maps, they realised how holistic their experience has, in fact, been. What for them was something fun, a 'hobby' and a way to socialise, proved to be a true educational experience that helped them understand how to think and act more sustainably.

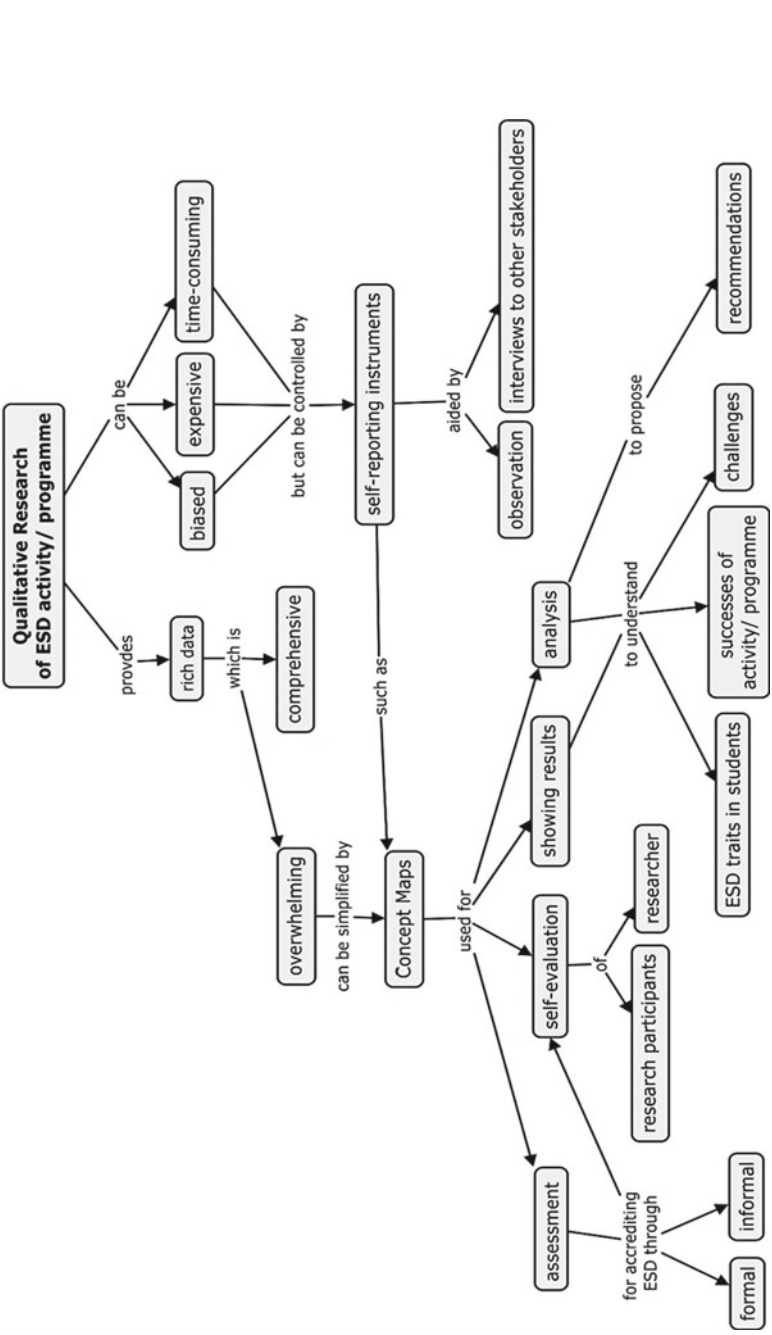

Fig. 5 Concept map analyzing the results of effectiveness of using concept maps in identifying pro environmental knowledge and value development in students

4.1 Practical Ways How to Incorporate ESD Activities in Schools

One problem that has been discussed in this study is the volatile implementation of practical ESD activities in schools. Although ESD should not be imposed upon teachers, it should be highly encouraged. Senior Management Teams of schools consisting of the Head of School, Assistant Heads and Head of Departments, together with teachers and Learning Support Educators (LSEs), should have ESD training sessions or refresher training courses, where good practices and innovative ideas are promoted. ESD should also be effectively incorporated at university level to educate and empower aspiring teachers.

Time constraints was amongst the leading factors inhibiting teachers from taking up such activities. This comes twofold:

(a) the limited student time for participating in these activities, and
(b) teachers' teaching load which hinders them from taking the extra commitment of carrying out activities during breaks.

This can be resolved in different ways as shown in the following diagram (Fig. 6):

Consequently, the following concept maps were created to illustrate how ESD can be better promoted in schools (Fig. 7).

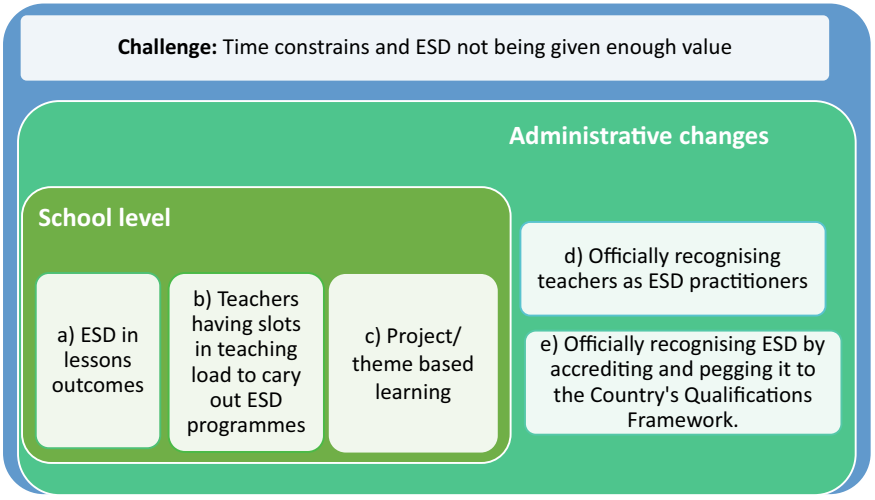

Fig. 6 Proposed ways how to overcome time constrains and assign more value to ESD

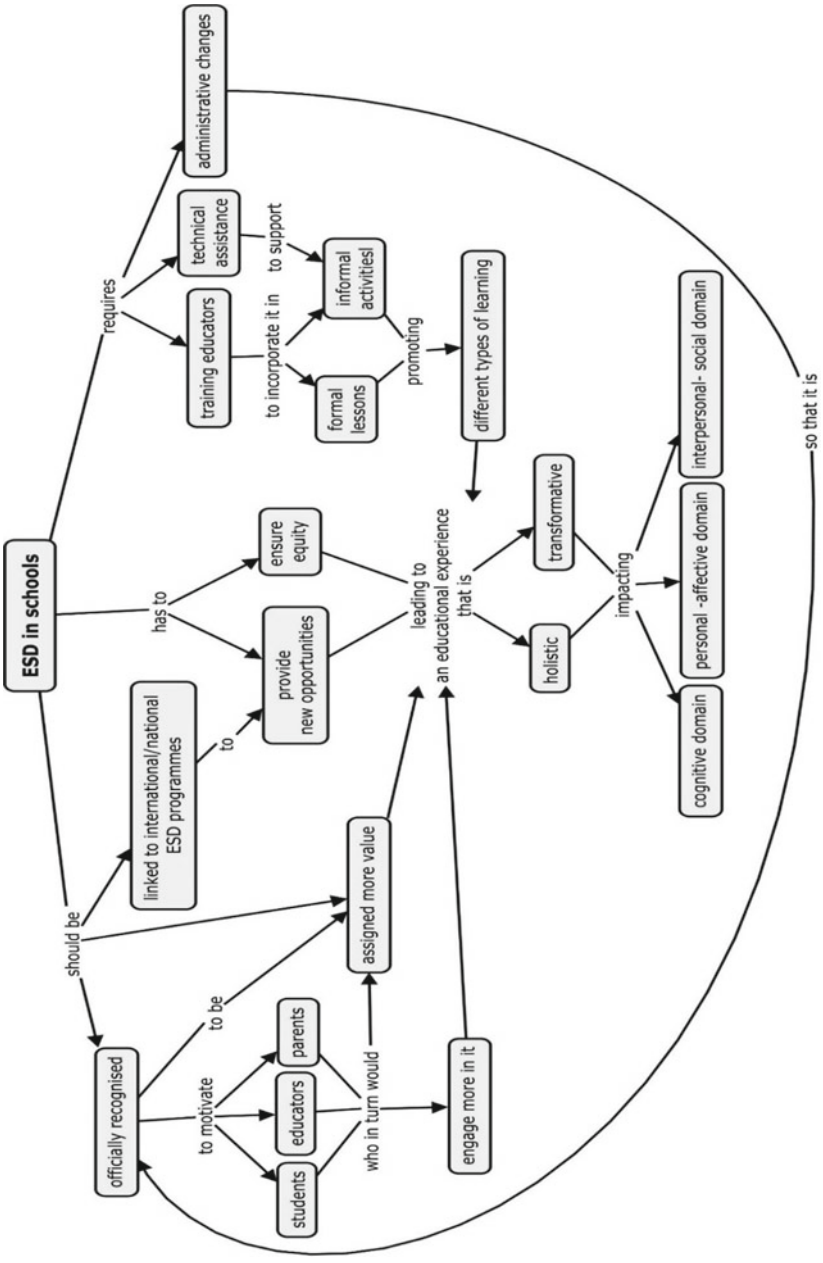

Fig. 7 Ways in which ESD can be better promoted in schools

4.2 Limitations of Study

Two of the most important criteria for the evaluation of any research are reliability and validity. One of the limitations of this study is the investigator bias, that of having a dual role as a teacher-researcher Unluer (2012). Retrospective pre–post-test interviews can also be a source of bias as this uses a self-report methodology. Such biases include social desirability (Krosnick 1999) where the respondent can inflate or deflate responses to comply with what's socially accepted and recall accuracy (Schwarz 2007).

To reduce measurement error and lessen these biases, the researcher opted for triangulation of data, including supplementing interviews of students, parents and Head of School with observations. Triangulation of data sources and types is important in case study research, so that the phenomena can be viewed and explored from multiple perspectives and ensure the study has a richer set of data and adds to 'confidence to findings' (Miles and Huberman 1994).

5 Conclusion

The natural environment can only seem precious to those who know it and who have some direct experience in it. The socialisation pattern of the consumerist 'modern western societies' largely promotes an unsustainable lifestyle, a quick-fix ideology and an ever-increasing nature-deficit disorder. Educating for Sustainable Development is complex and challenging as it includes teaching and learning that develops awareness, knowledge, as well as understanding of the environment and critical thinking skills. ESD can be obtained by linking education to students' lives and empower them into making change.

If education as we know it today has had little impact to promote SD, then maybe we have to redefine education and put a greater value on ESD concepts and experiences. But how can ESD be given more prominence and reach more students, if it is mainly voluntary or done in everybody's free time? The successes the students in this research gained are real and thus, it is imperative that such practices become officially recognised and encouraged. Students should not be expected to learn ESD concepts by chance, or out of the free will of teachers and SMT.

Equitable and effective education for sustainable development needs to move beyond formal exams and must also acknowledge different types of valuable learning. Effective ESD should focus on equity in education which does not entail giving everyone the same thing but providing different opportunities for different students to achieve their full potential and have a transformative education. ESD can thus be the key to open new doors, to promote different types of learning, and competences.

ESD needs to be promoted at university level to educate and empower aspiring teachers. "*Teacher trainers should be considered as key stakeholders in the ESD implementation process*" (UNECE 2009, p. 43). This can help educators create new

experiences for students based on their interests and foster ESD to achieve a more holistic, transformative education that tackles all the sustainability pillars. Moreover, officially recognising teachers as ESD practitioners through certification is also highly important and leads to decision making by qualified professionals.

This research shows that activities carried out-of-class, including gardening and the various activities and local and international programmes it is linked to, can be a valuable example of how schools can build upon their students' interests and promote ESD. This, however, requires administrative, curricular, pedagogical, and in-school changes amongst others, changes that are necessary but which at times might prove challenging. It is our responsibility as educators to find innovative ways to infuse effective ESD into the educational system, as after all, necessity, motivation, and initiative are the catalyst to change.

References

Bendell J, Sutherland N, Little R (2017) Beyond unsustainable leadership: critical social theory for sustainable leadership. Sustain Account Manag Policy J 8(4):418–444. https://doi.org/10.1108/SAMPJ-08-2016-0048

Blair D (2009) The child in the garden: an evaluative review of the benefits of school gardening. J Environ Educ 40(2):15–38. http://kohalacenter.org/HISGN/pdf/Thechildinthegarden.pdf

Braun T, Dierkes P (2017) Connecting students to nature—how intensity of nature experience and student age influence the success of outdoor education programs. Environ Educ Res 23(7):937–949. https://doi.org/10.1080/13504622.2016.1214866

Briguglio L, Pace P (2004) Education for sustainable development in Malta. Case study presented at the SIDS Expert Meeting on "Capacity development for sustainable development in SIDS: building partnerships for sustainable development through Education, through education, public awareness and training", 3–9 December 2003. University of South Pacific-Fiji

Cheang C, So W, Zhan Y, Tsoi K (2017) Education for sustainability using a campus eco-garden as a learning environment. Int J Sustain High Educ 18(2):242–262

Clark M, Cassar J (2013) Leisure trends amongst young people in Malta. Malta: Office of the Commissioner for Children and Aġenżija Żgħażagħ. https://youth.gov.mt/wp-content/uploads/2020/01/Leisure_Trends_Amongst_Young_People_in_Malta-1.pdf?80b578&80b578

Cooper G (2004) The contribution of outdoor education to environmental awareness and sustainability. In: Barnes P, Sharp R (eds) The RHP companion to outdoor education. Russell House Publishing, pp 154–160

Curry N, Brown K (2010) Differentiating outdoor recreation: evidence drawn from national surveys in Scotland. J Policy Res Tour Leis Events 2(1):29–50. https://doi.org/10.1080/19407960903542300

De la Vega L, Toscano W (eds) (2018) Handbook of leisure, physical activity, sports, recreation and quality of life. Springer International Publishing

Dewey J (1916) Democracy and education: an introduction to the philosophy of education, 1 edn. The Macmillan Company

Dewhurst Y, Pendergast D (2011) Teacher perceptions of the contribution of home economics to sustainable development education: a cross-cultural view. Int J Consum Stud 35(5):569–577. https://doi.org/10.1111/j.1470-6431.2011.01029.x

Dillon J, Rickinson M, Teamey K, Morris M, Choi M, Sanders D, Benefeld P (2006) The value of outdoor learning: evidence from research in the UK and elsewhere. Sch Sci

Rev 87(320):107–111. https://www.researchgate.net/publication/287621860_The_value_of_outdoor_learning_Evidence_from_research_in_the_UK_and_elsewhere
Foundation for Environmental Education (2019) Eco-schools- engaging the youth of today to protect the planet of tomorrow. https://www.fee.global/eco-schools-1
Fisher-Maltese C (2016) "We won't hurt you, butterfly!" Second-graders become environmental stewards from experiences in a school garden. Int J Early Child Environ Educ 4(1):54–69. https://files.eric.ed.gov/fulltext/EJ1120191.pdf
Fisher-Maltese C, Fisher D, Ray R (2018) Can learning in informal settings mitigate disadvantage and promote urban sustainability? School gardens in Washington, DC. Int Rev Educ 64(3):295–312. https://doi.org/10.1007/s11159-017-9663-0
Flick U (2014) The SAGE handbook of qualitative data analysis. SAGE
Higgins P (1997) Outdoor education for sustainability: making connections. J Adventure Educ Outdoor LeadShip 13(4):4–11. http://reconnectinnature.org.uk/wp-content/uploads/2018/08/higgins_making_connections.pdf
Higgins P, Kirk G (2001) Sustainability education in Scotland: the impact of national and international initiatives on teacher education and outdoor education. J Geogr High Educ 30(2):313–326. https://doi.org/10.1080/03098260600717414
Higgins P, Loynes C (1997) On the nature of outdoor education. In: Higgins P, Loynes C, Crowther N (eds) A guide for outdoor educators in Scotland. Penrith. Adventure Education and Perth, pp 6–8
Hughes H (2007) Critical incident technique. In: Lipu S, Williamson K, Lloyd A (eds) Exploring methods in information literacy research, 1 edn. Centre for Information Studies Charles Sturt University, pp 49–66
Irwin D (2008) Weaving the threads: challenges encountered while educating forsustainability in outdoor education. N Z J Outdoor Educ Ko Tane Mahuta Pupuke 2(3):36–53. https://search.informit.org. https://doi.org/10.3316/informit.984839416409531
James J, William T (2017) School-based experiential outdoor education: a neglected necessity. J Exp Educ 40(1):58–71. https://doi.org/10.1177/1053825916676190
Kinchin I, Hay D, Adams A (2000) How a qualitative approach to concept map analysis can be used to aid learning by illustrating patterns of conceptual development. Educ Res 42(1):43–57. https://doi.org/10.1080/0013188003639
Klemmer C, Waliczek T, Zajicek J (2005) Growing minds: the effect of a school gardening program on the science achievement of elementary students. HortTechnology 15(3):448–452. https://doi.org/10.21273/HORTTECH.15.3.0448
Krosnick J (1999) Survey research. Annu Rev Psychol 50(1):537–567. https://doi.org/10.1146/annurev.psych.50.1.537
Leicht A, Heiss J, Byun W (eds) (2018) Issues and trends in education. UNESCO
Lindemann-Matthies P, Bose E (2008) How many species are there? Public understanding and awareness of biodiversity in Switzerland. Hum Ecol 5:731–742. https://doi.org/10.1007/s10745-008-9194-1
Louv R (2005) Last child in the woods: saving our children from nature-deficit disorder. Algonquin Books
Maxwell J (2012) Qualitative research design: an interactive approach, vol 41. SAGE Publications
Merriam S (1998) Qualitative research and case study applications in education. Revised and expanded from "Case study research in education". Jossey-Bass Publishers
Mifsud M (2012) A meta-analysis of global youth environmental knowledge, attitude and behaviour studies. US-China Educ Rev B 2(3):259–277. https://files.eric.ed.gov/fulltext/ED532920.pdf
Mifsud M, Chisholm H (2018) An analysis on the effectiveness of the lifelong learning through nature programme. In: Walter LF, Mifsud M, Pace P (eds) Handbook of lifelong learning for sustainable development. Springer, pp 165–182. https://doi.org/10.1007/978-3-319-63534-7_12
Miles M, Huberman A (1994) Qualitative data analysis, 2nd edn. SAGE

Nanney M, Johnson S, Elliott M, Haire-Joshu D (2006) Frequency of eating home-grown produceis associated with higher intake among parents and their pre-school aged children in rural Missouri. J Am Diet Assoc 107(4):577–584. https://doi.org/10.1016/j.jada.2007.01.009

Noble H, Smith J (2015) Issues of validity and reliability in qualitative research. Evid Based Nurs 18(2):34–35. https://doi.org/10.1136/eb-2015-102054

Ozer EJ (2007) The effects of school gardens on students and schools: conceptualization and considerations for maximizing healthy development. Health Educ Behav 34(6):846–863. https://doi.org/10.1177/1090198106289002

Patton MQ (2015) Qualitative research & evaluation methods: integrating theory and practice, 4th edn. SAGE

Prince H (2016) Outdoor experiences and sustainability. J Adventure Educ Outdoor Learn 17(2):1161–1171. https://doi.org/10.1080/14729679.2016.1244645

Rashid Y, Rashid A, Warraich M, Sabir S, Waseem A (2019) Case study method: a step-by-step guide for business researchers. Int J Qual Methods 18. https://doi.org/10.1177/1609406919862424

Rickinson M, Dillon J, Teamey K, Morris M, Young Choi M, Sanders D, Benefield P (2004) A review of research on outdoor learning. National Foundation for Educational Research and King's College London

Ruiz-Gallardo J, Verde A, Valdés A (2013) Garden-based learning: an experience with "at risk" secondary education students. J Environ Educ 44(4):252–270. https://doi.org/10.1080/00958964.2013.786669

Sanders J (1981) Case study methodology: a critique case study methodology in education evaluation. In: Proceedings of the Minnesota evaluation conference, Minnesota Research and Evaluation Centre. Minnesota Research and Evaluation Centre

Schwarz N (2007) Retrospective and concurrent self-reports: the rationale for real-time data capture. In: Stone A, Shiffman S, Atienza A, Nebeling L (eds) The science of real-time data capture: self-reports in health research. Oxford University Press, pp 11–26

Springett D, Kearins K (2001) Gaining legitimacy? Sustainable development in business school curricula. Sustain Dev 9(4):213–221. https://doi.org/10.1002/sd.164

Sterling S (2001) Sustainable education: re-visioning learning and change: 06 (Schumacher briefings), 1 edn. Green Books

Summers M, Kruger C (2003) Teaching sustainable development in primary schools: theory into practice. Curric J 14(2):157–180. https://doi.org/10.1080/09585170302836

Sund P, Gericke N (2020) Teaching contributions from secondary school subject areas to education for sustainable development—a comparative study of science, social science and language teachers. Environ Educ Res 26(6):772–794. https://doi.org/10.1080/13504622.2020.1754341

Twiss J, Dickinson J, Duma S, Kleinman T, Paulsen H, Riviera L (2003) Community gardens: lessons learned from California healthy cities and communities. Am J Public Health 93(9):1435–1438. https://ajph.aphapublications.org/doi/pdfplus/. https://doi.org/10.2105/AJPH.93.9.1435

UNECE (2009) Learning from each other: the UNECE strategy for education for sustainable development. United Nations. https://unece.org/DAM/env/esd/01_Typo3site/LearningFromEachOther.pdf

UNESCO (2014) Shaping the future we want—UN decade of education for sustainable development (2005–2014): final report. UNESCO

UNESCO (2016) Education for sustainable development goals: learning objectives. https://www.unesco.de/sites/default/files/2018-08/unesco_education_for_sustainable_development_goals.pdf

Unluer S (2012) Being an insider researcher while conducting case study research. Qual Rep 17(29):1–14. https://doi.org/10.46743/2160-3715/2012.1752

Williams M (2013) Securing nature's future. Ecol Inf Nat. https://theecologist.org/2013/apr/04/securing-natures-future?fbclid=IwAR2SQ-WBTwkIvLyYxugWdO-EZLFUNCitbts3Sqc4srpIwOHetKbE55hK1aM

Yin R (2018) Case-study research design and methods, 6 edn. SAGE Publications

Zowada C, Belova N, Eilks I (2020) Enhancing education for sustainable development through geographical perspectives in chemistry teaching. Int J Sci Math Educ 19:87–109. https://doi.org/10.1007/s10763-019-10043-y

Moving Towards Sustainability Through Geographical Education in Malta

Rebecca Cassar and Mark Mifsud

1 Introduction

This paper deals with research conducted at a time of heightened global interest to address how education can overcome challenges of sustainability. ESD is stressed by the declaration "Transforming our world: the 2030 Agenda for Sustainable Development" and forms part of Target 4.7 of the UN Sustainable Development Goal 4. The need for ESD has also been highlighted in Malta's National Curriculum Framework published in 2012 as was its need for officially incorporating it in the educational system. The document lists ESD as one of its objectives for formal schooling, including primary and secondary levels of education in Malta. The goals set, promote the enhancement of knowledge, skills and attitudes of students, a thorough understanding of their surroundings, respect and value towards diversity, as well as their empowerment through creative and critical thinking skills (MEE 2012).

Filho and Pace (2016) state that post-compulsory education is the perfect opportunity for students to apply their knowledge in sustainable development to their academic and work life, and possibly even opt for further training in specialised sustainable development contexts. Moreover, ESD in a post-secondary setting allows these students to contextualise their learning to the realities of their own specialisation, profession, and personal life. The fact that this academic level of learning works with specialisation into individual subjects, it reduces the multi and interdisciplinarity of ESD (Tilbury et al. 2002) and drives ESD to be included into monodisciplinary structures (Moore 2005).

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One such discipline is Geography at post-secondary level. Geography has often been considered the subject responsible for education in sustainable development (Smith 2013). This is due to its multidisciplinary nature and its ability to relate the learner to issues on a global scale over time and space (Smith 2013). Learning geography educates students on Earth's diverse and interconnected cultures and societies, whilst understanding the consequences of our everyday decisions. This knowledge is in line with the United Nations Economic Commission for Europe (UNECE) Competences for ESD.

To emphasise the association, Skarstein and Wolff (2020) note how ESD knowledge, such as 'the distribution and changes of populations and population demographics, resource usage, environmental impact of human activity, resource and pollution-related conflicts, poverty issues, and political governance' (p. 3) are all taught in geography. Similarly, the 2030 Agenda for Sustainable Development identifies topics like soil and land degradation, desertification, biodiversity and its loss, climate change, water and oceans, poverty and justice, health and food, consumption, gender differences and equality, sustainable human settlements and participation, agriculture and biotechnology (UN 2015).

As students become more literate in geographical knowledge, they become participating agents in the worldly knowledge (Lawson 2016). Hence, students become aware of social differences on a global scale and can criticise these differences, developing a sense of empowerment and ultimately a deep cross-cultural mindfulness (Robertson 2018). Simultaneously, a key goal of teaching geography is to promote the students' understanding of their own ability in being creative citizens of the world to envision alternate futures (Lambert et al. 2015). This is also in line with the goals of ESD. Therefore, ESD through geographical issues allows students to not only understand but also reflect critically.

Moreover, Skarstein and Wolff (2020) discuss how students obtain the opportunity to consider and communicate these issues of sustainability by employing practical and social skills. In addition, they reflect critically on sustainability issues from both personal and collective perspectives.

Additionally, Nagel (2008) notes how utilising geography to implement ESD instils creativity and innovation, creative thinking and problem solving, communication and collaboration skills to help students face future challenges. These skills are listed in the UNECE Competences for ESD. This overview of the relationship between ESD and geography education shows how educators of geography play an important and influential role, both within the classroom and within the entire school (Wade 2002). Saunders et al. (1995) argue how motivated and committed geography teachers can justly influence the extent to which students develop their commitments to a more sustainable world and future. Wade (2002) however does lament that education in SD is not restricted to the geography classroom but should become a conscious reflection in all students' learning experiences. Ultimately, ESD opens new opportunities for teachers and students alike, both in and outside the geography classroom. Experience has shown that students learn just as much, if not more, from doing than from simply listening. This includes activities in the classroom but also those outside such as fieldwork and walks and experiences with the natural and built

environment. This belief is in line with France and Haigh's who state that 'Fieldwork is where Geographers learn "from doing" Geography to "do" Geography. Its special attributes include providing experiential, sometimes transformative, learning through the immersion of the learner in the field experience' (2018).

The central element of this research was to study the application of ESD within the geography post-secondary level in Malta. The results discuss the geography teachers' views and implementation of ESD by recording the teaching practices used to do so. Their strategies significantly taught issues of sustainability enhancing the quality of sustainability education for the leaders of the future. The research explored the opportunities and strengths, whilst also taking note of the challenges and weaknesses in implementing ESD within the geography classroom setting. The discussion generated through a thematic analysis focuses on the taught values of sustainable development, including the encouragement to think in an open and global manner; the ESD skills and the teaching strategies used to implement ESD.

2 Methodology

The research study used qualitative data collected through interviews with post-secondary geography educators, which can be characterised as qualitative content analysis as it gathered the first-hand experiences of educators with geography education and ESD. The participants interviewed were five educators who teach Geography at various post-secondary institutions in Malta.

The small sample was selected with a purpose as these participants could offer the research study 'insight into a particular experience' whilst allowing the researcher to 'examine convergence and divergence in some detail' (Smith et al., 2009, p. 48). In addition, Smith et al. (2009) also note how IPA studies usually benefit from a concentrated focus on a small number of cases … [as] the issue is quality, not quantity' (p. 51). All the geography educators at post-secondary level in Malta and Gozo were contacted by email to request their participation in the interview data collection process for research purposes. Five out of six educators responded. The small sample size could be seen as a limitation to obtaining further data, however this could not be helped as the number of post-secondary geography teachers in the country is a small one.

As research in education has tended to adopt qualitative 'post-modern' approaches that focus on constructing and hence describing phenomena in the world (Scheurich 1997), the research study took a constructionist and interpretivist stances, whilst using an interpretive phenomenological analysis methodology. Figure 1 gives an overview of the research design chosen for the research study.

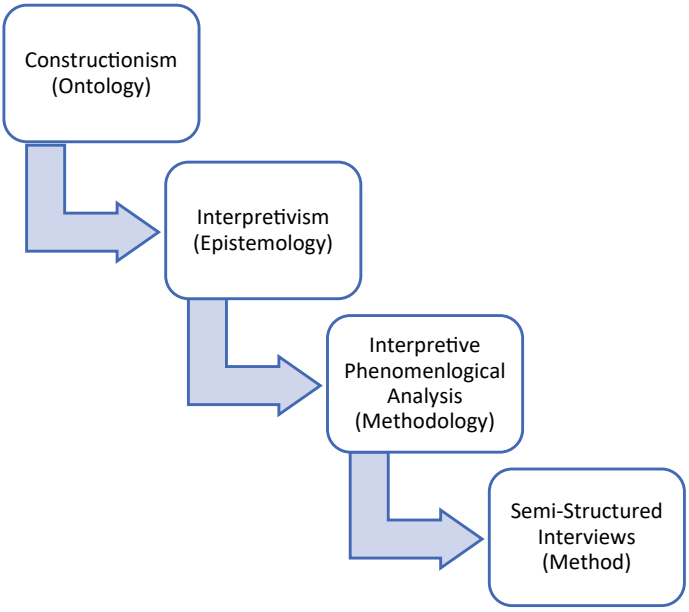

Fig. 1 Overview of research design used in the study. *Source* The authors

2.1 The Interview

The research study used semi-structured interviews to gather a substantial amount of information from the educator participants on their views and experiences with ESD. They were chosen as the qualitative method, as a rapport was easily established between interviewer and participant, and the questions were delved into further than direct structured interview questions would have been. The interviews were held through an online video call using the Microsoft Teams platform and lasted between thirty and forty-five minutes in duration.

The research areas for the interview questions surfaced from the literature on the UNECE ESD Competences. As the ESD competences were referred to, the elements of ESD that needed to be investigated in the interview became evident. Some questions were left open for the educators to freely mention values, skills and competences that pertain to ESD, whilst other questions specifically include an ESD value, skill or competence to gain their perspective. Table 1 describes the topics discussed during the interview and the intention behind those topics.

A summary of the interview method is shown in Fig. 2.

Table 1 Purpose of interview questions

Interview topics	Purpose of questions
1. The educator's role	Here the participant was asked to freely discuss their role at school and independently mention any values and competences included in ESD. The term Education for Sustainable Development was not included in any question, so not to direct the respondent to any specific values. The educators were asked on their views on how teaching geography can help students gain competences like problem setting, critical reflection, visioning, and creative thinking. The information given as a response to this question would also help conclude how ESD and geography education are related and how ESD features. It would also give information on how the educators view such competences, and possibly the importance they give to them through the teaching of their subject
2. Teaching strategies	This interview section would help gauge whether and how their teaching strategies resemble those in ESD, whilst also having the possibility of creating a bank of teaching strategies used in teaching Geography at post-secondary level. Similarly, the educators were asked to attach them to skills that they are attempting to train their students with
3. Transformative pedagogies	As one of the UNECE ESD competences, the interview also sought to pursues the views on educators reflecting on their teaching practices
4. ESD	The interview also requested the views on ESD in the geography classroom and also deduce how much the educators truly understand what ESD is

3 Results

The following section explicates a detailed discussion on the findings analysed through the five semi-structured interviews conducted. The overarching purpose of the thematic analysis is to analyse themes that emerge from the interviews. In this regard, the thematic analysis within this section discusses the views of educators on ESD and its implementation, the integration of ESD and its competences in their teaching strategies, and their critical reflection on their practice.

3.1 Implementing ESD in Geography Education at Post-Secondary Level

The Matriculation and Secondary Education Certificate (MATSEC) Geography syllabi at Advanced and Intermediate levels, last renewed in 2019, are divided into sections pertaining to physical and human geography. Both syllabi then incorporate elements of world and Maltese geography and include fieldwork and cartography

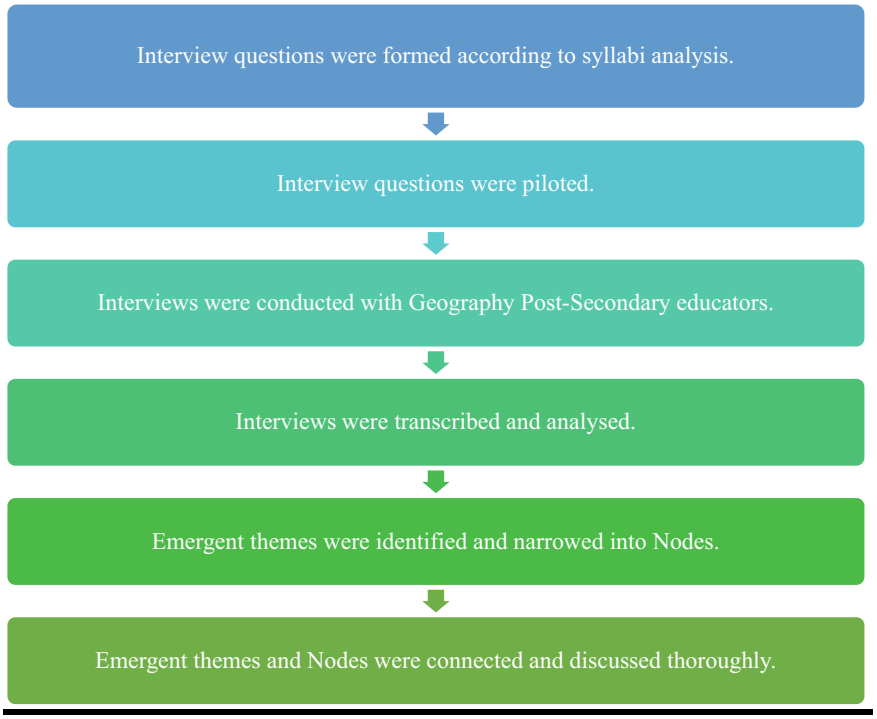

Fig. 2 Summary of the interview method. *Source* The authors

skills. The form of assessment includes a written examination where students answer questions, together with individual and teacher-led fieldwork reports. An analytical review of the syllabi shows that both syllabi feature several UNECE ESD competences. Every competence in this overview is typed in italics font. This analytical review was conducted by assessing the language, content and skills included in the syllabi.

The fundamental knowledge and skills within the geography courses overlap, and therefore include similar ESD competences. There is a repeated emphasis on *how humans and nature are interdependent; the evaluation of potential consequences of different decisions and actions; connecting the learner to their local and global spheres of influence; the importance of problem setting, critical reflection, visioning and creative thinking* and*, preparing learners to meet new challenges.* For example, the Advanced level syllabus states how geography at this level aims for students to apply their geographical knowledge to their everyday situations and hence encourage life-long learning, a principle strongly encouraged as part of ESD. This will be done through the education of various people, places and environments; the skills translated from the interpretation of maps and other geographic tools and technologies such as charts, graphs and photographs, and systematic problem-solving techniques in using geographic methods.

The description of the Intermediate level syllabus also contains issues of sustainability as it specifically emphasises the inter-relationships and inter-actions between human activities and the environment as an important aspect of the teaching and learning of Geography. It also facilitates learning skills, within and outside of the field, that would aid policy making and environmental management to build better leaders for society. The assessment objectives test 'human–environment problems at a global and/or local scale', whilst the learning content also requires students to refer to local and global issues, whilst having a 'critical understanding' of the issue learnt (p. 5).

The Advanced level syllabus includes far more content and geographical skills. In relation to ESD, it emphasises the evaluation of consequences of unsustainable practices (37 occurrences) and connects the learner to local and global issues (27 occurrences). It also attempts to instil problem setting, critical reflection, visioning and creative thinking in students through analytical and interpretative skills (15 occurrences). The assessment objectives ask students to 'analyse, organise, and present information in a coherent essay or structured response', 'collate, present and interpret data … or evaluate evidence in problem solving situation(s)' (p. 3). These skills are also gained through the content dealing with 'personal and group fieldwork' as students are trained in the use of cartographic and statistical tools to represent data. Moreover, the students are assessed through two group and one individual fieldwork report where students apply all the geographical research skills to obtain and analyse data in a critical and holistic manner.

Overall, both syllabi create the opportunity for ESD knowledge and skills to be integrated into the teaching. Although the knowledge and skills are present within these syllabi, it is still up to each individual teacher or student whether these will be translated into the ESD values. Students are being taught values in sustainability and environmental issues that are of concern, however whether students act on these values in their daily life is a personal choice.

3.2 Geography Educators and Their Views of ESD

The general view of the post-secondary teachers was that concepts and issues in sustainable development should be included in all lessons and learning material, mostly because ESD is an underlying concept in geography education. Several excellent examples of how it is included and implemented were given. Lastly, some participants also commented on the way ESD was addressed at this level, also noting the limitations to do so successfuly.

The educators felt that it is imperative to feature ESD, and particularly issues regarding sustainability and sustainable development, at this level. They felt that ESD is vital for students during these formative adolescent years, where they are being educated in ways that would be of benefit to them in their future. They believe that students should understand and be aware of issues regarding sustainable development before, throughout, and after their two academic years at post-secondary. The

educators argued that whether it was taught and experienced through their school ethos, activities, or lesson time, both in and outside of the geography classroom, its implementation was crucial. Their academic college years should also teach them to be participative in sustainable development and encourage them to be active citizens. Participant 1 noted how this form of education would "*lead students to take an active role and realise that they cannot simply be armchair critics … not simply criticise on Facebook*" (Participant 1). This is also reflected by Filho and Pace (2016) who highlight that ESD at Higher Education levels considers learners as active participants as opposed to passive learners.

Participant 2 noted how issues in sustainability have become more important on a national level, and that "*today students start to learn about the environment from a young age (as) we are giving sustainable development more importance, hearing about it more, more NGOs or people protesting when something is going to happen*" (Participant 2) which would also encourage their activism in such issues. Overall, it seems that the educators believe that educating students in matters connected with sustainable development is crucial to instil respect towards the environment and people. This is also why many participants believed ESD is cross-curricular and noted how these values are also taught through post-secondary subjects in Maltese colleges like Home Economics, Environmental Science and Systems of Knowledge and its course work. This is exemplified by Amadio (2013) who concluded that ESD is cross-curricular is his study.

Whilst discussing the relevance of ESD to geography, most of the teachers connected this with how and why they integrate it into their teaching. Whilst discussing the link with geography, Participant 1 concluded that ESD is the basis of all education and stated that the concepts of sustainable development were underlying principles in geography, therefore making it inherent to integrate it into the teaching. A comparison can be drawn to the study of ESD 'action themes' by Haubrich (2007) where he concludes that ESD should be integrated into geography education due to their geographical dimension.

This participant also exemplified the integration of ESD in their teaching by stating that it is connected to discussions on quality of life, whether this be social standards involving equity, clean air or an equal distribution of resources, gender balance or the eradication of famine.

Another argument made by another participant was that the implementation of ESD through geography makes students aware of all the issues around them. Here the participant tied its implementation with activities like fieldwork, the school initiative Ekoskola and a Green Committee in the school that conduct green initiatives like the use of a greenhouse and tree planting. Ultimately, all educators felt that ESD was cross-cutting, combining their lessons or teaching experience to issues of sustainability in various ways.

However, geography educators still face challenges to implement ESD. These generally include time constraints, lack of commitment, skills, knowledge and confidence. Firstly, within the research, two participants stated that although there was

room to integrate issues of sustainability into their teaching, there were time limitations as to how much could be included. Notably, time constraints in the implementation of ESD was also quoted by Cini and Mifsud (2018) in their study with secondary teachers.

Secondly, whereas some had stated that the syllabus permitted concepts in sustainable development to be included, another participant mentioned that although they integrated them into their lesson, it was not stipulated in the syllabus. Moreover, the form of the assessment through structured examination papers would not properly reflect the efforts placed into teaching these concepts. Nevertheless, another participant felt that its integration was important because indeed, it has become a popular topic for assessment in examinations and therefore would highlight issues of sustainability more for the students to be more prepared to answer different kinds of questions. Therefore, it can be stated that opinions on the inclusion of ESD into the syllabi vary, even between the few teachers at this level. This brings us to a final limitation brought about by two participants, that the application of ESD, its competences and knowledge depends entirely on the lecturer.

With regards to this point of discussion, a comment was made in reference to the ESD competence *Allowing for sharing ideas and experiences from different disciplines/places/cultures/generations without prejudice and preconceptions.* Here, Participant 1 presented the example of culture and secularisation in different countries. It would be up to the lecturer to present the concepts in a way that did not include any prejudice, which very much depends on their personal interpretation and outlook. The lecturer used policies addressing birth control as an example. Ultimately, the integration of any ESD competences will always depend on the lecturers passing on their knowledge, attitudes, and beliefs.

3.3 Integration of ESD and Its Competences in Teaching Strategies

3.3.1 Teaching Issues of Sustainability

One of the major points of discussion included the educator's role to empower students with ownership over the care of the environment. Participant 3 noted how it was important to teach the value of balance between the economy, society, and the environment as it allows students to draw conclusions and answer questions on sustainability. It is important to note that this way of critical thinking of sustainable development is the target of ESD. This teacher also stated that this balance between the three pillars of sustainable development is vital in geography as it allows the branches of physical and human geography to be combined. The lecturer goes on to say that this is instilled by encouraging "*the love for planet Earth. (That) We can still live, whilst taking care of planet Earth, even by doing the everyday things in life*" (Participant 3).

This integral role of the educators' teaching was echoed by Participant 2 who quoted the 1991 UNEP publication 'Caring for the Earth: a strategy for sustainable living: summary' saying that the first principle 'Respect and Care for the Community of Life' encapsulates everything intended to be passed on the students. Here, "*respect to other people, at school, outside and in the planet; respect to the future generations and respect to every form of life existing*" (Participant 2) was emphasised by the participant as being important values integrated in their teaching. The participant commented that this way of thinking should teach students to give everything value, "*even if it does not have any economic value*" (Participant 2).

Upon affirming the importance of ESD in teaching geography, the educators volunteered examples of topics and discussion points where they feature relevant issues. Participant 1 stated that issues of sustainable development are addressed, though they might not be referred to by the Sustainable Development Goals. This participant exemplified the integration of ESD in their teaching by stating that it is connected to discussions on quality of life, whether this be social standards involving equity, clean air or an equal distribution of resources, gender balance or the eradication of famine. Participant 2 then stated that ESD and concepts of sustainable development were implemented into the teaching of geography at these levels because the syllabus permitted it to be, making it all that easier to do so. This teacher illustrated their argument by using the topics of sustainable fishing and waste management as examples. The teacher would discuss issues of sustainability on how one could consume fish that was in less demand or at healthy population numbers; or separate one's waste. This form of education acts to create more responsible citizens and leaders.

3.3.2 Integrating ESD Skills into Teaching Geography

The competence *Problem setting, critical reflection, visioning and creative thinking* was analysed as an emerging theme. This occurred as educators often stated that preparing their students to think in a more complex matter, whilst relating different aspects of the world and sustainability together was part of their role and the basis of geography. Most participants commented how this is tied in with the ever-so important skill of problem solving. One teacher exemplified their case that students learning geography can think critically about current topics, even on the situation regarding the spread of COVID-19. The lecturer gave an account of their experience where the effects of the pandemic on the tourism industry and its recovery were being discussed with the students. Here, the students brought different opinions to the discussion. As a subject at this academic level, geography allowed *critical and creative thinking* amongst the students during the lesson. The lecturer commented that geography creates such an opportunity to do so, unlike other subjects, like Mathematics.

With regards to problem solving, Participant 3 stated that they would question the students on what they would do, and prompt them with the best solutions if they could not think of a solution entirely independently. Here the argument continued with examples of issues that would need to be criticised by the students, such as a rural land

use, an urban land use, a farming practice, a fishing practice, land reclamation. This participant also effectively pointed out that encouraging students to envision these problems and solutions would help them to foresee into the long-term future. Indeed, this is a crucial ESD competence, and the lecturer's emphasis on its importance is shown in the following quote:

> In many topics having a long-term vision, of what is going to happen next, in the future, or what can happen in any circumstance, is also very important. With geography, it is not only the now, but also what happened before, what is happening now and what can happen in the future. So, seeing long-term is very important. (Participant 3).

Once again, this participant noted how critical thinking could be utilised during an examination.

Similarly, Participant 1 stated that teaching geography allows students to think critically as "*students should relate different aspects on different levels and from different perspectives, from various regions.*" Here, the educator connected this point of view with critical thinking in active citizenship, arguing that it leads them to act on what they would be processing critically. As an example, they hoped that through this form of teaching surrounding such questioning and criticism, students would realise that when watching the news, they were handed a form of bias from news agencies. Similarly, students would be able to research and from their knowledge and judgement, critically seek the best sources.

3.3.3 Encouraging an Open and Global Way of Thinking

All educator participants noted that their role was to prepare the students for the realities of the world that reflect a global society. As Participant 1 stated, geography taught "*interdependence and the global element that we are not living in isolation but part of a globalised system*" (Participant 1).

In this way, ESD is being incorporated to its full potential to relate the learner to issues on a global scale, another connection between geography education and ESD (Smith 2013). The educator states that their teaching encourages students to appreciate all people and their struggles. The topic of migration was particularly used as an example. Here Participant 1 stated that the teaching encourages students "*to appreciate that emigrants, refugees or asylum seekers are not moving from one place to another without a reason but because there is a form of threat on their life*" (Participant 1). Therefore, their approach teaches students respect, the dignity of life and moreover, the quality of life tied to different levels of social and economic development. It teaches students to realise that there are different realities in the world, which could be very different to theirs. In turn, students would appreciate their lives whilst also considering the difficulties of other people.

3.3.4 Implementing ESD Teaching Strategies

Many teaching strategies utilised by the educators were inline with ESD. Most of the teaching strategies mentioned, fall under the constructivist and transformative pedagogical approaches which stimulate student participation and independent learning. The various practices and classroom experiences discussed by the participants have a strong connection with ESD transformative education and implement the ESD competence *Building on the experience of learners as a basis for transformation.*

All the teaching strategies discussed by the educators move away from the traditional chalk-and-talk methods of teaching and involve a blend of learner-centred processes. The pedagogical techniques revealed by the participants to be in line with ESD included various eliciting and questioning techniques, making use of student experiences, and engaging and collaborative activities such as groupwork, discussions, student-led presentations, and the use of Information Technology in the lessons.

The UNECE ESD Competences list *Taking considered action even in situations of uncertainty* and *Engaging with learners in ways that build positive relationships* as teaching competences to achieve transformation in students. Many participants mentioned the necessity to create a safe and comfortable environment for participative learning. One participant mentioned that this would help in student involvement. However, other than caring for the class environment, this is also done by caring for the student "*in a holistic manner*" (Participant 2), though still knowing their limitations.

Participant 2 stated that their role is to fulfil what is needed by the students. This follows the teaching strategy facilitative learning as it aids learners to construct meaning and come to an understanding of important ideas and processes (McTighe and Wiggins 2007). This strategy includes such cited methods like questioning, probing, and process-related commentary, with little or no direct instruction and is rooted in inquiry-based learning. In this account, the educator is interested in the social and academic well-being of the students. Once again, the teacher stressed that their role was not just about passing an examination but giving importance to preparing the students for life experiences, hence enabling them to become better students and human beings. This is also in line with ESD's lifelong learning process, an integral part of quality youth and adult education and embraces continuity in learning (Cassar and Caruana, in Filho et al. 2018).

Therefore, a striking student-centred approach was observed. In this regard, Participant 1 mentioned how their teaching strategy always had the student as a participant in the learning, so much so that might not know how the lesson is going to unfold. Comparably, Bonello (2018) also noted that inquiry-based learning through questioning techniques was highly used in the geography classroom.

The use of eliciting and brainstorming also involves the students by finding out what the students already know on the topic being discussed. This is easily done as the issues elicited from the students are those experienced every day. Therefore, the teacher would inquire what the students already knew and then build on that knowledge. This fits with Vygotsky's constructivist approach which states that knowledge is

not acquired unconsciously, but actively constructed within the learning environment (Liu and Matthews 2005).

Similarly, Participant 3 mentioned that they would "go back to where [they] left off and have a quick revision of what we last covered" (Participant 3) and continue the lesson by brainstorming, asking the students what the topic is about, a similar technique to the What-do-you-know strategy. This is also embedded in constructivism and, according to Bonello's analysis of constructivism in the geography classroom, leads to students thinking geographically (2018).

Other inquiry-based methods included the use of visual aids, teamwork and discussions. Participant 2 praised the use of discussion in the classroom as it enabled students to express different ideas and opinions, and according to Driver et al. (2006) makes the students think critically and commit to the learning.

Similarly, involving students to give verbal presentations and create poster presentations was also suggested. This participant stated that this was a skill learnt through doing. This is certainly a form of active learning related to ESD transformative pedagogy which draws on the experience of leaners and creates opportunities for student participation to develop their creativity and innovation (UNECE 2012). Likewise, another participant cited the use of maps and graphs as means to allow students to learn whilst obtaining vital skills, both for the subject and everyday activities.

Finally, the ultimate 'learning by doing' activity cited by every teacher was the use of fieldwork activities. There was a consensus on the skills taught through students experiencing geography and its techniques in the field, extending beyond the classroom where the students could apply their knowledge. This is another element of constructivism as it provides experiential and transformative learning (France and Haigh 2018). Fieldwork sessions were noted to teach the students to gather, interpret and analyse data, hence leading them to draw their own conclusions on what is being studied. They were linked to achieving problem solving skills and independent learning, especially as students would compile a fieldwork report. Under a similar impression, Borg and Saliba (2006) conclude that field trips are an opportunity for students to learn with greater motivation.

3.4 Educators as Reflective Practitioners

The UNECE ESD competences also state that transformation within an educator occurs to educators who can change their own practice as critical reflective practitioners. The participants had two main viewpoints on the ways and reasons why they are critical of the teaching practices. These are summarised in Table 2.

Four participants contributed accounts of critical reflection on their practice exhibited by the first viewpoint. Here the chief view was that the teachers evaluate their teaching after a certain period to understand which practices, lessons and topics were more successful, and change techniques of lesson strategies according to their evaluation. Participant 4 said that this was done as some lessons are conducted smoothly and

Table 2 Participant's viewpoints on how critical reflection on their practice takes place

Viewpoint 1	Teaching practices are evaluated over time as teaching realities change. This is done to improve in their craft
Viewpoint 2	Teaching practices naturally improve over time as experiences and teaching methods change over time

successfully with one class but might produce different results with another. Therefore, their teaching strategies are changed over time to accommodate the student learning and facilitate their understanding better. Participant 3 noted that they reflect on their teaching and question their techniques, at times even doubting their ability. This can be seen in the reflective self-questions: "*I reflect on my teaching all the time, I question, Is it good enough? Have I made myself clear? Have the students understood what I wanted to tell them? Have the students acquired the needed skills?*" (Participant 3) and concluded that this was done because the same material was covered and taught year after the next.

A note-worthy explanation was given by Participant 1 who summed up the reason for critical reflection due to the changing realities of the students and the teacher themselves. The lecturer noted how their realities have changed since they began teaching many years ago, leading them to gain different perspectives on life, their teaching, and students' realities. This educator argued that by evaluating the realities experienced both by themselves and the students, they could reform to engage students better rather than simply give information, as "*for that there is Google, the National Geographic or Discovery* (channel)" (Participant 1). This reflects the emphasis placed on critical reflection for transformative education by UNECE (2012), as it states that it will aid educators and learners to build positive relationships. Educators that present themselves as faulted humans instead of sources of answers would be able to empathize with the views and situations of the learners they relate to (UNECE 2012).

The second viewpoint was given by one participant who stated that although they did not take note of the way they taught, they improved naturally over the course of their teaching years. It was stated that they would improve automatically after realising that a certain lesson would not have turned out as planned. Over time they would also change teaching methods, for example by introducing more visual and interactive aids into the lessons.

4 Conclusion

The study was posed with a few limitations to gathering optimum data. The data was obtained from a small sample size as the number of post-secondary geography teachers in the country is a small one. Secondly, the interviews had to take place via video calls due to social distancing procedures due to the ongoing pandemic. This was both advantageous and limiting. On the one hand, the participants preferred to

conduct the meeting online and participated at any time wherever they were available, whether it be at work or home. On the other hand, a different rapport could have been created face to face, where the participant's expressions could have been read better.

The results presented suggest that the educators implement ESD within their classroom setting. This is done as they view issues in sustainable development as crucial for the education of geography and the students' lifelong learning. Educators implement ESD through the teaching of skills, where students are encouraged to be creative with problem solving situations regarding issues of sustainability in Malta, all whilst having long-term vision on the matters being discussed.

The transformative teaching of geography at post-secondary level reflected in the educators' accounts prepares students for a global world. This encourages students to appreciate all nations, cultures and their people, and the challenges presented with creating a sustainable future. The educators' pedagogical approach resembled ESD strategies where outdoor learning is encouraged, together with strategies that reflect inquiry-based learning and other participative methods. Overall, the educators integrate ESD in combination with their teaching of geography, however time, syllabus, and rigid examination structure were constraints quoted as being limitations of its successful implementation.

At the policy and institutional levels, the current geography syllabi do not stipulate for the implementation of ESD competencies within teaching and learning contexts. This situation ultimately leads to the integration of ESD competencies in the education system as a personal choice on the teacher's part. The weaving of ESD competencies throughout the syllabi and a complimentary document aimed at educators to instil ESD values directly connected to the content laid out in the syllabi would be a significant way forward. This would encourage transformative education in the teaching of values related to sustainable development and the attainment of skills that will help to create equitable, healthy, and sustainable communities.

References

Amadio M (2013) A rapid assessment of curricula for general education focusing on cross-curricular themes and generic competences or skills. Paper commissioned for the EFA Global Monitoring Report 2013/4, teaching and learning: achieving quality for all. http://www.ibe.unesco.org/sites/default/files/resources/225939e.pdf

Bonello K (2018) School geography teachers' pedagogical choices: the claim for 'geographical thinking'. Masters dissertation, University of Malta

Borg C, Saliba E (2006) '*Water*' a curriculum pack for the Ekoskola Programm [Bachelor thesis, University of Malta]

Cini A, Mifsud M (2018) Knowledge, attitudes and behaviour towards the environment of secondary school teachers. In: Handbook of lifelong learning for sustainable development. Springer, Cham, pp 211–227

Driver R, Newton P, Osborne J (2000) Establishing the norms of scientific argumentation in classrooms. Sci Educ 84(3):287–312

Filho WL, Pace P (2016) Teaching education for sustainable development: implications on learning programmes at higher education. In: Filho WL, Pace P (eds) Teaching education for sustainable development at university level. World sustainability series. Springer, Cham, pp 1–6

Filho LW, Mifsud M, Pace P, Caruana V, Cassar C (2018) Empowering youths as lifelong learners through education for sustainable development: a critique from the perspective of Maltese youths. In: Handbook of lifelong learning for sustainable development. Essay, Springer Nature, pp 87–107

France D, Haigh M (2018) Fieldwork@40: fieldwork in geography higher education. J Geogr High Educ 42(4):498–514. https://doi.org/10.1080/03098265.2018.1515187

Haubrich H (2007) Geography education for sustainable development. In: Geographical views on education for sustainable development, proceedings of the lucerne-symposium, Lucerne, Switzerland, 29–31 July 2007

Liu CHH, Matthews R (2005) Vygotsky's philosophy: constructivism and its criticisms examined. Int Electron J 6(3):386–399

McTighe J, Wiggins G (2007) Schooling by design: mission, action, and achievement, 1st edn. ASCD

Ministry of Education and Employment: Malta (2012) A national curriculum framework for all 2012. https://curriculum.gov.mt/en/Resources/The-NCF/Documents/NCF.pdf

Nagel P (2008) Geography: the essential skill for the 21st century. Soc Educ 72:354–358

Moore J (2005) Barriers and pathways to creating sustainability education programs: policy rhetoric and reality. Environ Educ Res 11(5):537–555

Saunders L, Hewitt D, MacDonald A (1995) Education for life: the cross-curricular themes in primary and secondary school. Slough

Sheurich JJ (1997) Research method in the postmodern. Falmer Press, London

Skarstein F, Wolff BB (2020) An issue of scale: the challenge of time, space and multitude in sustainability and geography education. Educ Sci 10(5). doi:https://doi.org/10.3390/educsci10010005

Smith JA, Flowers P, Larkin M (2009) Interpretative phenomenological analysis: theory, method and research. SAGE

Smith M (2013) How does education for sustainable development relate to geography education. In: Debates in geography education. Essay, Routledge, pp 257–269

Tilbury D, Stevenson RB, Fien J, Schreuder D (eds) (2002) Education and sustainability: responding to the global challenge. Commission on Education and Communication, IUCN, Gland, Switzerland and Cambridge, UK

UNECE (2012) Learning for the future: competences in education for sustainable development. UNECE, Geneva. https://unece.org/fileadmin/DAM/env/esd/ESD_Publications/Competences_Publication.pdf

United Nations (2015) 2030 agenda for sustainable development and its 17 sustainable development goals. www.un.org/sustainabledevelopment

Wade R (2002) Sustainable development education and Curriculum 2000. Planet 8(1):4–7. https://doi.org/10.11120/plan.2002.00080004

Making Career Development Sustainable: A Senior Capstone Course Case Study

Candy T. Y. Ho

1 Introduction

Presently the largest cohort on Earth with more than 2.47 billion members (Miller and Lu 2018), those born between late 1990s and early 2010s, is Generation Z (Gen Z); a group known for their care and concern for the world. Notably, social and environmental issues such as poverty, inequality and injustice, and climate change are significant considerations for this generation who have a keen focus on activism for social change as epitomized by iconic leaders such as Greta Thunberg, Malala Yousafzai, and Amanda Gorman. While striving for a sustainable world where people make use of present resources without compromising the resources from future generations (United Nations [UN] 2022), many who belong to Gen Z are experiencing feelings of hopelessness and fear about the future due a perceived lack of action from country leaders to tangibly and forcefully move towards a sustainable reality.

That said, in some cases, these feelings of despair and negative emotions can simultaneously facilitate a sense of determination for this generation to take action themselves, particularly when they feel empowered and believe they have the agency to advocate and enact change on individual, organizational and community levels. Notably, given that over 50% of this generation are enrolled in some level of higher education learning (Organisation for Economic Cooperation and Development [OECD] 2021), institutions can play a role in helping Gen Z increase their hope and activism to improve the prospects of their future.

The purpose of this paper is to describe a case study showcasing how a career capstone course has leveraged the United Nations Sustainable Development Goals (SDGs) to facilitate student awareness and understanding of local and global issues, which has implications for sustainability education across disciplines. The course activities and assignments described in this paper provide students with opportunities

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to consider how they want to apply their knowledge, skills, and talent to address the 17 SDGs. Through ongoing reflections, they solidify their identity and roles as leaders, change agents, and stewards of this planet.

2 Background

2.1 Generation Z as Change Agents

Global issues such as climate change and social injustice and inequalities are issues that gravely concern youth these days as they see themselves ultimately inheriting these issues that impact their livelihood. In fact, those aged 18–34 in the United States alone identify that global issues are causing some level of stress in their lives (Johnson 2021). They feel the need to mobilize and take collective action to avoid the significant consequences that will undoubtably impact their generation if they sit idle (Haugestad et al. 2021).

Members of Gen Z believe their generation has the potential to change the world for the better (Kimball 2014; Golestani 2016) and want their voices heard to raise the level of accountability that governments and businesses display on a regular basis. They are of the belief that the current approaches taken by their government and country leaders are not sufficient to effect real change (Kosko et al. 2022, 140; Qasem 2013) and often voice concerns through more non-traditional means such as protests, strikes, and social media to prompt for action.

In this sense, youth are shifting from the role and perception of a victim or bystander to active change agents working hard to shape and change their future, finding ways to insert themselves in key forums and conversations to assert influence. They feel more accountable than any previous generation to shift the trajectory that the world and climate are moving towards. In essence, members of Gen Z are redefining the role youth play on the world stage and are shifting from being thought of as 'citizens of tomorrow' and 'future citizens' to 'deliberators' or "effective agents of democracy" (Nishiyama 2017, 11; Harris 2021).

Those belonging to Gen Z are more likely to pursue higher education studies than any previous generation (OECD 2021). These educational experiences "enable young people to work in collectives and give them opportunities to socially connect and identify with others" (Wallis and Loy 2021, 8), and in turn, share common concerns and envision similar ideals. In many cases, students are leveraging these connections and the resources they can access within their higher education institutions to practice agency, use their voice, hone leadership and activist skills, and to seize the opportunity to collaborate with their peers. This case study explores a senior-level university career development course that helps students achieve these very outcomes while simultaneously supporting their desire to mobilize their care and concern for the world.

2.2 Career Development Courses in Higher Education

In a traditional higher education model in North America, generally, the core content within academic offering includes disciplines such as humanities, social science, business, and natural and applied sciences. Additionally, a student affairs or student services area complement that facilitates campus life, social and career development, and general mental, physical, and academic support services. However, some institutions are beginning to formally blend elements of those offerings, notably on the career development front, into courses that facilitate career transition support that also provides credit towards a student's graduation requirements (Reardon, Peace, and Burbrink 2021, 1).

While this more explicit offering of career development courses within a formalized curriculum is becoming more prevalent, career development courses themselves date back to as early as the 1930s when Hoppock (1932) documented 18 colleges who offered career courses for their students. These courses emphasized the importance of helping students discover their place in the world by getting to know themselves, considering their options, and making informed decisions and taking action. The curriculum encouraged students to focus on identifying their "calling", "fit", "purpose", "life vocations", and "life work" and recognized that career success is not just about work but also crafting a meaningful life.

Nearly a century after the first career development courses were identified, the landscape of work and higher education has no doubt shifted drastically. Since the 1930s, the world has become a lot more complicated with advancement in technology, increased human population, and societal and environmental issues. The rate of change in the labour market is also evolving, with the anticipation that "job creation is slowing while job destruction accelerates" (World Economic Forum [WEF] 2020, 5), requiring workers to reskill and upskill. Overall, there is much uncertainty in the world of work as we can no longer expect careers and professional trajectories to be linear.

Students are realizing this dynamic workforce environment they are attempting to navigate. According to Spight (2020), at least one fifth (20%) of first year students are undecided on their major and future career, and 50% of undergraduates will change their major and careers while enrolled in a higher education program. As well, Selingo (2018) asserts that Gen Z students are more likely than previous generations to pursue higher education to facilitate insights into their career decision making.

Consequently, it becomes more important than ever for career development courses to help students embrace uncertainty throughout their lifetime. This involves the notion of career management which requires students to continually examine their evolving strengths, skills, and goals, constantly assess the environment, and gather relevant labour market information to make informed career and life decisions that suit their needs (Stebleton and Diamond 2018).

With that in mind, Brown and Krane (2000) outlined five components of effective career interventions that would also apply to career development courses to reflect our contemporary society. Effective career development courses.

(a) Enable students to articulate their professional and personal goals through writing;
(b) Provide tailored, individualized feedback, such as results from personality assessment tools;
(c) Provide updated labour market information on their potential occupations and fields;
(d) Consist of studying individuals, such as role models, who practice effective career strategies and behaviours; and
(e) Help students find and foster support systems toward their career aspirations.

In addition to enhancing self-awareness and promoting information gathering, as indicated by (d) and (e), there is also an action-oriented element prompting students to develop a supportive network to sustain their careers. Part of this action-taking piece also links student career aspirations with the broader context by having students consider how they want to serve their communities and identify the contributions and legacies they want to impart upon the world (Ho 2020). Gen Z is seen as the generation who will take action, advocate for positive and social change, and can do so through their careers. Career development courses help them figure out how to do this by helping them explore and discover their purpose. The next section discusses specific curricular elements that are introduced into a senior career capstone course to help blend the core attributes of a career development course with the goals and desires of a generation who is keen to mobilize and change the world.

3 Methodology

This case study is situated within a senior career capstone course taught at two teaching-intensive universities in the province of British Columbia, Canada. Teaching-universities are mandated to have small class sizes; each section of the course has up to 36 students who take the course as early as the beginning of their third year of studies, or at their final semester before graduation. Students range from a variety of disciplines, from arts and humanities, sciences, to business, design, and technology. The course is delivered in a hybrid format with asynchronous modules and monthly in-person classes (which shifted online during the COVID-19 pandemic). Perhaps what makes the course particularly unique is the infusion of the SDGs as a framework that guides activities assignments, and outcomes, all of which are next discussed.

3.1 Introductory Mindmap

The SDGs are introduced at the beginning of the semester to reinforce the significance that the goals will have throughout the course A video featuring Malala Yousafza, the

Fig. 1 Introductory mindmap template

world's youngest Nobel Prize laureate, introduces the SDGs as "the world's largest lessons" (World's Largest Lesson 2016). Upon gaining a general understanding of the SDGs, students complete a mindmap identifying personal elements such as their perceived strengths, interests, career aspirations, and goals for the course. In addition, they state up to three SDGs they feel connected to and elaborate on these connections, which can be personal and/or professional. The mindmap is shared with their classmates during the first week of the course when they introduce themselves (Fig. 1).

3.2 Portfolio and Personal Mission Statement

The portfolio project is a major assignment of the course where students apply to an opportunity of their choice such as a professional role or a graduate school program; students with entrepreneurial aspirations may adapt the assignment to create a website for their company as well. Many students use this assignment to receive feedback on their portfolio components (resumé or curriculum vitae, cover letter or personal statement, artifacts demonstrating their relevant skills and experience, etc.) before actually applying to their desired opportunity.

An important element of the assignment is a personal mission statement where students articulate how they intend to contribute to society and the impact they hope to have upon individuals they serve. Prior to crafting their mission statements, students review mission statements from organizations they admire and consider important elements that go into compelling statements, such as being concise while impactful and memorable. In their final submission, students also provide a rationale

explaining their statement creation process and discuss how and why they selected their identified SDG(s) during the process.

3.3 Information Interview Project

In the course, developing and furthering one's professional network is emphasized as an important strategy for professional and career success; additionally, for students connecting with professionals in their desired field also promote informed career decision making. To facilitate professional networking, the course has an information interview project where students identify three or more individuals who can provide insights on their career aspirations. For instance, a student applying to graduate school may interview faculty members, admission officers, current students and alumni of their desired program. Students also hone research skills from this project as they visit company and school websites to identify potential interviewees, and conduct background information research to generate information interview questions.

Once they complete these information interviews, students submit a reflective component that can be in forms of a reflective paper, a video journal, an infographic, or a presentation to the class. In their reflection, they highlight key themes from the conversations, discuss how these themes influence their career aspirations and decisions, and draw connections between the conversations and their identified SDG(s).

3.4 Various Discussions and Reflective Activities

Throughout the course the SDGs are infused into activities, where appropriate. An example is the lifelong learning submodule, where students are asked to research learning opportunities that help them advance their understanding and activism toward their identified SDG(s). Another example takes place during the future of work submodule, where students review resources on local and national work trends and record their thoughts in a reflective journal around how these trends may impact their identified SDG(s).

3.5 Data Collection and Analysis

Evidently, these activities connect and build on one another to help students consider how they can play a role in addressing global issues, in addition to fulfilling their career aspirations. Students complete a short questionnaire at the end of the term. Included in the questionnaire is a question asking: "*In what ways, if any, did the UN SDG(s) help you learn more about yourself and your career development?*" The

questionnaire serves a dual purpose, firstly to assess any shift in students' thinking and behaviour as a result of incorporating the SDGs in the course, and secondly to provide an opportunity for students to reflect on their overall course learning.

From Fall 2019 to Summer 2021, responses to the question were gathered from 513 students who completed the course. From the 367 responses received, 14 responses were omitted as they were deemed irrelevant as they did not reference the SDGs. With 353 responses, a 69% response rate was yielded. A thematic analysis approach was employed to identify common themes from the data; the results of these themes are discussed in the next section.

4 Results

As noted above, assessment of the effectiveness and impact of leveraging the SDGs to inform students' personal reflection and career development was captured through both assignment submissions and a final survey.

The theoretical framework used to analyze the student questionnaire responses was derived from Kohler-Evans and Barnes' (2015) Model of Influence. This particular model was selected as it is designed for experiential and service-learning type courses. Additionally, the model recognizes that students follow a sequence of stages—four levels of affective development—when being exposed to new information, such as the SDGs: Developing consciousness, acknowledging beliefs and affirming perspectives, realizing benefits to self and others, and taking action and embracing influence. This section aligns each of the four levels of affective development with students' experience in the course based on testimonials submitted in the course's final survey.

4.1 Developing Consciousness

Kohler-Evans and Barnes' (2015) state that the first level in the Model of Influence, individuals develop consciousness and curiosity about the topic at hand, which in this case, are the SDGs within the context of a career capstone course. When beginning the course, most students acknowledge that they are generally interested in global issues, though are unaware of the SDGs. As career development concepts are introduced, the SDGs are continually referenced to help students connect their own perspectives, experiences, and interests to a larger cause, which helps bolster students' understanding of the career development process.

The following testimonials showcase how beneficial students have felt gaining this awareness of the SDGs helps them in adopting a broader and more applied perspective:

What I have learned about myself in relation to the UN SDG'S is that I'm actually big when it comes to gender inequalities/reduced inequalities. When I conducted the career connection assignment the [sic] 2/3 of the people I interviewed within my career were female and I was happy to see how females are starting to dominate and are being seen as equal to men nowadays.

I've realized that I do have a deep passion for my UN SDG's b/c I see it come through when I think about my mission statement or how I reflect upon myself in my personal statement.

Students also commented about how the SDGs can help them gain a sense of direction and where the goals might take them with respect to potential professional and academic pursuits:

One of the biggest things I learned about myself in relation to the UN SDG(s) is the importance of having a mission statement because this gives a direction of what I have to do and where I am headed in life. Having a mission statement is like having a life-long commitment that you can always go back to in case you need some direction or reaffirm yourself in your life. I see the UN SDG(s) as something similar to a mission statement. It is one of the organization's purposes designed in helping other people and making this world a better place. The organization uses it to channel their time and energy and can gauge their own performance against. Similarly, I can use my own mission statement to assess myself, my work and progress in life.

This course had us complete multiple assignments that assessed our education and experience in relation to our career goals. The Sustainable Development Goals I identified included: Good Health And Well Being, Quality Education and Peace, Justice And Strong Institutions. This experience has helped me realize that although I have a variety of experiences in different fields, which I have been often troubled with and felt like I had no direction, I seem to have a better sense of purpose and direction with my career path. It was neat to see how our SDGs are reflected in the path we have chosen. With deeper thinking, it has also become more clear on how I want to tie these goals and experiences together in the future, including which courses I want to teach and which masters program I will work towards taking.

Discussed next is how students take the SDGs beyond this initial awareness level as they discuss how the SDGs help them expand their perspectives while reinforcing their values.

4.2 Acknowledging Beliefs and Affirming Perspectives

Kohler-Evans and Barnes' (2015) assert that at the second level, individuals encounter various worldviews that invite them to "affirm, extend, challenge, or even, change one's [their] thinking" (35). Student responses at this second level go beyond the basic level of awareness; they touch on how the SDGs reflect their personal values, and how they see their values and beliefs transpire in future professional contexts. As the following testimonials indicate, the SDGs become 'personal' for students as they articulate the meaning these goals hold for them through course activities:

My original justification for choosing quality education and reduced inequalities was because they go hand in hand as education can be used to reduce inequalities. However, I

have taken these at a much more personal level now. I look at myself as a future educator and try to think of ways I can reduce inequalities in my classroom. For example, during one of my information interviews one of the interviewees was discussing being cultural aware and used the example of the idiom "pale as a ghost". For anyone who is not white, this would not make any sense. So it is important to be aware of these things. Addressing the inequities in the curriculum and the classroom materials is one way to work towards quality education.

I identified 2 SDGs that I'm passionate about initially, but I ended up finding 3 by the end of the course! I feel that the UNSDGs really helped inform my personal statement for my law school application. Knowing which ones I identified initially really helped me shape how I discussed my passions and what I want to change about the world, which is the entire reason why I want to become a lawyer. It also really came in handy when I was doing my ePortfolio, so that was really nice.

By acknowledging and expanding on their beliefs, students begin to think beyond themselves. The SDGs now represent something much larger, beyond their individual scope, as they begin to consider how they can leverage their skills and talents to help advance the SDGs and in turn be of service to others.

4.3 Realizing Benefits to Self and Others

The third level of the Model of Influence calls for individuals to consider how gaining knowledge and insights can provide benefit beyond their personal gain. This level manifests in the course as students identify ways to effectively serve others through contributing towards their identified SDG(s). By doing so, students enhance their perspective-taking ability by making connections between their needs and those of others:

Reading these goals, I thought to myself, 'Wow, I really want to contribute to mental well-being, diversity and inclusion, and access to justice. I know for sure that I want to enter the field of Clinical Psychology, as I want to be a support system for those who are struggling with any aspect of these goals not being met'. I think that as the course progressed, the SDGs I identified in the beginning became even more of a rationale as to why I want to enter the field that I do. In my ePortfolio, my Mission Statement solidified this too, and made me reflect on what I want to accomplish in a career even further. I guess overall, I learned that I am even more passionate about helping others than I thought, and that the impact a 'helper' can have on an individual's life can impact a larger community and even have global advancements. This is so inspiring to me.

With the UN SDG Goal 16, Peace, Justice, & Strong Institutions, I believe that I am capable of reflecting this SDG in my career path and ensuring everyone in the community has equal access to justice with or without funds. Everyone has the right to justice and I want to be able to give that back as a part of my career. Every module and assignment was tied to our SDGs directly and indirectly in a lot of ways and it made us think about the SDG and how to include that in a mission statement or our e-portfolio. The mission statements were definitely helpful and it really does make an impact for a first impression.

As indicated above, the activities and assignments completed throughout the course afforded students the ability to consider the benefits they can bring to themselves and others. This provides the required foundation for them to advance into the

final level of the Model of Influence that connects thinking with action so students can enact their goals and aspirations.

4.4 Taking Action and Embracing Influence

In the previous three levels, students do a lot of thinking: From gaining awareness of the SDGs, to thinking how they can act on their identified SDG(s) to benefit themselves and others. At this final level, Kohler-Evans and Barnes' (2015) see individuals developing courage to take action and embrace change.

At this final level, students now make a commitment to how they themselves can become advocates and change agents who have a tangible impact:

> *I am really passionate about education. Going into the class I was certain about education but also uncertain because I thought that I would not make a good teacher. When I completed the interview assignment I was looking back at why I want to be a teacher. There are so many kids around the world that do not have access to quality education and it breaks my heart. I was thinking back to my experience in Nicaragua and I remember helping one girl study for her English exam so that she could go onto middle school. Thinking back to that moment I am remind that education was so much more than a goal for her but it represented a hopeful future. I want to be a part of the global solution. I want to work hard so that I am working purposefully not just for a paycheck.*

> *My identified UN SDG is Peace, Justice and Strong Institutions. As a result of the Career Connections assignment and speaking to experienced individuals in the field of probation, I have learned that there are certain skills needed in this position to ensure not only personal success but also the success of the organization as a whole. These skills are: Empathy, communication, organization, writing, time management and adaptability/flexibility. Through these interviews, I learned that I possess a lot of these skills that I had never even thought about prior to completing this assignment. I was able to critically apply these skills to my SDG as they are essential in developing peace, justice and strong institutions within the Community Corrections Division. Therefore, the Career Connections assignment assured me that I am a good fit for this position (as I previously had some doubts in regards to whether or not I would be successful in this career path), and do have a chance at proving so to potential future employers.*

Both testimonials featured above showcase some initial hesitance the students exhibited towards being able to either pursue their profession of interest or to have the skills and abilities to affect change. However, after completing the course and engaging in the reflective process, students began to realize how they can make a contribution toward their identified SDG(s) with the skills and talents they already encompass. Consequently, the course and its various curricular interventions empowers students to move from awareness of their thoughts to taking concrete action to make the world a better place.

5 Conclusion

The largest percentage of students enrolled in higher education institutions globally belong to Generation Z; a generation characterized by an historic rising level of social and environmental anxiety. As a whole, these young adults are not feeling fully confident or empowered to tackle the world's wicked challenges, and are notably concerned that future generations will not prevail. That said, as faculty members and professionals in higher education, there is an immense opportunity to leverage a curricular approach that empowers students to learn more about tangible ways they can leverage their skills, abilities, and interests to become change agents. One framework that can be adopted to allow students to envision possible solutions is the United Nations Sustainable Development Goals. The SDGs can simultaneously be used to raise awareness of global challenges, while also inspiring students to realize their skills and knowledge, and how they contribute toward addressing the SDGs.

This paper presented an overview of a liberal arts career capstone course that introduced a number of curricular interventions to help students both learn about career development theories while also motivating them to situate themselves within a broader global context. When aligned with the Kohler-Evans and Barnes' (2015) Model of Influence, the results showcase that incorporating the SDGs into the curriculum had significant pedagogical outcomes. Notably, students explicitly acknowledged they were able to identify their own learning and development while gaining significant clarity on how their career aspirations could have a positive impact on society.

When students can more overtly make connections between their individual goals and broader community or global goals, their outlook on life seemingly becomes more positive and their level of hopelessness decreases as they begin to see the impact of their actions and their effects on the environment and their communities.

5.1 Limitations

For faculty interested in incorporating the SDGs in their courses, this paper has only described the infusion of the SDGs within a career development course. While the course assignments and activities might not be able to generalize to other disciplines, it is the reflective elements and practices that faculty can transfer to their course.

Additionally, the results in forms of student comments were drawn from a single question in the questionnaire issued at the end of the course, as such, more comprehensive data is needed to detect and assess long-term impact of incorporating the SDGs in the curriculum. It would be tremendously valuable if follow up studies can be conducted to see if students have continued to reflect on the SDGs and enact on them in their professional and personal lives.

5.2 Implications

While this paper presented the interventions and outcomes from a single course on career development, the intention is that it can inspire other educators to integrate sustainable education and SDGs into the curriculum, as mentioned in the previous sub-section. This can also go beyond social and environmental disciplines and can be infused into all academic programs, particularly if structured from a problem-based approach that is already incorporated into many interdisciplinary programs.

Arguably, the impact can be the most powerful when faculty members give students space to identify how the SDGs can be interpreted at an individual level. It would be feasible for faculty to consider how their teaching and curriculum can help enhance students' knowledge, skills, and confidence to address the SDGs, and furthermore, make these considerations explicit to the students. That way, students can be invited to draw connections between course learning and the SDGs, and determine ways they see themselves take ownership and leadership in advancing the SDGs to support longer-term outcomes that will benefit society.

References

Brown SD and Krane NER (2000) Four (or five) sessions and a cloud of dust: Old assumptions and new observations about career counseling. In: Brown SB & Lent RW (Eds.), Handbook of counseling psychology (3rd ed). John Wiley & Sons, New York, p 740

Golestani C (2016) Social activism and extended education. Int J Res Ext Educ 4(2):110–127

Harris C (2021) Looking to the future? Including children, young people and future generations in deliberations on climate action: Ireland's Citizens' Assembly 2016–2018. Innovation: The European J Social Sciences 34(5):677–693

Haugestad CAP, Skauge AD, Kunst JR, Power SA (2021) Why do youth participate in climate activism? A mixed-methods investigation of the #FridaysForFuture climate protests. J Environ Psychol 76:1–15

Ho C (2020) Teaching career education using the united nations sustainable development goals. https://youtu.be/Iqq9aq3t_Vo (Last Accessed 28 Feb 2022)

Hoppock R (1932) Courses in careers. J High Educ 3(7):365–368

Johnson SS (2021) Climate change & well-being: The role for health promotion professionals. Am J Health Promot 35(1):140–143

Kimball G (2014) Why recent uprisings are led by youth. http://www.heathwoodpress.com/why-recent-global-uprisings-are-led-by-youth-gayle-kimball/ (Last Accessed 6 Mar 2022)

Kohler-Evans P, Barnes CD (2015) Compassion: How do you teach it? J Educ Pract 6(11): 33–36

Kosko SJ, Dastin A, Merrill M, Sheth R (2022) Marginalised youth activism: Peer-engaged research and epistemic justice. J Hum Dev & Capab 23(1):136–156

Miller LJ and Lu W (2018) Gen Z is set to outnumber millennials within a year. https://www.bloomberg.com/news/articles/2018-08-20/gen-z-to-outnumber-millennials-within-a-year-demographic-trends (Last Accessed 3 Mar 2022)

Nishiyama K (2017) Deliberators, not future citizens: children in democracy. J Public Deliberation 13(1):1–24

OECD (2021) Education at a glance 2021: OECD indicators. https://www.oecd-ilibrary.org/sites/b35a14e5-en/1/3/3/4/index.html?itemId=/content/publication/b35a14e5-en&_csp_=9689b83a12cab1f95b32a46f4225d1a5&itemIGO=oecd&itemContentType=book (Last Accessed 5 Mar 2022)

Qasem A (2013) Five barriers to youth engagement, decision-making, and leadership in Yemen's political parties. https://www-saferworld-org-uk.ezproxy.kpu.ca:2443/resources/publications/785-five-barriers-to-youth-engagement-decision-making-and-leadership-in-yemens-political-parties (Last Accessed 6 Mar 2022)

Reardon RC, Peace CS and Burbrink IE (2021) College career courses and instructional research from 1976 through 2019. Scholarship of teaching and learning in psychology 1 Apr 2021

Selingo JJ (2018) The new generation of college students: How colleges can recruit, teach, and serve Gen Z. https://highland.edu/wp-content/uploads/2018/12/NewGenerationStudent_i.pdf (Last Accessed 1 Mar 2022)

Spight DB (2020) Early declaration of a college major and its relationship to persistence. NACADA J 40(1):94–109

Stebleton MJ, Diamond DK (2018) Advocating for career development and exploration as a high-impact practice for first-year students. J CollE Character 19(2):160–166

UN (2022) Sustainability. https://www.un.org/en/academic-impact/sustainability (Last Accessed 6 Mar 2022)

Wallis H, Loy LS (2021) What drives pro-environmental activism of young people? A survey study on the Fridays For Future movement. J Environ Psychol 74:1–10

WEF (2020) The future of jobs report 2020. https://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf (Last Accessed 6 Mar 2022)

World's Largest Lesson (2016) Malala introducing the World's Largest Lesson. https://vimeo.com/138852758 (Last Accessed 23 Feb 2022)

Documentary Film and Institutional Behavioral Change: A Student-Driven Mobilization for Sustainability

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1 Introduction

For the last century, film as a medium has provided an additive opportunity for relaying information and sharing perspectives. The ability to communicate a scene, idea, or statement in high definition and in color has expanded the horizons of entertainment far beyond the edge of a stage to make the real and the imagined tangible. The impact of film is beyond the visual and can transform the viewer, irrespective of whether the information relayed is fiction or fact. This is perhaps more significant for documentary film. Due to its focus on an experienced event, this genre creates an opportunity to connect with an audience through facilitating a shared journey.

From their roots in exoticism and the newsreel tradition, documentaries are something akin to artistic journalism, where scripting and performance take a backseat to

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visual storytelling. However, these films largely differentiate themselves from traditional journalism with their foci. By focusing on unexpected or otherwise obscure topics, they can critically examine potentially controversial subjects without falling into sectarian or politicized commentary. When producing a documentary, it is far easier to lend a narrative framework to observable reality rather than to seek out examples which confirm prior beliefs, and it is this constraint which enables an objective and authentic transmission of nearly any situation.

Documentary film is perhaps at its best when it captures the unseen, revealing a reality to the audience they wouldn't otherwise be able to access. Brazilian educator and philosopher Paolo Freire, in his seminal work *Pedagogy of the Oppressed,* defines praxis as "reflection and action upon the world in order to transform it" (Freire 2000 p 51). Many documentary filmmaking efforts stem from a desire to transform the world, and their products often serve as a starting point for praxis by providing a vehicle for reflection and, in some cases, prescribing an action. It turns out documentaries are themselves very Freirean, as they force an individual viewer to engage with objective reality in color and perhaps in high definition. Filmmakers then have an opportunity to critically confront this reality; in our example this was the assignment of responsibility to anyone who uses paper coffee cups. While uncomfortable, it is this realization of the problem which inspires action to correct it.

Freire thought about this in the context of oppression and liberation; in many ways this translates directly to the way in which we are oppressed by the normalized patterns of consumption we so carelessly fall into. We might be liberated from this paradigm and strive for better outcomes for our health and the environment, but only if there is a realization that we are subjugated by it. According to Freire this is the first stage of the pedagogy of the oppressed, wherein "the oppressed unveil the world of oppression and through the praxis commit themselves to its transformation" (Freire 2000 p 54). Thus, the call to action is instrumental in any impactful documentary, even if it is as simple as urging the viewer to learn more about the topic. This is because it constitutes a commitment to make a change now that the viewer's perception of the issue has been objectified. It is effectively trusting the audience to reflect and take up their own course of action.

Once they have been exposed to the truths of systemic racism, the imminent extinction of the North Atlantic Right Whale, or convenience culture to enumerate a few examples, the viewer cannot shut their eyes and return to a state of ignorance. They can no longer find security in fearing freedom from that which oppresses them. The natural continuation of this process is to do something about it—to become anti-racist, campaign to close areas of ocean to fishermen, or drink from a reusable coffee cup. It is through this action that permanent liberation can be achieved when the myths of a false and unchangeable reality are expelled (Freire 2000 p 54).

Simply put, documentary film has the power to awaken and empower viewers to solve problems they may have previously been unaware of. If done correctly, there are few better ways to inspire simultaneous reflection and action beyond mere activism or verbalism (Borish 2021).

In the sections that follow, the development of the documentary film genre and its use in higher education are addressed to provide a foundation for the use of the

documentary as a learning opportunity from production to screening. The discussion focus, which then follows, is on the creation of Sustainable U, a student initiative and educational vehicle for student-based change agency at Northeastern University. Highlighted is the process of the creation of this organization and its first documentary project, *Plastic Linings*. The documentary short film reflects a multi-disciplinary student collaborative effort to educate to facilitate change through individual and collective empowerment.

2 Documentary Film

In 1922, Robert Flaherty, an American filmmaker, created what is known as the first ever documentary (van Dongen 1965 p 3). With help from the Inuit tribe, Flaherty was able to develop a film that showcased how this tribe lived. Flaherty believed his films could make the audience feel intimate with the people they were watching on the screen. In his eyes, there was a big difference between simply reading about a man's experience, grief, and pain versus watching him live out those moments. Critics argue that Robert Flaherty started the influx of documentaries, where real people and events were captured and narrated through film.

Bill Nichols is attributed as being one of the first scholars to apply modern film theory to the study of documentary. He identified six modes of representation in documentary films (Yu and Yan 2021). They are the expository, participatory, observational, performative, reflexive, and poetic modes (Nichols 1991 pp 32–75). The definitions are as follows.

(1) *Expository mode*: emphasizes verbal commentary and an argumentative logic.
(2) *Participatory mode*: emphasizes the interaction between filmmaker and subject.
(3) *Observational mode*: emphasizes a direct engagement with the everyday life of subjects as observed by an unobtrusive camera.
(4) *Performative mode*: emphasizes the subjective or expressive aspect of the filmmaker's own involvement with a subject.
(5) *Reflexive mode*: calls attention to the assumptions and conventions that govern documentary filmmaking.
(6) *Poetic mode*: emphasizes visual associations, tonal or rhythmic qualities, descriptive passages, and formal organization.

Since the time of Nichol's formal categorization of documentaries, other film critics have both supported and critiqued Nichol's framework. However, most agree in the principle that documentaries have the ability to conceptualize and visualize important events in history. Reviewing these different ideologies, researchers have also noted that documentaries, though a great visual medium, can sometimes offer an unclear image of a topic. For example, a documentary could properly encapsulate real people, places, and events, but fail to properly articulate the context behind the media in the manner writing could. Still, there is the ability of the filmmaker to plan a way to physically capture the object that a writer lacks. Of significance is the fact

that writing is not without subjective bias, which like film may be unobserved due to the perceived objectivity of the medium by the reader.

With the ability to visually incapsulate history, emotions, and the general unstaged occurrence of the world, documentaries allow filmmakers to narrate a story that is authentic and meaningful (Nichols 1983). If used in educational settings, students can learn historical and social concepts in a way that is interactive and impactful. Documentaries can be a powerful tool in education (Marquis 2022).

Interestingly though, despite the potential of film, documentaries remain relatively under-used in educational settings. In 2009–2010, the Documentary Film in Educational Research Project (DFER), funded by the British Academy, sought to understand how documentaries are and can be used in education. The researchers addressed how documentaries could direct student's self-observation, the intersection between media and education, and the extent to which documentaries aid students in learning. The assessment analyzed the origins of documentaries and the original motive of using film to convey certain messages (Warmington et al. 2011). The outcomes of the study supported the significance of film in education and provided a call to action in the promotion of the use of film as an educational tool.

Unfortunately, the perception of film as entertainment may account for its limited use as an educational tool (USA Art News 2020). Despite the perception of higher education as progressive, there remains a conservatism that defaults to traditional modes of instruction as defined by lectures and textbook readings (Mandell & Jelly 2020). Though the increased access and deployment of technology in the classroom has facilitated availability of non-traditional resources and multimedia inclusion, these have not been incorporated on a discipline basis and in general, adoption has been aligned to an individual instructor decision.

3 Film in Higher Education

In classes, professors have freedom to choose which mediums they use to educate their students (Euben 2002). Professors can also assign projects that require students to create their own documentaries or videos to portray their knowledge on certain subjects. However, there are apparent disciplinary variations in the use of documentary and visual arts. When speaking to staff from media resources at Northeastern University in Boston, Massachusetts, it was noted that professors in Communications, English, and Art, among other subjects, utilized film in their classes more. This points to a bias that aligns humanities courses with the use of non-traditional and creative mediums like short films. This is also evident in arts and design courses, where for example, video essays have become a means of documenting a project.

There is immense value in the use of different media in instruction, and recent studies have evaluated how the use of media over traditional methods like textbook readings can aid in retention. In a study conducted on 25 s-year medical students at Queen's University, those assigned multimedia learning tools performed at or above the level as those assigned a textbook excerpt, even showing better retention

on a few exam questions. While this does not show definitive proof for the absolute superiority of multimedia learning tools, it shows that the non-traditional medium, in this case a video, provided a different way of disseminating information that may help students retain more information (Steedman et al. 2012). Fitzgerald and Lowe (2020) highlight that documentary can be used not only for instruction and retention but also for research development and enhancing insight and perspective. From the standpoint of online instruction, documentary film has been shown to enhance student empathy and connection to international issues (Blum & Smythe 2021). Moskovich and Sharf (2012) in their analysis of film use in sociology highlight their findings that film "contributes to the involvement, collaboration, pluralism, creativity, assessment, and evaluation of the students" (p 62).

Empirical work in economics education reveals that the discipline was slow to modify instruction beyond traditional lecturing methods, which may be the reason for the decline in enrollments. Researchers at California State University of Fresno decided to create an economics course based on films and documentaries. The results of this study found that enriching economics with music, drama, films, and other mediums resulted in "enhanced learning experiences" for students (Leet & Houser 2003). In another study conducted on a general environmental studies course, course materials included films, lectures, worksheets, and discussions. Participants in the study answered survey questions with a 5-point Likert scale before and after taking the course and these results were quantitatively analyzed. Additionally, a few participants were also selected for individual interviews. After compiling the results from the quantitative and qualitative tests, it was determined that the students showed a positive change in their environmental attitudes (Liu 2018). The results of Leet and Houser (2003) and Liu (2018) emphasize the value of film and documentaries in the effective education of topics like environmental education and displays how a variety of learning topics helps improve the experience for students. In the conclusions, both studies provide encouragement for greater inclusion of media and film, providing the foundation by way of empirical evidence for the legitimacy of film as a teaching tool.

When documentaries are used in the educational setting, there is a richness in how films can connect with students. Brain Friel, an Irish short story writer and dramatist, wrote "It is not the literal past, the "facts" of history that shape us, but images of the past impeded in language. We must never cease renewing those images" (Friel 1980 p 66). As technology progresses and the digitalization of information increases, the use of documentaries in education provides a supplement and substitute to the information traditionally conveyed through the written word and lecture. Documentary film provides a connection between the individual and collective experience with the transmission of information that through its sensory dependence, enables empathy and enhances students' understanding of various topics.

In courses where films and documentaries are used, it is easier to invoke emotions and passion for topics. Films present issues in a more robust way that often involves firsthand testimonies from people. Watching documentaries where people describe the tragedy of losing a loved one to company negligence is far more powerful than reading about the events. Because of the intimate nature of documentaries and films,

it is likely that important issues will be taken more seriously than if they were presented in a textbook. Only employing the use of written and spoken word is a missed opportunity to truly reach students in a variety of ways (Winton, 2010, 17). Diversifying the mediums used in academia will not only improve retention but will also ignite more passionate and concern for important topics like climate change.

4 Sustainable U

4.1 Funding and Purpose

The documentary film project addressed in this paper originated with a faculty member in the Economics Department at Northeastern University, Dr. Madhavi Venkatesan. In the spring 2021, she received a Northeastern University Humanities Center Grant that funded her proposal to develop a documentary short film. The funding was for $3,000 and grew to $4,000 with support from her non-profit, Sustainable Practices. The film described in the grant application was to address the issue of convenience waste from the perspective of the cost of convenience, highlighting the externalities. The rationale was to increase the tangibility of externalities to students and engage them in the significance of economic concepts that are minimally addressed with respect to their environmental impact in standard entry-level economics texts and courses.

An excerpt from her *Economics of Sustainability* syllabus provides an understanding of the role of film in her teaching style (Venkatesan 2021):

> The teaching of economics is related to the outcome of increasing overall economic literacy and promoting student appreciation of a holistic decision-making process that includes both quantitative and qualitative factors in the analysis. To this end, given the behavioral and explanatory foundation of economics, it is incumbent on the part of instructors of economics to explicitly address sustainability from the perspective of market failures inclusive of social justice, environmental justice, and economic equity, and to then relay the concept of sustainable development, inclusive of environmental, economic, and social equity. For example, through an evaluation of the implicit consumption-based value structure inherent in the GDP-focused economic framework, students are engaged in a discussion of the relationship between the implicit values integrated into indicators of economic progress and current economic issues, specifically addressing the human resource footprint and the externalities created in the form of environmental degradation and human and non-human exploitation. Through use of selected documentary film, the tangibility of the externalities related to production and consumption are accessible and foster empathy that may not be attainable through reading and lecture alone. Additionally, through an outcomes-based discussion, students are provided with an ability to contextualize sustainability and the evolution of the concept of sustainable development. The incorporation and discussion of sustainability increases the relevance of the subject to the student and promotes the tangibility of the discipline of economics to daily life.

The documentary film project was announced to Dr. Venkatesan's spring 2021 *Economics of Sustainability* as a call for participation. One student of the 19 enrolled

volunteered, Amani Chinni, and she along with Dr. Venkatesan, developed the core team of six members, four of whom were former students of the professor and two who were friends of former students: Radhika Barot, Amani Chinni, Adam Regenstreif, Priyasha Singh, Julia Sucov, and John Sun. The project team was assembled by late May and by June, the production team had a name, Sustainable U. The project and production team were branded as "A Northeastern University Student Initiative" with Dr. Venkatesan as the team's faculty advisor.

4.2 Development Process

From the start of the project, of key import was the intent of the film, and the discourse and action to be generated by its distribution. The focus of the project from inception was to raise awareness of sustainability issues on college campuses by highlighting the hidden cost of consumption. The goal was to include the life cycle of a product and the externalities that promoted its overconsumption relative to its resource footprint. Over the course of hourly weekly meetings through the summer, the theme narrowed to the impact of convenience consumption of coffee, a good chosen based on its ubiquity and the number of coffee shops both on and immediately off the Northeastern University Boston campus.

Once the topic was determined, a sub-group was created to develop a life-cycle assessment where all stages of coffee production were evaluated from production to consumption to disposal. The latter considered the impact of planned obsolescence and due to the significant environmental and health consequences of plastic and the plastic linings in single-use coffee cups. Following a few weeks of research assisted by the faculty advisor, the sub-group presented their findings to the full production team and the production team decided to focus on the topic of plastic linings.

In acknowledging the limitations of the budget, the team focused on resources that were freely available, including experts that would be highlighted. Given the sponsorship of Sustainable Practices, there were pre-existing relationships with experts that were synergistic to the project and contributed to depicting the life cycle of disposable coffee cup consumption. By early fall semester 2021, interviews highlighting the production, consumption, and disposal impact were recorded with Alex Eaves, a reuse edutainer, and Kirstie Pecci, senior attorney, Conservation Law Foundation. Further the film was able to address both individual contributions and solutions by including the emerging, shared economy model of USEFULL, a company promoting reuse by partnering with closed campuses to offer reusable stainless-steel cups at the cost of disposable units. The company's founder, Alison Rogers shared the business model in her interview in the late fall. The development of the interview process provided the outcome of the film as Alex was a Northeastern alumnus and Alison had a product that was tailored to a closed campus environment. What remained was how to piece together the interviews and include students on film.

A subgroup was dedicated to reviewing all the interview footage to determine a sequence that could determine the flow of the documentary. Three individual

sequences were created and then reviewed by the entire production team (six students and their faculty advisor). At this point, a general script of visuals and information was constructed, b-roll and text were addressed as to where and what should be included, and this is the point where student interviews were decided on. Five students were interviewed across different campus sites to answer the same set of questions, as in the earlier editing, these interviews were reviewed and recombined for flow and inserted in the larger film project. At this point with the interviews completed, the project began to take form, narrative was recorded at a public radio station, and animation purchased for a nominal fee from the artist Hannah Folz. The animation was previously created and used, which reduced the expense for the documentary project. When the majority of the film was pieced together by Adam Regenstreif, it was shared with the composer, Joseph Sowa, who created a musical score to accompany the scenes in the film.

At completion, the film incorporated several modes of representation: Expository, participatory observational, and poetic. The development of the project highlighted the usefulness of varying the communication patterns to foster engagement; however, the use of multiple communication channels also enabled a perceived sophistication of the film that may also have facilitated engagement.

The film was screened live and was accessible in-person and through live stream, followed by a panel of the same experts featured in the film on April 5, 2022, in Blackman Auditorium, Northeastern University. (The venue had been booked a year in advance and in anticipation of the final film by Dr. Venkatesan upon her receipt of the Humanities Center grant.) More than 300 students were registered, and nearly 30 student organizations sponsored the film. Following the screening, the film was a topic of discussion on campus for the five weeks that remained in the spring semester.

4.3 Outcome

The screening of *Plastic Linings* was a success specific to its initiating intention; it highlighted an issue and culminated in a call for action. Additionally, as a learning tool, the film is demonstrative of the power of documentary film, as a genre, it has value not just as entertainment, but additionally serves as both a pedagogical tool and an instrument for building empathy for its subject. A unique characteristic of documentary is the way in which it achieves both goals—as educational material that seeks to create a shared outlook and awareness in all those who watch it—and as a visual narrative that imbues both its subjects and viewers with humanity by providing an authentic view of the world.

Sustainable U sought to create something that would simultaneously educate students and other viewers of the implications of rampant coffee-drinking while motivating them to organize around the issue and change their behavior. This is arguably very hard to achieve, but ultimately boils down to making them care about what their choices are doing to their bodies and the planet. As noted by Kirstie Pecci, “if you’ve used a paper coffee cup, you’ve created an environmental problem that

will not go away" (Sustainable U 2022 3:01–3:06) While some viewers might not take kindly to this blatant accusation, it is necessary that by engaging the audience and reminding them of their own contributions to this problem, we can generate a common understanding of the challenges we face, and the behavioral changes needed as a response. Alex Eaves addressed the myth that one person cannot make a difference by changing their behavior. In his championing of reuse, he noted in the film that the number of disposable coffee cups saved from the landfill due his commitment to reuse alone "the stack of disposable coffee cups for the past 13 years that I haven't been using them be higher than the tallest building in the world, the Burj Khalifa" (Sustainable U 2022 8:54–9:03).

Since the original screening of the film, *Plastic Linings* has been released on YouTube and social media as well as shared with the University academic administration through the Provost's office. Sustainable U is now an on-going entity and will be following up with University facilities to promote reuse and facilitate the incorporation of USEFULL on campus. Having learned the process of documentary film making, the group is dedicated to promoting sustainability education and will start another project in fall 2022. Finally, and of significance, students across disciplines have emailed to be involved with future projects and initiatives creating an opportunity for more campus engagement.

5 Reflection and Next Steps

Sustainable U members involved with *Plastic Linings* joined for a variety of reasons but stayed with the project from beginning to end—nearly an entire year. The team members have committed to remaining a part of the production company through graduation, through 2024 for four members and 2022 for the two seniors. The following are reflections related to their participation in the project. The comments provide insight into the impact of the project on the students and the significance of documentary film not only as a passive educational tool but an active engagement learning vehicle.

Radhika Barot

When I first started working on *Plastic Linings,* I had almost an ignorant view of sustainability. Though I was aware of topics such as climate change, the plastics issue, and so many more environmental and human tragedies, my perception of sustainability was small and disconnected from my everyday life. Having worked on this short film for almost a year now, I have had the privilege of being educated on how sustainability affects me in my everyday life. I am now aware of how sustainability can be incorporated in my daily actions, attitude, and outlook on consumption. Whether it be my small decision to eliminate single-use plastic from my daily life or to stop buying clothing from companies that degrade the environment, I am now conscious of the fact that I can help create a healthier world to live in.

Amani Chinni

Creating this film has taught me a lot about sustainability and the power of the individual. I learned that one person can drive change and inspire others and when you have a group of people with a purpose and passion, even greater things can be achieved. I also learned that there is a lot of ignorance about environmental issues despite all of the resources and tangible harm we see like litter. This film helped to break my personal ignorance and become more aware of the problems around me like land and water pollution in addition to waste accumulation.

Adam Regenstreif

What started as a portfolio opportunity developed into a sustainable consumption habit. Somewhere along the production process, I realized that I was stressing too much about the professional benefits I'd reap from producing this film. Our project and initiative are not about me, nor is it about our featured speakers, students, or audiences. We're part of a larger movement to end single-use products. It's rare that I feel profoundly changed by the films I work on, but I can say that *Plastic Linings* was a complex emotional negotiation that asked me to reconsider the cost of convenience.

Priyasha Singh

Working on this film has provided me with access to crucial information about sustainability issues that I might not otherwise be exposed to. Over the months it constantly and consistently challenged my perspective and provided me with the inspiration to make the world around me a better place for everyone. The making of this film also provided me with professional insights into little-known aspects of sustainability and reusability. It helped me open my mind and challenge my thinking around the concepts of carbon footprint, climate change, and the effects of single-use plastic. Furthermore, I developed an emotional connection with these causes during the production and pre-production of this film. I hope this film reaches as many people as it can and creates the impact the world needs.

Julia Sucov

Before participating in the creation of *Plastic Linings*, I was not convinced that individual action was an effective solution to combatting the current environmental crisis, nor that enough people cared about such a niche topic to make the behavioral change we planned to ask of them. Throughout the process of making *Plastic Linings* and showing it to my peers, I have developed a new sense of hope for the future of the planet and for myself. My outlook on individual consumption and the power of one has changed dramatically, and I feel now as though I have a better understanding of how I can have autonomy and power in the movement towards environmental justice and sustainability. I feel this project has given me the resources to understand the complexities of the most pressing issues of our time, and has provided me with a newer, more positive outlook on how I personally can change the course of the future. Additionally, I was able to understand that people really do care about this issue and are willing to partake in the difficult changes we ask of them, just that no one is asking yet. Knowing now that my peers are interested in the same commitments I am, I feel genuinely hopeful that my community can be one of the leaders in the movement towards sustainable, behavioral change. I am forever grateful to this project for opening my mind and heart to the power of individual action, for providing me with the hope that I can challenge the course of our future, and that I am not in this movement alone.

John Sun

Working on *Plastic Linings* influenced my perception of sustainability. I think that despite being interested in environmental science for years and writing a capstone paper focused on a sustainability issue, making this film has helped me appreciate the importance of individual action. I have a newfound appreciation for the impact one person can make because it will likely inspire others to do the same—and that is perhaps more powerful than an instantaneous change in policy, regulation, etc.

The next steps for Sustainable U include having a dedicated team to address a campus-based issue through film and discussions are underway with respect to the focus of the next project. In addition, given the number of requests to be involved in future activities, the team is exploring a fall and spring Sustainability Day and an annual sustainability themed documentary film series with one film screened per semester, with each followed by a panel discussion.

The process and time commitment for the project was significant and one of the most significant learning outcomes highlight the dedication needed to participate in the project. Though this is a positive, it also reinforces a challenge for sustainability education: Though sustainability may be of ideal importance it is in opposition with an individual-centric perspective; sustainability projects require a collective mindset and a value for teamwork relative to individual-centricity. It is the very topic and sentiment embodied by sustainability that may limit its traction.

6 Conclusion

Sustainability is a buzzword that appears on many university and college websites. The concept is a marketing term but more importantly signifies a worldview that reflects an augmented human perspective toward all other life and resources on the planet. A challenge to the discussion and facilitation of sustainability is its opposition to how present socialization manifests in human domination of the environment and Earth. The opportunity in teaching sustainability concepts is in making sustainability tangible.

The focus of this discussion is an example of how students can promote sustainability traction. An outline the process related to the development of a documentary short film is provided. The included personal reflections of the six students involved in the project highlight the transformational nature of creating a short educational film. In using resources and inter-disciplinary and disciplinary expertise, the film was created with a limited budget, while sponsorship from student organization enhanced student engagement across campus and colleges. Outcomes from the film project include an ongoing film production team and a desire to promote sustainability initiatives on campus. The interest in action was facilitated by the film to include the viewers of the film. Selected comments are provided below.

"Watching the film was very insightful and it delivered the information in a different manner than the usual. Since it is centered around coffee cups and university, I believe it catered very

well to todays audience. The panel that followed the movie was a great addition, especially since students were able to ask questions about the issue that was addressed in the movie. An occurring theme that I took note of in the questions being asked was about how students can change their lifestyle and make different choices that would address this issue, and how one individual can make an impact. I interpreted this as a sign that the message had gotten through and that this was the first step in taking action towards making a change."

"This film truly did an amazing job highlighting the importance of your own individual actions. The film effectively outlined the problem, how you as an individual can take action, and the tremendous positive impacts that your actions will have if you shift your habits in the way described. The film is not forceful in any way, it is intellectual in its elaboration and encourages action by highlighting the benefits that would ensue if you shift your habits. I can't wait to share what I learned in this film with my peers!"

"I really enjoyed watching the film and appreciated that it emphasized things that a lot of people don't know. I think that the visualization of how tall a stack of cups would be if you didn't use a reusable cup is a great way to illustrate how much of an impact we can actually make. I also really liked the quote "the price we pay for convenience is much greater than the price we pay at the counter." Ultimately, the film does a great job establishing its points, spreading awareness to the viewers, and leaves with a simple yet important idea."

Though the film and the project process as well as the outcome all point to a positive or potential catalyst for sustainability action, this outcome remains uncertain. As other research has also noted, there is a disconnect between awareness, knowledge, and action, where the first two items do not necessarily result in the latter activity. This reflects a limitation of this project as a sufficient catalyst for change and aligns with the need for student action to result in operational changes that are both passive and active. Passive changes are reflected in facilities management and the types of tools and resources available for use, whereas, active choices reflect individual decision-making. Having passive programs to support the focus of the documentary film both reinforces the legitimacy of the topic and expresses a norm of behavior on campus. However, tracking the permanence of attitudinal shift and action is also valuable and should be implemented to determine the context of why certain policies may be superior relative to attaining sustainability and under what circumstances.

Table 1 Sustainable U plastic linings production team and roles

Adam Regenstrief	Director, editor, camera
Amani Chinni	Production manager, producer
Radhika Barot	Producer
Priyasha Singh	Producer
Julia Sucov	Producer
John Sun	Producer
Madhavi Venkatesan	Faculty advisor, executive producer, narrator

References

Blum D, Smythe, JL (2021) Beyond "Feeling Blessed": Using international documentary film to foster global awareness in an online college course. Int J Multicult Educ vol 23:2 pp 107–126 https://doi.org/10.18251/ijme.v23i2.2659

Borish D, Cunsolo A, Mauro I, Dewey C, Harper SL (2021) Moving images, moving methods: advancing documentary film for qualitative research. Int J Qual Methods https://doi.org/10.1177/16094069211013646

van Dongen, H (1965) Robert J. Flaherty 1884–1951. Film Quarterly, 18:4 pp 3–14 https://doi.org/10.2307/1210252

Euben D (2002) Academic freedom of individual professors and higher education institutions: The current legal landscape. American Association of University Professors https://www.aaup.org/sites/default/files/files/Academic%20Freedom%20-%20Whose%20Right%20(WEBSITE%20COPY)_6-26-02.pdf

Fitzgerald A, Lowe M (2020) Acknowledging documentary filmmaking as not only an output but a research process: a case for quality research practice. Int J Qual Methods. https://doi.org/10.1177/1609406920957462

Freire P (2000) Pedagogy of the Oppressed (30th, Anniversary. Continuum Publishers, London

Friel B (1980) Translations. Faber and Faber, London

Leet D, Houser S (2003) Economics goes to hollywood: using classic films and documentaries to create an undergraduate economics course. J Econ Educ 34(4):326–332. https://doi.org/10.1080/00220480309595226

Liu S (2018) Environmental education through documentaries: assessing learning outcomes of a general environmental studies course eurasia journal of mathematics. Sci Technol Educ 14:4 pp 1371–1381 https://doi.org/10.29333/ejmste/83653

Mandell A, Jelly K (2020) Creative tensions in progressive higher education. J Adult Contin Educ 26(1):149–173. https://doi.org/10.1177/1477971419876295

Marquis E (2022) Student reading of documentary and fiction film. In Manarin K (Ed), Reading across the Disciplines (pp 102–120). Indiana University Press https://doi.org/10.2307/j.ctv224v185.9

Moskovich Y, Sharf S (2012) Using films and a tool for active learning in teaching Sociology. J Eff Teach 12:1 pp 53–63 https://files.eric.ed.gov/fulltext/EJ1092141.pdf

Nichols B (1983) Voice Documentary Film Q 36(3):17–30. https://doi.org/10.2307/3697347

Nichols B (1991) Representing reality: Issues and concepts in documentary. https://www.google.com/books/edition/Representing_Reality/Jq2cS7qARd8C?hl=en&gbpv=1&pg=PR9&printsec=frontcover

Steedman M, Abouammoh M, Sharma S (2012) Multimedia learning tools for teaching undergraduate ophthalmology: results of a randomized clinical study. Can J Ophthalmol 47:1 pp 66–71 www.sciencedirect.com/science/article/pii/S0008418211003358, https://doi.org/10.1016/j.jcjo.2011.12.006

Sustainable U [Sustainable U] (2022, May 13) Plastic Linings. [Video] YouTube https://www.youtube.com/watch?v=I1z41AV99Ts

USA Art News (2020, November 24) 6 Advantages of using movies for educational purposes. https://usaartnews.com/news/6-advantages-of-using-movies-for-educational-purposes

Venkatesan M (2021) Economics of sustainability syllabus. January 7, 2021 Department of economics, Northeastern University, Boston, Massachusetts. Canvas https://northeastern.instructure.com/courses/65322

Warmington P, Van Gorp A, Grosvenor I (2011) Education in motion: uses of documentary film in educational research. Paedagog Hist 47(4):457–472. https://doi.org/10.1080/00309230.2011.588239

Winton E (2010) Beyond the textbook: Documentary as a tool for teaching. Point of View vol 77(spring). https://povmagazine.com/beyond-the-textbook/

Yu H, Yan Y (2021) Legitimation in documentary: modes of representation and legitimating strategies in The Lockdown: One month in Wuhan. Vis Commun. https://doi.org/10.1177/14703572211015809

Leadership Through Operations, Engagement and Partnerships

The Role of Higher Education Institutions in the Promotion of Collaborative Community Partnerships and Engagement: The Case of Federal Institute of Santa Catarina, Brazil

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1 Introduction

Higher Education Institutions—HEIs are recognized as important sources of initiatives that culminate in sustainable development—SD. From this perspective, Kang and Xu (2018) understand that universities need to establish values and convictions of sustainable development goals—SDGs in all their activities, notably through effective collaboration with stakeholders, relating to good governance and transparency and, going beyond ordinary and conservative teaching/learning practices, where students are conceived and seen as mere spectators. Attempts for greater coverage of HEIs in the world increased and the managers of these institutions began to look beyond their main teaching and research activities, becoming more understanding and action in the outreach initiatives; this more complex and intimate involvement in the way of working with the community's resources can bring about impasses relevant to the autonomy of the scientific process, where it is necessary to rethink the roles and attributions of scientists and educators in society, and the students themselves in society for a more sustainable future (Zilahy et al. 2009).

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In this perspective, understanding the main approaches inherent to education for sustainable development—ESD in outreach initiatives in HEIs is useful and relevant. Thinking like this, Thomas (2009) admits that the teachings related to SD for students and those interested must come from the real world, where involvement with the challenges arising from living with the community, make students learn collaboratively to intervene in reality, with participation and learning guided by teachers based on a critical view and student focus. The rise of sustainability arising from social participation and collaboration (going beyond outreach projects), education, research, and a green posture will progressively integrate the fundamental missions of the HEIs, since changes are needed to deal with the plans and intended results in the universe of the societies involved and training its agents for sustainability (Beynaghi et al. 2016).

Zilahy et al. (2009) understand that the distinctions in the way of being of organizational cultures, added to the problems in the flow of information between institutions and partners, in many opportunities prevent HEIs from implementing interventions in communities through your students more efficiently, given the isolation from real-world problems and lack of motivation and interest in outreach activities, which culminates in a small number of leading institutions in implementing sustainability programs that rely on significant outreach components. Outreach activities are repeatedly managed by people or small teams of collaborators guided by their own academic and personal determinations (Shiel et al. 2016).

Shawe et al. (2019), when comparing initiatives established on Campuses in different strands, state that outreach is almost always neglected, and that for a change of vision, where outreach is seen as a central duty for academic and administrative staff, and fully recognized as part of the mission of HEIs, support structures and relationships such as governance, leadership, external moral elements, public perception, and values related to the environment, are essential for the success and permanence of sustainability projects, and interfere and condition their effectiveness of the training of students for this purpose and of the institutions vis-à-vis their surroundings.

In the view of Atici et al. (2021), the sustainability dimension can be counted as one of the most significant factors to be included in the ranking of universities, since they generally emphasize the social as one of their main missions. For this social action to be achieved, it is seen that educators should use the motivational force of their students in these works, notably to influence the current and future perspectives of education for sustainability and the ability to reproduce leaders for this future. However, although there are successful experiences, many of the commitments for this scenario need to be further matured. Faced with the impositions for HEIs to be linked to the SD in their regulations, many of them signed declarations, statutes, and initiatives to demonstrate their commitments; despite this, such agreements rarely turned into effective execution (Lozano et al. 2015).

Given this context, Lange Salvia et al. (2020) state that universities urgently seek channels of collaboration with local communities, government bodies, especially in the context of public policy, and companies or NGOs, in such a way as to involve students in practical activities and pilot projects, promoting professional experience and community engagement, considered essential for the practice of sustainability

in HEIs and the training of students as drivers of ESD and as possible future leaders for sustainability. Therefore, the research question that guides this scientific investigation is: Do the students of the Federal Institute of Santa Catarina—IFSC become representative agents of education for sustainability with the development of community partnerships established with the support of two outreach programs? Given the research question, the objective of this investigation is: To identify and characterize two outreach programs, intending to disseminate and explain approaches aimed at training students as representative agents of education for sustainability, based on community partnerships established with the support of programs of this nature.

From there, Kassab (2019) understand that the obstacles faced by sustainability researchers derive from the need for discoveries for innovative solutions to the major problems of current society, which turns outreach into an indispensable activity for researchers, since, according to the author, performance in academic research is positively related to the involvement of academics in outreach activities. Thus, Leal Filho (2021), confirms that these innovative elements are fundamental in teaching and research, but especially in outreach activities as a component of the "third mission," which comprises a direction for change in which the role of society becomes better understood, since the process of change does not consist and will become reality based only on academia, therefore, it must necessarily encompass the collaboration of individuals, the social fabric, government, the private sector, and the international community. Already in (2012), Barth & Rieckmann also emphasized that one of the greatest responsibilities of HEIs is to contribute to the transformation of societies, especially with regard to reforming concepts that can make humanity more sustainable.

For Pizzutilo & Venezia (2021), management, HEIs educators themselves and students, representatives of the academic community, and public policymakers are capable of discovering areas where developments can arise in relation to SD, as they are prepared to advise and recommend with a greater foundation and potential feasibility, possibly supported by the governance systems of these institutions, which are provided with elements and spaces for the development of actions that effectively promote the SD, from the approaches developed with students in the environments of society that lack interventions aimed at sustainability. When it comes to policies, higher education networks encourage partnerships involving non-academic institutions as well, develop relevant strategies and dialogues for the development of public policies, not just for educational or scientific discourse; in this way, these networks promote a fertile environment for the emergence of support policies based on international strategies and guiding documents, such as the United Nations for example, which provide guidance to HEIs and other organizations in the implementation of plans that provide important structures for practical activities with the students, while creating spaces for strategies within the network and also at the institutional level (Dlouhá et al. 2018).

For Leal Filho et al. (2021), governance systems are essential elements for the implementation of the SD in the HEIs, since, lacking compatible governance systems, the task of following up on the plans and actions related to the SD becomes very arduous, as such initiatives concur with other institutional priorities. Making this

governance system capable of understanding and guiding important acts and connections between outreach activities and ESD for affected societies is vital for the achievement of SDGs, since partnerships are formed with populations and civil society institutions existing in those spaces, which will intervene in association with HEIs in the problems and difficulties faced routinely, with a focus on the 2030 Agenda.

For Hernández-Diaz et al. (2021), ESD in HEIs provides communities with fundamental skills and abilities to contribute to the achievement of SD, and there is evidence that ESD has been introduced into curricula, research, outreach activities, and Campus operations and currently, there are different instruments to assess this incorporation; however, in most of these initiatives, education is focused on the environmental aspect of the Campus operation and academic issues, and still does not consider the system as a whole, holistically. Despite this there are plenty of determinations for achieving the SD and a growing number of HEIs, implementing sustainable operations and activities with your students, most of these institutions remain with traditional thinking and are dependent on mechanistic and cartesian models, which results in institutions that still deliver less than a private initiative when it comes to helping societies become more sustainable (Lozano et al. 2013).

2 Methodology

The methodology used in this investigation consists of exploratory research with a qualitative approach, based on literature review and documental research. Data collection was developed in these first two phases of the research, which consists of 4 phases (literature review; documental research; presentation and discussion of results; and, conclusion). Therefore, the two initial phases are: 1) review from literature; 2) documentary research on two IFSC outreach programs. IFSC is a century-old Brazilian institution of basic, technical and technological education, public, and free. Data collection was separated into these two stages so that the objective of consolidating the data could be achieved, to favor the elaboration of the topic of presentation and discussion of the results, and provide possible conclusions later on. The literature review was carried out during the second half of 2021 and used the Emerald, Science Direct, and Scopus databases, adopting as a search strategy the combination of the following terms: Outreach, Education for Sustainable Development, Sustainable Development Goals, Engagement, and Higher Education Institutions.

Therefore, the present research refers to a descriptive investigation, with a qualitative approach, covering two outreach programs. The first has been successfully carried out for a few years on some IFSC Campuses and is called YES Women Program. The second is the Island Mariculture Program, whose development takes place in the state capital, Florianópolis/SC. Documentary research on the two objects of study also took place in the second half of 2021. The secondary data, which in this case are data referring to the institution's outreach programs, were obtained from

documents such as websites, institutional documents, and videos, scientific publications of the programs, and a master's thesis. In short, everything that was available on the IFSC digital platforms and others about the outreach programs was studied so that we could analyze the content, relating it to the literature, following the items in Table 1, which is later presented, and with the SDGs, without forgetting the central role of student training, according to the objective proposed in the investigation (Yin 2015; Creswell 2014).

The procedures adopted in this research are broken down into four phases. The Fig. 1 presents these phases.

In this sequence, the third phase consisted of the presentation and discussion of the results found, taking into account the analysis of the programs from a framework developed together and based on research from the theoretical framework. This framework concentrated the dimensions involved and indicated the elements of analysis and indicators. The importance of the dimensions involved reflects the analyzes that are carried out and punctuated by important sustainability assessment tools in HEIs, which are listed below, based on Zahid et al. (2021): AASHE (Association for Advancement of Sustainability in Higher Education), AMAS (Adaptable Model for Assessing Sustainability), BIQ-AUA (Benchmark Indicator Questions alternative university appraisal), CITE-AMB (Red de Ciencia, Tecnologia, Innovacion, Educacion Besides, Ambienalem Iberoamerica), GASU (Graphical Assessment of Sustainability in Universities), GMID (Graz Model for Integrative Development), SAQ (Sustainability Assessment Questionnaire), SCAS (Sustainable Campus Assessment System), STARS (Sustainability Tracking Assessment and Rating System), SUM (Sustainable University Model) and USAT (Unit-based Sustainable Assessment Too). The Table 1 presents the framework that supports the presentation of results and the development of discussions in this research (third phase).

The connections arising from the dimensions that are represented in the framework are directly associated with all 17 SDGs in order to highlight the reach that the 2030 Agenda represents for HEIs and the performance of students, the latter seen as new representatives and possible leaders for future sustainability. The Fig. 2 presents the goals of sustainable development.

Finally, and based on all these elements, in the fourth phase, the research conclusions were drawn, gathering the main lessons of the study, limitations, and future perspectives. The community reflects in the joint action from the students and the observable peculiarities of each program and place of action search.

The choice of the analyzed programs considered the aspects that support their respective actions in the communities, the benefits resulting from the interventions, and the connections with the SDGs. Thus, the YES Women Program, by addressing gender issues, primarily meets SDG 5, starting from SDGs 1, 2, 3, 4, 8, 10, 16, and 17. This program mainly aims to contribute to women in vulnerable situations through basic education, enabling income generation and socialization. YES, Women Program is a program that seeks to contribute to SDG 5, which is to achieve gender equality and empower all women and girls. The Island Mariculture Program enables the maintenance of work activity in one of the oldest communities on the Island of Santa Catarina. The activities to improve working conditions, together with those

Table 1 Framework for analysis of an outreach program for sustainability

Dimension	Analysis Element	Indicators	Sustainability Assessment Tool
Teaching/Education for sustainable development	It involves and enhances the cognitive, social, emotional, and behavioral dimensions of learning, with a global understanding of the phenomena, covering the content and learning outcomes, pedagogy and the learning environment itself	Development of transformative learning environments, able to train and mobilize young people, with the increase of actions at the local level related to sustainable development	AASHE; AMAS; BIQ-AUA; CITE-AMB; GASU; GMID; GP; SAQ; SCAS; STARS; SUM; USAT
Faculty development	It by passes the activities that teachers carry out, with the creation of situations where there is a need for an expansion of creative capacity to solve problems	Expansion of vision and connection with something bigger than the teaching activity, being a stimulus to the awareness of being part of something bigger	GASU; GP; SAQ; STARS
Outreach/public engagement	Ability to promote sustainable communities through education, service delivery and community partnerships	Involvement by public policy in the development of activities, promotion of continuing education with generation of opportunities	AASHE; GASU; SCAS; STARS;
Student engagement	Represented every grounded connection that a student has in relation to any aspect of learning, whether from school or any educational aspect	Teaching from the classroom to provoke the potential benefits of those involved outside it, based on assisted and guided learning	GMID; SAQ; STARS
Innovation	Recent, extraordinary, unique, innovative or unusual results, policies, and practices that build on sustainability challenges	Practical innovations related to any of the activities developed, be it product, process, marketing, and organization	STARS

(continued)

Table 1 (continued)

Dimension	Analysis Element	Indicators	Sustainability Assessment Tool
Identity	Interconnection with community-based projects that promote professional initiation	Evidence of potential adaptations to sustainable initiatives and way of life	AASHE

Source: Prepared by the authors, based on OECD (2005), UNESCO (2014), Fletcher (2021) and Zahid et al. (2021)

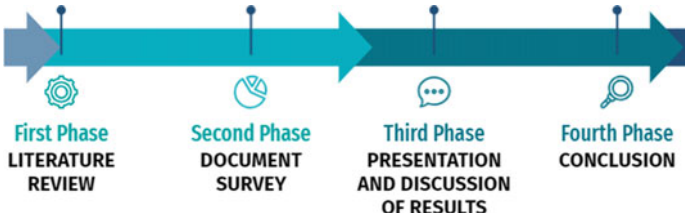

Fig. 1 Research Phases. *Source:* Prepared by the authors, 2021

Fig. 2 Sustainable Development Goals. *Source:* United Nations, 2021

related to sustainability, make it possible for the tourist activity that exists in the region to be boosted. So to speak, the Island Mariculture Program, for addressing issues of sustainable community, meets SDG 11 essentially from SDGs 1, 2, 3, 4, 5, 8, 14, and 17.

3 Results

The IFSC is a federal public educational institution. It offers professional, scientific and technological education, offering courses at the most diverse levels: Professional qualification, youth and adult education, technical, higher, and postgraduate courses. The IFSC's outreach guidelines are in strict alignment with the 17 SDGs and actions are based on interventions to face these emergency agendas for the country, such as the end of poverty and hunger, gender equality, health promotion, environmental protection, inclusive education, among others (Ifsc 2021a, 2021b).

The IFSC is a federal autarchy linked to the Ministry of Education, has its headquarters and jurisdiction in Florianópolis, and has administrative, patrimonial, financial, didactic-pedagogical, and disciplinary autonomy. Its purpose is to offer training and qualification in various areas, at various levels and teaching modalities, as well as to carry out research and development of new processes, products, and services, in conjunction with the productive sectors of society in Santa Catarina. The IFSC currently has 22 Campuses spread across all regions of the state of Santa Catarina, endowed with administrative autonomy and their offer of courses, prepared in accordance with local needs (Ifsc 2021b, 2021c). Figure 3 presents some actions developed by the programs presented below and their connections with the SDGs, in a non-exhaustive way.

Fig. 3 Actions and connections with SDGs. *Source:* Prepared by the authors, based on IFSC (2021) and United Nations (2021)

4 YES Women Program

The YES Women Program is an outreach program of the IFSC with a gender outline, understood to work with women in situations of social vulnerability with low or no education. Its objective is to seek the valorization of women, access to rights, citizenship, and possibilities of income generation, so to speak, the empowerment of the female public. It is attributed to women over 15 years of age, in a situation of social vulnerability and preferably without education. It consists of four projects: The course "Education and Gender" or "Income Generation", "Solidarity Economy Fair", "Cycle of Workshops" and "Monitoring of graduates" (Ifsc 2021a; Michels 2018).

It aims to promote the implementation of public social policies to promote the inclusion of women in educational, economic, social, and cultural dimensions. It seeks to support the development of political autonomy, the eradication of extreme poverty, the fight against violence, the consolidation of female citizenship, and SD in line with the mission and values of the IFSC and guidelines of other social assistance, health, safety, and income-generating movements. The program is justified in meeting educational policies, such as the SDGs and its Institutional Development Plan. It was conceived in 2013 and the initiative arose from the institutional demand for the continuity of care for women in situations of social vulnerability with low or no education (Michels 2018).

The YES Women Program held its first edition in 2014, offering courses once a year. The Program lasts for five months, taking place in the second half of the year, generally from August to December. Admission is made through a public draw, with free registration. Courses have already been held on several IFSC Campuses, many of them aimed at specific audiences, such as women in prison, Haitian immigrants, "quilombolas", transsexuals, among others (Ifsc 2021a).

To reach the target community, the Campuses articulate partnerships and volunteer work to carry out their actions. These actions are concentrated in locations where the IFSC can act, considering its area of coverage, thus being able to collaborate by making its physical structures available. However, in some cases, it goes beyond the limits of the educational institution, as it moves to its target audience to act more efficiently and effectively. In this way, the YES Women Program aims to direct its actions to the locations where the students are located (prison, for example). This strategy is necessary to facilitate the access of the students to the activities, as well as to respond to the possible evasions of the participants. These connections with the community range from changes in the forms of access, formatting of courses, permanence in the school, and partnerships with other organizations that can guarantee the various demands brought by the students. The challenge is to establish the approximation and adapt the methodology to the realities, without leaving aside the objectives of raising the levels of empowerment, autonomy, and inclusion (Michels 2018).

The program has been producing a relevant impact on women's family life and in the community, modifying social relations and, as a result, also modifying the perception of these women in relation to themselves and the environment in which they live, and thus new reach is affected, as the objective of the program to provide women with inclusion, the feeling of belonging, the discovery of citizenship, improved self-esteem, a greater degree of autonomy, critical awareness, in addition to a change of perspective, that is, a process of empowerment. Thus, several elements of the construction of the subjects' autonomy, through a process of individual and collective empowerment. The Projects contribute to expanding the capacity to improve the quality of life of these women as economic and rights subjects under equal conditions in the environment in which they live. The leading role of women is evidenced in results such as: Increased capacity to generate income, willingness to further study and provide better education for their children, demand digital inclusion, among others (Michels 2018).

5 Island Mariculture Program

The Island Mariculture Program: Safety & Health & Sustainability seeks to contribute to solving problems of lack of techno-scientific information for actors in mariculture (marine water aquaculture) and its surroundings, whose shellfish production takes place in Ribeirão da Ilha, Florianópolis/SC, Brazil. Ribeirão da Ilha is one of the oldest villages on the island of Santa Catarina and historically represents an important place for the cultivation of mollusks, serving as a supply, marketing, and distribution center at a municipal and regional level. The high productivity of the Ribeirão da Ilha region in the area of mariculture is extremely important for the local economy and also makes this neighborhood one of the main representatives of the country in this area (Ifsc 2021d). Currently, about 25% of maricultures claim that they throw their waste into the sea, and 10% dispose of it on land in the region. When thrown into the sea, the shells can negatively influence oyster cultivation because of the siltation of the bay. In vacant lots and in areas where shells accumulate, there is the problem of bad smell and visual pollution. Technically, it is possible to transform shells into raw materials for marketable products (Ifsc 2021e).

The IFSC, as a disseminator of techno-scientific knowledge, should contribute to obtaining and expanding information, contributing to environmental sustainability, developing technological devices, and spreading educational actions for individual and collective training in activities involving mariculture. All projects are in progress and involve mariculture actors, and use "research" to gather information on the activity and its implications for areas of knowledge. It proposes "outreachist" technological solutions, for sustainability, occupational health and safety, and for the improvement of environmental liabilities. And it exposes, through "educational" actions linked to the IFSC, schools, associations, and other forms of sharing the knowledge generated from the program's interactions (Ifsc 2021d).

It consists in part of a program by the Ergonomics, Safety and Occupational Health research group at the IFSC Campus Florianópolis, which will accompany a group of mariculturers to research and propose actions related to safety, health, and sustainability for the category and its community. The initiative also aims to contribute to culture, economy, history, gastronomy, hospitality, and technical and scientific knowledge for the well-being of everyone involved in the mariculture production chain. The program will feature a survey of mariculturers, which consists of the first project: Environmental and sustainability risk factors present in shellfish production. For data collection, a total of 10 land visits and three boardings will be carried out. Physical–chemical and bacteriological analyzes will be carried out in seawater, in the water used for drinking, and in the water used for sanitizing mollusks. An analysis of environmental and sustainability risks will also be carried out (Ifsc 2021e).

The second project included in the program is entitled Ribeirão da Ilha Mariculture Actors: Diagnosis of the Reality of Occupational Health and Safety, Sustainable Tourism and Educational Actions. The objective is to map and analyze the occupational risks inherent to mariculture activities and the situations that generate unwanted factors in work interactions. The issue of sustainable tourism will also be addressed. This step is also underway through on-site observations and questionnaires (Ifsc 2021e). The recognition of occupational risks and situations that generate unwanted factors in the work interactions of productive actors in mariculture involves other issues of occupational health in sustainable forms of work, such as the practice of sustainable tourism, promoting work and income, as well as environmental preservation. For data collection, 30 (thirty) visits on land and 30 (thirty) embarkations will be carried out, observing the workers developing their activities. The analysis of occupational hazards will be prepared through a checklist in accordance with the regulatory standards of the Ministry of Labor and the research results will indicate whether mariculture workers have adequate working conditions and working practices and presented in the form of reports. In addition to educational actions (Ifsc 2021e).

The last stage of the program will be the elaboration of a prototype for the processing of oyster and shellfish shells, combined with educational activities. According to the program's justification, the increase in mariculture has raised the issue of disposal of generated waste, especially shells. The use of shells for construction materials has been researched, as a raw material in the production of poultry feed, for soil reconstitution, and also to remove phosphate from the water used in the process (Ifsc 2021f). In the current reality, there is a difficulty concerning the disposal and use of these shells, mainly due to their volume. To develop technological research and, consequently, low-cost equipment for processing the shell from the cultivation and consumption of oysters and shellfish from Ribeirão da Ilha, quantitative studies were carried out to determine the requirements of the machine. These studies were carried out directly with the mariculturists associated with AMASI (Association of Seafarmers of the South of the Island) in visits organized by the IFSC. The machine is currently in the prototype phase (Ifsc 2021f).

6 Discussion

This research is framed as an investigation bibliographic and documental, dealing with two IFSC outreach programs, to analyzing their impacts on SDG benefits and community engagement from the ESD and their students. According to information on its website (2021), IFSC's mission is: To promote inclusion and educate citizens, through professional, scientific, and technological education, generating, diffusing, and applying knowledge and innovation, contributing to socio-economic and cultural development. It also declares as a vision: To be an institution of excellence in professional, scientific, and technological education, based on participatory management and the inseparability of teaching, research, and outreach. These purpose statements are based on its core values of social commitment, democracy, equity, ethics, innovation, quality, respect, and sustainability.

Based on these milestones, it is possible to see support in the conception of Lange Salvia et al. (2020), which is of paramount importance that educational institutions seek the collaboration of various local agents, to involve students in activities in the practical atmosphere of sustainable actions. Students attend especially to SDG 4, with integration to the communities served. These environments of development of activities that are observed in both analyzed programs represent the changes regarding the use of formal education, starting from the classroom, but not limited to it, with opening for other expositions guided by the protagonism of the students. The subsidiary is related to SDG 8, for which both programs work, which deals with decent work and economic growth.

On the other hand, with development thinking based on teacher training, Weng et al. (2020) argue that low-cost faculty development is more appropriate than devising an unrealistic new faculty development system, so since this is not cost-effective, it is more advisable to focus on competence. ESD, using the currently established teacher competency training system. Given this scenario, the training bias that the use of outreach services can provide to teachers is seen as positive for the SD of affected communities, as in both programs analyzed in this research, since the costs are those that guide the institution and do not represent a significant contribution to the focus on the SD. In the understanding of Whittaker & Montgomery (2013), universities need a systemic institutional change that includes the development, support, and empowerment of the faculty to foster an institutional culture that develops diversity at all levels. Such stimuli comprise relevant approaches to the development of activities inherent to ESD and to engagement with the community, highlighting the initiatives for action regarding the SDG 17, to strengthening partnerships and viable means for implementing the SD.

From there, the outreach activities seen as public engagement reflect how the HEIs and your students permeate and influence their surroundings and the societies involved. In the cases analyzed in this research, the presence and engagement of the institution itself of your students were present in the communities, not limited to the teaching environments or the walls of the institution. Therefore, for Yepez-Reyes &Williams (2021) the outreach programs, to become expressive in community

engagement need to be endowed with an inclusive and culturally relevant transformative development, where universities can work with communities and not for them, making in-service learning experience-based learning space, motivate universities to work together with local communities, satisfying their deficiencies and expectations and fulfilling the professional skills acquired by students. ESD perspectives play a changing role in students' expertise and actions, which become who become visionaries of attitudes more sustainable, as work assignments include real-world responsibilities, with the consequence of environmentally beneficial attitudes, which revere the practice of a pedagogy centered on the student, allowing the permanent search for SDGs (Abner, Baytar & Kreiner 2019).

The engagement of students, on the other hand, represents interactive activities with social fabrics, a space where interventions effectively take place. For Archer-Kuhn, Wiedeman & Chalifoux (2020), contact with people and spaces within communities provides students with real learning experiences, which enable them to engage and instigate their ways of knowing, being, and doing, in such a way that these real-world tasks provide opportunities for students to relate their learning also sustainability to practice intensely and properly. The university outreach programs that develop groups of students with on-site research, as seen in the case of the Island Mariculture Program, offer a real opportunity for social action and co-produce solutions for adversities encountered in communities, but not only, given that integration of students in the private sector also contributes to the training and professional guidance of these students, as the IFSC is an institution of education, science, and technology. The possibility of disseminating the knowledge acquired with a view to sustainability provides the training of agents representing sustainability and the propagation of culture for the SD from the lives of these students.

Innovation, on the other hand, provides development geared to the demands of local and economic sectors, substantially contributing to local productive arrangements. The IFSC focuses on developing and stimulating activities in its surroundings based on the potential of each region. The academic research present in this element is essential, as it is potentially in HEIs that innovations emerge to the real world. According to Flodin & Vidovich (2019), for a dynamic of innovation to take place, the investment of time and energy in structuring true and sustainable community and academic partnerships for each target region, creating a trust-based on the resilience of relationships, acting in a useful way in the face of challenges faced by the community. Such reach evidently benefits SDG 9, starting from the promotion of innovation for the SD and, additionally, SDGs 11, 13, 16, and 17.

For Bergerson, Hotchkins & Furse (2014), working with identity-based on the work developed and together with the career and professional performance of students is to act in the development of professional identity, therefore, it presupposes disclosing and working in a more concentrated way in the fields in which students are present, developing their academic activities, without forgetting the emphasis on sustainability. Interacting with the local community provides the students with professional initiation that promotes benefits for everyone involved, reinforcing SDG 9, in addition to other advisory services. Recognizing that marketing and traditional communications need to adapt to community communications can have a relevant

impact in achieving specific capabilities of an outreach program, so that the embracement and establishment of bonds with the community effectively occur (Flodin & Vidovich, 2019).

Given the observations made based on the dimensions of the framework and the SDGs, the analyzed programs are found to be initiatives that transform local realities, endowed with social engagement, which promote the institution's mission and guide its actions as an entrepreneur of the SDGs, from the students. Management or governance initiatives were not identified within the programs, consisting of outreach practices related to the institution's core activity, only. Despite this, programs such as the ones presented help the community's demands to be met and the HEIs become powerful allies in the search for SD. It is admitted that entrepreneurship in HEIs combined with the activities of the third mission, or outreach, give rise to new moments and advantages for HEIs and their faculty; however, the integrity and understanding that objectivity and the absence of conflict of interest are essential and must be pursued since care is important not to deviate from their primary missions, which are to serve the public interests as a major interest (Rubens et al. 2017).

7 Conclusions

Based on the study carried out, it can be concluded that the analyzed programs correspond positively to the initiatives to promote SD in the affected communities, favoring the 2030 Agenda, since students become agents representing the ESD and have the possibility of positively intervening at them throughout their lives and careers for a more sustainable future. The knowledge, skills, and resourcefulness involved in these broader training activities provide the praxis that outreach programs need to advance in terms of training students based on education for sustainability. This investigation emphasized, as an alternative to overcoming a teaching model conservative, the search for questions and movements of the faculty, administration, and management that bring new problems, new contents, new approaches, answers that emerge from the demands of society and are oriented to the solutions of practical problems for students, constantly acting in the search for SDGs through outreach activities. Directed and local teaching made it possible, by itself, to engage students and the community, with the support of partner institutions.

Thus, the outreach programs demonstrated the possibility of using new methodologies and ways to overcome the common problems of the communities in their surroundings, through partnerships, collaborations, and student protagonism. The six dimensions of the developed framework consolidate axes for the improvement of these activities in the HEIs. On the other hand, as seen in the programs, female empowerment, as well as safety and health focused on sustainability, have demonstrated, despite the differences between the analyzed programs, as having notable favorable effects on community life. The performance of students and their subsequent experiences, after the knowledge and visions acquired in the activities also favor the SD where these current students work. In the analyzed programs, such

characteristics are guided by the peculiarities of the study places and the student's potential, and these elements are seen as facilitators for each type of training, since the experience and the very experience of the community is transformed, with a view to a future and a more sustainable life.

As limitations, the data obtained are indicated, since the research was based only on literature review and documentary research, and related to SD issues and student development, based on the most common characteristics of both analyzed programs, in a broad way. These data and the respective analysis, in the case of different objects, in a way, collected relevant information and structured them, to reinforce such initiatives, only, not discussing pedagogically about the activities considered or even generating any type of practical application of these activities, as in a ready-made program model. The fact that two different programs were analyzed deflected deeper immersions, which is also seen as a limitation, even if the intended objective was not to build a single representation. Possible convergences between programs to be analyzed in future studies are seen as facilitators of more consolidated discussions and analyses, as well as structuring for more detailed and precise arguments, indicating the use of a greater number of sources of evidence.

Finally, the results of the study have the function of showing that HEIs, as institutions that serve communities, can promote social benefits at the expense of a change of vision regarding the way of working with their students. The break with the traditional, with a vision of the future for sustainability, comes from the practical involvement in the lives of citizens and other stakeholders, which makes studies that disseminate such initiatives relevant in terms of academia. There is an urgency to build partnerships between these actors, mainly as a result of the Covid-19 pandemic and the new challenges for future sustainability. It is hoped that this study will provoke new investigations on SD in the HEIs topics, especially those that seek to drive partnerships for the improvement of students and the community, especially using the outreach and support of the ESD and the SDGs.

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References

Abner M, Baytar F, Kreiner D (2019) Applying the ESD approach in textile and apparel education. Int J Sustain High Educ 20(1):75–90. https://doi.org/10.1108/IJSHE-02-2018-0029

Archer-Kuhn B, Wiedeman D, Chalifoux J (2020) Student engagement and deep learning in higher education: reflections on inquiry-based learning on our group study program course in the UK. J High Educ Outreach Engagem 24(2):107–122

Atici KB, Yasayacak G, Yildiz Y, Ulucan A (2021) Green university and academic performance: An empirical study on UI GreenMetric and World University Rankings. J Clean Prod, 291. https://doi.org/10.1016/j.jclepro.2020.125289

Ávila LV, Leal Filho W, Brandli L, Macgregor CJ, Molthan-Hill P, Özuyar PG, Moreira RM (2017) Barriers to innovation and sustainability at universities around the world. J Clean Prod 164:1268–1278. https://doi.org/10.1016/j.jclepro.2017.07.025

Barth M, Rieckmann M (2012) Academic staff development as a catalyst for curriculum change towards education for sustainable development: An output perspective. J Clean Prod 26:28–36. https://doi.org/10.1016/j.jclepro.2011.12.011

Bergerson AA, Hotchkins BK, Furse C (2014, January 1) Outreach and identity development: New perspectives on college student persistence. J CollE Stud Retent: Res, Theory Pract. Baywood Publishing Co. Inc. https://doi.org/10.2190/CS.16.2.a

Beynaghi A, Trencher G, Moztarzadeh F, Mozafari M, Maknoon R, Leal Filho W (2016) Future sustainability scenarios for universities: Moving beyond the united nations decade of education for sustainable development. J Clean Prod 112:3464–3478. https://doi.org/10.1016/j.jclepro.2015.10.117

Creswell JW (2014). Investigação Qualitativa e Projeto de Pesquisa-: Escolhendo entre Cinco Abordagens. Penso Editora

Dlouhá J, Henderson L, Kapitulčinová D, Mader C (2018) Sustainability-oriented higher education networks: Characteristics and achievements in the context of the UN DESD. J Clean Prod 172:4263–4276. https://doi.org/10.1016/j.jclepro.2017.07.239

Fletcher A (n.d.) Defining student engagement: A literature review. Retrieved September 02, 2021, from http://www.soundout.org/student-engagement-AF.pdf.

Flodin C, Vidovich N (2019) Innovations and insights for higher education aspiration and outreach programs (pp 163–178). https://doi.org/10.1108/s2055-364120190000017012

Hernández-Diaz PM, Polanco JA, Escobar-Sierra M, Leal Filho W (2021) Holistic integration of sustainability at universities: Evidences from Colombia. J Clean Prod, 305. https://doi.org/10.1016/j.jclepro.2021.127145

IFSC (Federal Institutefrom Santa Catarina) (n.d.). Retrieved September 24, 2021a, fromIniciativas Sociais: https://www.ifsc.edu.br/iniciativas-sociais

IFSC (Federal Institutefrom Santa Catarina) (n.d.). Retrieved September 25, 2021b, fromO IFSC: https://www.ifsc.edu.br/o-ifsc

IFSC (Federal Institutefrom Santa Catarina) (n.d.). Retrieved September 25, 2021c, fromPDI 2020–2024: https://www.ifsc.edu.br/pdi-2020-2024

IFSC (Federal Institutefrom Santa Catarina) (n.d.). Retrieved September 28, 2021d, fromConsulta Extensão: https://sigaa.ifsc.edu.br/sigaa/public/extensao/consulta_extensao.jsf

IFSC (Federal Institutefrom Santa Catarina) (n.d.). Retrieved September 29, 2021e, from Notícias: https://www.ifsc.edu.br/conteudo-aberto/-/asset_publisher/1UWKZAkiOauK/content/id/1581948/programa-multidisciplinar-ir%C3%A1-propor-a%C3%A7%C3%B5es-de-seguran%C3%A7a-sa%C3%BAde-e-sustentabilidade-%C3%A0-maricultura-de-florian%C3%B3polis

IFSC (Federal Institutefrom Santa Catarina) (n.d.). Retrieved September 30, 2021f, fromMARICULTURA IFSC: http://sites.florianopolis.ifsc.edu.br/snct/2020/11/02/maricultura-ifsc-prototipo-de-equipamento-para-trituracao-de-conchas-de-ostras/

Kang L, Xu L (2018) Creating sustainable universities: organizational pathways of transformation. Eur J Sustain Dev, 7(4). https://doi.org/10.14207/ejsd.2018.v7n4p339

Lange Salvia A, Londero Brandli L, Leal Filho W, Gasparetto Rebelatto B, Reginatto G (2020) Energy sustainability in teaching and outreach initiatives and the contribution to the 2030 Agenda. Int J Sustain High Educ 21(7):1607–1624. https://doi.org/10.1108/IJSHE-05-2020-0180

Leal Filho W, Amaro N, Avila LV, Brandli L, Damke LI, Vasconcelos CRP, Salvia A (2021) Mapping sustainability initiatives in higher education institutions in Latin America. J Clean Prod, 315. https://doi.org/10.1016/j.jclepro.2021.128093

Leal Filho W (2021) Universities, sustainability and society: A SDGs perspective. https://doi:https://doi.org/10.1007/978-3-030-63399-8_35

Lozano R, Lukman R, Lozano FJ, Huisingh D, Lambrechts W (2013) Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system. In J Clean Prod (Vol. 48, pp. 10–19). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2011.10.006

Lozano R, Ceulemans K, Alonso-Almeida M, Huisingh D, Lozano FJ, Waas T, Hugé J (2015) A review of commitment and implementation of sustainable development in higher education: Results from a worldwide survey. J Clean Prod 108:1–18. https://doi.org/10.1016/j.jclepro.2014.09.048

Kassab O (2019). Does public outreach impede research performance? exploring the 'researcher's dilemma' in a sustainability research center. Sci Public Policy, 46(5), 710–720. https://doi:https://doi.org/10.1093/scipol/scz024

OECD (Organisation for Economic Co-operation and Development) (2005) Oslo manual: The measurement of scientific and technological activities. Paris: OECD. Retrieved 06 September 2021, from https://doi.org/10.1787/24132764

Michels PJ (2018) Inovação social: o caso do programa mulheres sim do IFSC.(Masters dissertation). RUNA (Repositório Universitário da Ânima).Retrieved 06 January 2022, from https://repositorio.animaeducacao.com.br/handle/ANIMA/2938

Pizzutilo F, Venezia E (2021) On the maturity of social responsibility and sustainability integration in higher education institutions: Descriptive criteria and conceptual framework. Int J Manag Educ, 19(3). https://doi.org/10.1016/j.ijme.2021.100515

Rubens A, Spigarelli F, Cavicchi A, Rinaldi C (2017) Universities' third mission and the entrepreneurial university and the challenges they bring to higher education institutions. J Enterprising Communities. Emerald Group Publishing Ltd. https://doi.org/10.1108/JEC-01-2017-0006

Shawe R, Horan W, Moles R, O'Regan B (2019) Mapping of sustainability policies and initiatives in higher education institutes. Environ Sci Policy 99:80–88. https://doi.org/10.1016/j.envsci.2019.04.015

Shiel C, Leal Filho W, do Paço, A., & Brandli, L. (2016) Evaluating the engagement of universities in capacity building for sustainable development in local communities. Eval Program Plann 54:123–134. https://doi.org/10.1016/j.evalprogplan.2015.07.006

Thomas I (2009) Critical thinking, transformative learning, sustainable education, and problem-based learning in universities. J Transform Educ 7(3):245–264. https://doi.org/10.1177/1541344610385753

UNESCO (United Nations Educational, Scientific and Cultural, Organization) (2014) Roadmap for implementing the global action programme on education for sustainable development. Paris: UNESCO. Retrieved 16 September 2021, from http://unesdoc.unesco.org/images/0023/002305/230514e.pdf

Weng SS, Liu Y, Dai J, Chuang YC (2020) A novel improvement strategy of competency for education for sustainable development (ESD) of university teachers based on data mining. Sustainability (Switzerland), 12(7). https://doi.org/10.3390/su12072679

Whittaker JA, Montgomery BL (2013). Cultivating institutional transformation and sustainable STEM diversity in higher education through integrative faculty development. Innov High Educ, 39(4), 263–275. https://doi:https://doi.org/10.1007/s10755-013-9277-9

Yepez-Reyes V, Williams ER (2021) Service-Learning Through Immersive Technologies in Ecuador. J High Educ Outreach Engagem 25(2):177–185

Yin RK (2015) Estudo de caso: planejamento e métodos. Daniel Grassi, tradutor, 5th edn. Bookman, Porto Alegre

Zahid M, Ur Rahman H, Ali W, Habib MN, Shad F (2021) Integration, implementation and reporting outlooks of sustainability in higher education institutions (HEIs): index and case base validation. Int J Sustain High Educ 22(1):120–137. https://doi.org/10.1108/IJSHE-10-2019-0308

Zilahy G, Huisingh D, Melanen M, Phillips VD, Sheffy J (2009) Roles of academia in regional sustainability initiatives: outreach for a more sustainable future. J Clean Prod 17(12):1053–1056. https://doi.org/10.1016/j.jclepro.2009.03.006

Contextualized Sustainable Development: How Global University Systems Educate Sustainability Leaders and Impact Local Communities in Central Asia and East Africa

Fayyaz Vellani and Naveed Nanjee

1 Introduction

Research on the important work of educating the sustainability leaders of the future is relatively new. In their comprehensive study, "Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system," Lozano et al. (2013) argue that universities are not yet playing enough of an innovative role in making education more sustainable and that these institutions have the potential to be more actively involved in the work of sustainability. Seeing this as a lost opportunity, the authors point out that "universities have remained traditional" (2013:10), more focused on preserving existing power structures and paradigms than advancing new modes of thinking about the world in its present and future states.

Universities possess tremendous potential to influence sustainability not just through research and new modes of thinking, but also through training the next generation of thinkers and actors to live and work in harmony with the environment. As Bowser et al. (2014:699) propose,

> The future of environmental sustainability is dependent upon the education of an interdisciplinary workforce with broad skills related to environmental stewardship. At the basis of that education must be a core understanding of sustainability and the development of confidence in one's ability to use acquired skills to contribute to sustainability management issues.

While literature exists on rethinking curricula for sustainability in specific disciplines, such as in archeology (Carman 2016), and business studies (Stubbs and Schapper 2011), there is a dearth of published research on the efforts transnational universities are undertaking to incorporate sustainability into their efforts, across

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various academic disciplines and curricula. Recent research has focused on how universities themselves can function as sites of experimentation for creating innovations in sustainability. For example, Purcell et al. (2019) posit that universities have the potential to do a great deal more in order to promulgate and apply the Sustainable Development Goals (SDG).

Beyond changes to curricula and adding sustainability as a priority in their own operations, scholars point to the role universities can play beyond their own institutional boundaries. The so-called third mission entails the role universities can play in advancing knowledge societies and benefiting human society, writ large. Specifically, the third mission is about (1) harnessing academic knowledge to solve real-world problems, and (2) sharing solutions and technologies in partnership between universities, governments, and private organizations. As Compagnucci and Spigarelli (2020:1) state, "The Third Mission represents the economic and social mission of the university and its contribution to communities and territories."

Keeping this third mission in mind—the idea that universities should go beyond the traditional domains of teaching and research in order to help their surrounding communities and societies—this chapter examines the University of Central Asia (UCA) and the Aga Khan University (AKU) as case studies. Both institutions broadly adhere to the idea that a university should publicly state its sustainability goals, in keeping with Lozano et al. (2013). More importantly, these two transnational institutions of higher education have declared their commitments to fostering sustainability through leadership and in their local and national contexts and view these as foundational to their respective institutional purposes and missions. This chapter explores how the UCA and AKU fulfill this third mission, with an emphasis on sustainability leaders and local communities.

2 Methods

The UCA and AKU were selected as case studies for three reasons. First, each is a transnational university operating in a developing part of the world, a sector within higher education that has been understudied. As sustainable development is an issue that transcends national boundaries and jurisdictions, understanding how transnational universities can address this issue regardless of geography, and because of it, is important. Second, it was hypothesized that both of these transnational universities are employing innovative approaches to addressing sustainability, which could impact how sustainability itself is conceptualized and defined. Third, they were selected as case studies because the innovative sustainability work of both institutions has been largely unheeded in the literature. Apart from our own earlier research (Vellani and Nanjee 2012, 2014), very little has been written on sustainability at the AKU or the UCA, or even about these unique institutions more generally. Given their geographical contexts—the AKU operates in Pakistan and the United Kingdom, with planned expansion in Tanzania, and the UCA operates in Kyrgyzstan and Tajikistan,

with a campus planned for Kazakhstan—these universities offer insights into how sustainability can be addressed in remote and developing regions.

The methodology used consisted of a three-stage process beginning with a comprehensive literature review, followed by interviews with senior stakeholders, and coding and analysis of interview transcripts as well as documents provided by informants, such as a Framework for the UCA's Graduate School of Development, and a Narrative and Self-Assessment for its School of Professional and Continuing Education. The literature review used a systematic approach (Mangas-Vega et al. 2018) to discover neglected research, and with the purpose of avoiding unintentional biases. For the interviews, an open-ended questionnaire was developed with the goal of enabling interviewees to describe the sustainability efforts of their respective institutions in granular detail. Finally, methods for the coding and analysis consisted of both narrative summary and thematic analysis (Dixon-Woods et al. 2005). Limitations of the study included time and access to informants, particularly given the remote locations of these institutions, the challenge of finding stakeholders employed in organizations that are not yet fully formed, and the facilitating of interviews across multiple time zones.

3 Literature Review: Sustainability in the AKDN

The Aga Khan Development Network (AKDN) is the umbrella organization for a consortium of private, nondenominational development agencies whose mission is to improve the quality of life of people living in poverty in Asia, Africa, and the Middle East. Founded and chaired by His Highness the Aga Khan, the spiritual leader of the world's Shia Ismaili Muslims, the AKDN's work focuses on health, education, rural development, microfinance, and culture (AKDN, n.d.). Operating in thirty countries, through its programs, the AKDN works to improve the living conditions of those living in poverty, regardless of nationality, gender, or religious denomination. Employing 96,000 people, the AKDN is one of the largest private development agencies in the world; it is important to note that while the network's humanitarian ethos is guided by the Muslim values of its founder, its work—including that of its two universities—is entirely secular.

Long before the term sustainable development was coined in 1987 (Kostecka, 2019), the AKDN's work has centered on enhancing the quality of human life in ways that are sustainable both for local communities and for their natural environments. For example, the Aga Khan Rural Support Programme (AKRSP) was founded in 1982 to improve the quality of life of people living in Gilgit Baltistan and Chitral (GBC) in Northern Pakistan (Fazlur-Rahman 2007). The undertakings of the AKRSP include work on agriculture, access to clean drinking water, educational opportunities, gender equality, and the development of local infrastructure. In all of these areas, the notion of enhancing human development in ways that are sustainable and environmentally responsible has been an underlying principle.

Sustainable development forms a foundational cornerstone of all the work undertaken by the AKDN. As they note, "For over 40 years, AKDN's development agenda has incorporated the preservation of natural resources" (AKDN, n.d.). The environmental undertakings of the AKDN have included creating arable productive farmland in previously desertified areas, planting over 130 million trees, providing cleaner fuel stoves to people living in poverty, and designing rain-water harvesting systems that increase food production and decrease pesticide use (Ibid.).

The AKDN details the work done across its various agencies in keeping with the Sustainable Development Goals (Ibid.). One of the Sustainable Development goals is quality education. In this area, the AKDN has been operating for over 100 years to provide access to quality learning opportunities to individuals of all ages, from infancy into adulthood (Ibid.). Reaching nearly 2 million students a year—including early childhood education, primary, secondary and tertiary education—the network has from its inception worked to make these educational opportunities sustainable in the broadest sense (Ibid.).

Within academia, there is a dearth of research on sustainability efforts of universities within the AKDN (Vellani and Nanjee 2012), though one recent article notes the impact of transnational universities on their local communities vis-a-vis sustainability (Chen and Vanclay 2021). In their comprehensive, mixed-methods study of six transnational universities in China, Chen & Vanclay found that these institutions' sustainability efforts would benefit from clearer communication and enhanced engagement with their respective local communities. Given the under-developed economies of some of these regions, a concern for the livelihood of residents in areas surrounding the campuses was seen as a cornerstone of institutional social responsibility, a finding also echoed in our own research (Chen and Vanclay 2021).

The most insightful context-specific research located in the literature review was an article by Breu et al. (2005) on sustainability work in the Pamir Mountains of Tajikistan. Although it details the work of actors other than the AKU or UCA, it provides insight into the challenges of working in a remote geographical context, analogous to both case studies here. Their study also demonstrates the need for expanding concepts of sustainability to include nonacademic stakeholders, and for this work to demonstrate its impact on communities beyond institutional boundaries: The so-called third mission. For example, Breu et al. note that actions for sustainability taken in the mountainous Gorno Badakhshan Autonomous Oblast (GBAO) required consideration of the region's harsh economic conditions. They pointed to the fact that 93% of the GBAO's budget consisted of direct transfers from the national Tajik government; economic activity within the Oblast consisted primarily of subsistence agriculture (Breu et al. 2005).

More directly related to the work of institutions within the AKDN, Fazlur-Rahman (2007: 332) points out that "sustainable development of this region and judicious utilization of the available natural resources are important for local inhabitants" in reference to the mountainous regions of Pakistan. By virtue of the UCA's choice of operating in remote locations, as well as the AKU's planned campus in the shadow of Mount Kilimanjaro, these universities' sustainability efforts will be influenced by their surrounding environs. In such geographical contexts—coupled with challenging

economic and social conditions—sustainability necessitates broadening its definition, including working with non-academic partners, and committing to improving the quality of life for local communities. The Findings sections demonstrate how this work is being undertaken by the UCA in Tajikistan and Kyrgyzstan, with planned expansion into Kazakhstan, and by the AKU in Kenya and Uganda, and through its planned campus in Tanzania.

4 Findings: The University of Central Asia

Central Asia—which stretches from Afghanistan and Iran in the south to Russia in the north, and from China and Mongolia in the east to the Caspian Sea in the west—is a region that faces a unique set of environmental and socioeconomic circumstances. These countries—Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan—feature large populations, many of which are dispersed across low-density settlements. This runs counter to the oft-stated Sustainable Development Goal of concentrating human populations in high-density locales, with a view to creating economies of scale and effectively lowering the collective carbon footprint. As noted by the World Bank:

> Climate change further exacerbates environmental pressures and threatens progress made by Central Asian countries in reduction of poverty and achievement of shared prosperity. These environmental pressures include mountainous landscape deforestation and soil erosion, changing water balances linked to the drying Aral Sea, and resource-intensive production tied to increasing urban pollution (Ibid.).

Situated in a geopolitically significant region—including the Silk Road and segments of China's Belt and Road trade route—Central Asian countries are expanding economically, but at such a rapid rate that environmental conditions are suffering (World Bank 2019). The region's heavy reliance on carbon energy sources has led to alarming pollution, earning the Kyrgyz capital of Bishkek the distinction of being the "most polluted city in the world based on international air quality ratings for several days in December 2020" (Bjerde 2021).

The region is home to large populations that are acutely susceptible to the effects of climate change, given their high-altitude settings, the remoteness of these fragile communities, and the fact that they are cut off from outside resources in the event of an emergency. For example, Afghanistan's Wakhan Corridor—though surrounded by Pakistan, Tajikistan, and China, is largely cut off from the sort of swift outside assistance that could arrive by road or even air. (Weaver 2018). Residents of remote areas such as the Wakhan Corridor are still heavily reliant on subsistence agriculture and the harsh environmental conditions associated with a region featuring mountain passes higher than 16,000 feet above sea level and year-round snow.

Recognizing these unique challenges, the AKDN, already active throughout Asia and Africa, including through the Aga Khan University, decided to establish the University of Central Asia (UCA) as the world's first and only transnational university

specifically dedicated to alleviating the issues faced by mountain societies. The UCA has used its unique and remote setting to think about its own sustainability as an institution, and to challenge its faculty to engage in research that is socially relevant to inhabitants of its surrounding areas.

The UCA was founded in 2000 by His Highness the Aga Khan, 49th hereditary Imam of the Shia Ismaili Muslims, as an international university with campuses across three countries: Tajikistan, Kyrgyzstan, and Kazakhstan. Although there is a significant Shia Ismaili population in Tajikistan, the UCA was founded as a secular, not-for-profit institution aimed at improving the social, educational, economic, and environmental status of the residents of all three countries, with a particular focus on the specific challenges faced by those His Highness referred to as mountain societies. As he noted in his remarks on the occasion of the university's opening:

> By creating intellectual space and resources, this University (UCA) will help turn the mountains that divide the nations and territories of Central Asia, into links that unite its peoples and economies in a shared endeavor to improve their future well-being (Weaver 2018).

Interviews with senior university leaders revealed that they view sustainability, broadly defined, as a core foundational underpinning of the UCA. Bearing in mind the Aga Khan's vision for the university as a place that would improve the quality of life for people in these three countries, sustainability is seen as a long-term undertaking. Bohdan Krawchenko, the current Dean of UCA's Graduate School, and the university's Director-General from 2004–2014 draws a distinction between the work of the UCA and that of other nongovernmental organizations (NGO) working in the region. He notes that "sustainability is not a project at the UCA"; rather "this institution was built on certain foundations" including sustainability—of the environment and the university itself. Where other development agencies work in two- to three-year increments, the UCA sees itself as a more permanent actor in Central Asia. As Krawchenko says, "building that endogenous capacity is the key to long-term sustainability" (B. Krawchenko, personal communication, December 7, 2021). This is similar to other transnational universities, such as the University of the West Indies, that prioritize their own sustainability as institutions and see this as integral to their sustainable development efforts (De Four-Gill 2014).

In terms of its operations, the UCA maintains a robust set of practices to monitor and report on sustainability. Sohail Naqvi, University Rector, noted in an interview that the UCA has an established environment committee, which includes administrative and scientific personnel, and that prepares monthly and quarterly reports on the institution's environmental impacts. This committee keeps a close watch on all institutional actions, "tracking every liter of fuel spent and every tree that is felled or grown" so that the university maintains both a granular level of detail and a big picture view of its environmental impacts. In the longer term, the UCA is tracking its emissions of greenhouse gasses (GHG) with the goal of becoming a zero-emissions institution. Naqvi reiterates that the UCA maintains "a very active monitoring process… we have a combination of the administration and the scientific working side by side to figure out what the university can do to address that" (S. Naqvi, personal communication, January 10, 2022).

Extending beyond the UCA's operational monitoring of its own environmental impacts and aspirational alignment with the UN Sustainable Development Goals, the university's sustainability practices include its research undertakings and its educational offerings. In keeping with its founding mission of serving the inhabitants of mountain societies, the university's Mountain Societies Research Institute (MSRI), which forms part of its Graduate School of Development, fosters interdisciplinary research aimed at improving people's livelihoods. Through the MSRI, the university emphasizes the management of natural resources, and efforts to build resilience in communities facing climate change and other natural hazards by virtue of their being situated in high-altitude mountainous regions (UCA, n.d.).

The MSRI is based at the UCA's campus in Khorog, Tajikistan—one of the most remote and inaccessible cities in the world—where it offers a Bachelor of Science degree through its Earth and Environmental Sciences department. Through a combination of its curriculum, its context-specific research, and its dissemination of valuable environmental information to local communities, the MSRI works on sustainable development in a long-term, sustainable manner. Naqvi notes that the university recently had 30 credits recognized for a European certificate course "for government officials directed at environmental understanding and issues and aspects." Further, he notes that "we work with the training of senior government civil servants in all of the countries we operate in, and provide for them a scientific basis of decision-making, as far as environmental issues are concerned" (S. Naqvi, personal communication, January 10, 2022). In this way, the UCA is working to create future sustainability leaders outside of its own institutional boundaries.

Another unique aspect of the UCA is its ability to build local capacity through partnerships. As part of the wider Aga Khan Development Network, the university works with partners such as the Aga Khan Foundation, a development agency, the Aga Khan Educational Service, and the Aga Khan Agency for Habitat (AKAH), a disaster relief organization. In a recent partnership with the AKAH, Krawchenko noted that the university conducted modeling of avalanches in Northern Afghanistan. Using the UCA's data model, researchers found that they were eighty percent accurate in predicting where avalanches would occur, a finding with real consequences for residents of these remote mountain settings. The idea of using partnerships to foster sustainability in community settings is emphasized by Mossman (2018):

> It is hopeful that an increasing number of faculty, supported by their administration, will voluntarily consider the social relevance of their work and seek new ways to partner with their communities and collaborate in teaching and research. In fact, working with all stakeholders to develop adaptations will result in stronger investment by the university or college and surrounding community.

The UCA's collaborations extend to international organizations and local governments. Krawchenko noted, for example, that the UCA will serve as a knowledge hub for the OECD on sustainable infrastructure in Central Asia. In keeping with its underpinning of sustainability as a long-term endeavor, the UCA sees its role as bringing together institutions and people so as to build "knowledge capital" (B. Krawchenko, personal communication, December 7, 2021). Another initiative mentioned by both

Krawchenko and Naqvi is the university's urban resilience plan. The plan is aimed at addressing all manner of external shocks and threats, be they environmental, economic, or political. Recent geopolitical events in Kazakhstan underscore the wisdom of robust preparation for the unexpected (Cornell 2022).

Time and time again, interviewees point to the university's efforts to build local capacity, and its urban resilience plan is a prime example of this goal. The urban resilience plan is focused on the traditional understanding of resilience, for example, incorporating the knowledge and practices of local individuals and organizations who have survived under challenging conditions in all three countries. The university acts as a clearinghouse and sounding board, aggregating data, disseminating it, and vitally, ensuring that it gets into the hands of key decision-makers, including "the many different organs of government that deal with future planning, so that all of their planning is informed" (S. Naqvi, personal communication, January 10, 2022). Again, this indicates the university's commitment to creating sustainability leaders beyond the ranks of its students, and outside the bounds of its institutional walls. Naqvi notes that the urban resilience plan, which has been in existence for the past year and a half, is funded by the Swiss Development Corporation, and has ambitions that extend to all three countries, including Kazakhstan, where the campus is in the planning stages. He emphasizes that the project is "entirely focused around aspects of sustainability, because the whole premise is that all of your planning should be informed by aspects of sustainability, as it applies to you" (S. Naqvi, personal communication, January 10, 2022).

The university is pleased that its unique set of offerings—a focus on building local capacity in mountain-based societies through education, research, and community outreach—is gaining international recognition. Krawchenko notes that when the World Bank wanted to present its studies in Kyrgyzstan, it approached the UCA, who hosted a public lecture. Drawing on its network of local community leaders, including leaders working for governments, the UCA sees its role as going beyond merely providing education to disseminating knowledge more broadly, and equipping communities to foster their own development. The UCA's Executive Masters in Economic Policy, for example, enrolls civil servants from the Ministry of Finance in Afghanistan, and as well as officials from Tajikistan and Kyrgyzstan. The university recently worked with the Ministry of Agriculture in one of its home countries to help them report on their Sustainable Development Goals. It now sees the value of not just fostering such partnerships, but widening its communication about this important work, inviting more local leaders to the table, and disseminating research that can aid local communities.

This research and community engagement work, as well its dissemination, is done by the UCA's very own sustainability leaders, a result of the institution's Central Asian Faculty Development Program, a long-term initiative started eight years before any of its campuses opened, in which talented researchers are funded for Ph.D. study in universities in Europe and North America. This investment in human capital has paid off, with the UCA now employing a cadre of faculty producing research with high impact factors that benefits local populations. Krawchenko notes that this program is currently working with the University of Cambridge as well as

the German Exchange Program, with ten students currently in the doctoral pipeline. Naqvi also highlights the importance of the Central Asian Faculty Development Program as emblematic of the UCA's approaches: Building local capacity, planning for the institution's long-term sustainability, and contributing to local economic and social development. He notes that,

> Having state of the art operations run by expatriates or foreigners from the region is not a sustainable solution, you have to have a local solution, and so we have been working very hard on that. We have a Central Asian Faculty Development Program… and that is a significant challenge for us, but that is going to be in the end, true sustainability is when you have local capacity (S. Naqvi, personal communication, January 10, 2022).

The importance of building local capacity is directly related to the UCA's foundational approach to sustainability: Employing a broad definition of sustainability, including the long-term viability of the institution itself, ensuring that its research is relevant to local communities, and fostering a network of local actors and decision-makers—sustainability leaders—who can act on the knowledge which is collectively synthesized.

5 Findings: The Aga Khan University

The Aga Khan University (AKU) was founded in 1983 in Pakistan and is an agency of the AKDN (Aga Khan University, n.d.). Its mission is to "improve quality of life in the developing world and beyond through world-class teaching, research and health-care delivery." (Ibid.) The AKU started as a health-science university and built a network of hospitals in Pakistan and East Africa. Since its founding, AKU has grown to include programs in teacher education, the study of Muslim civilizations, journalism, early childhood development, and public policy (Ibid.). The broader goal of AKU as stated by the Chancellor, His Highness the Aga Khan, is to be "on the frontiers of scientific and humanistic knowledge, radiating intelligence and confidence, research and graduates, into flourishing economies and progressive legal and political systems" (Aga Khan University, n.d.). In a 1983 address accepting the founding charter of the AKU in Karachi Pakistan, His Highness noted, that,

> The overall aim of the Aga Khan University will be to make clear and rational judgements as to which foreseeable future needs of the developing countries requires new educational programs and, having identified those openings, to address them by the appropriate means, setting the highest standards possible whether in teaching, research or service (Khan 1983).

Since its founding charter, the AKU has been an agent for social development and now operates an international network of campuses in South Asia, East Africa, and Europe. The Aga Khan University has made significant contributions to environmental health and research on climate change through its Institute for Global Health and Development (IGHD) (Farooq et al. 2020). This section of the findings will focus on how AKU is expanding on its original mission as well as championing environmental stewardship and sustainability at its future campus in Arusha. In 2007, AKDN

announced its plans to build a major new university campus in Arusha, Tanzania, called the Faculty of Arts and Science, East Africa. The campus will sit on a 3,200-acre site and is said to be an over $450 million investment, one of the largest private investments in education in Tanzania (AKDN, 2007). The site's long-term plan will also include graduate professional schools, a mixed-use village, as well as a hospital, schools, and hotels. The discussion is focused on the campus of the Faculty of Arts and Science, East Africa, a four-year liberal arts university.

The campus is still in the development stages, but the AKDN has established a Community Outreach Center (COC) at the site where the university plans to be. The COC is serving the neighboring areas, providing a number of resources and knowledge and skills development in agriculture and business development as well as several other areas. (Aga Khan University 2019). In March 2020, Prince Rahim Aga Khan, the Chair of the AKDN Environment and Climate Change Committee, and his wife, Princess Salwa, visited Arusha to see COC–including its agricultural demonstration plots, which aim to teach local farmers about innovative agricultural practices (AKDN, 2020). Prince Rahim—the son of His Highness the Aga Khan—discussed sustainability initiatives and strategies that AKU has in its plans for its upcoming campus. Prince Rahim's leadership is driving decision-making at the AKU at the highest level to incorporate environmental stewardship in all aspects of the campus. AKDN's partnership with leading environmental non-profit organizations, like The Nature Conservancy, is providing the campus AKU best practices in climate adaptation measures and long-term sustainability. In his recent visit, he chaired a roundtable discussion with various AKDN agencies and external stakeholders in the environmental field. Some of the outcomes from the discussions included a commitment to "joint efforts to collaborate on raising awareness about climate change and to mitigate risk" as well as "scaling up existing sustainability initiatives to improve energy efficiency and reduce consumption" (AKDN, 2020).

The importance of community development is significantly important to the campus in Arusha which makes it unique. In Tanzania, one of the world's least-developed countries, the planned campus is already improving the lives of those in the neighboring communities (United Nations 2021). Tanzania's gross secondary enrollment ratio and stability of agricultural production are lower than that of most other countries worldwide. While the approval of the campus is finalized, the COC has already made positive impacts on 28,000 people in the surrounding communities through its agricultural demonstration and business skills development initiatives (Aga Khan University 2019). This mission of improving the quality of life of communities beyond the campus itself is what makes the AKU's approach to sustainability unique.

The Faculty of Arts and Science, East Africa, is being designed by the architects at Legorreta + Legorreta and Beyer, Blinder, and Belle, and the entire campus structure will emphasize sustainability. The architects' plans for the campus provide a Sustainability Framework that aims to address "critical issues of economic, social and environmental sustainability and the resilience of ecological and infrastructure

systems" (Kittredge et al., n.d.). The AKU, like other AKDN-agencies, incorporates both environmental sustainability and cultural sustainability in its built environment. The campus plans to incorporate local artisan and traditional practices throughout the campus through elements like using local materials such as volcanic rock and including native decorative patterns in its screens and floors (AKU, n.d.). An interview with Dr. Alex Awiti, the Vice Provost of AKU East Africa revealed that the university plans for its Arusha site to be a "green campus, with a desire to minimize its ecological footprint." (A. Awiti, personal communication, January 25, 2022). He stated that "the entire campus-core will be designed to be non-motorized, including all deliveries will be underground, which will create a residential-walking campus" (Ibid.). Noting a widespread environmental concern in sub-Saharan Africa and beyond, Dr. Awiti emphasized that the biggest consumption of most universities is water and energy. Dr. Awiti noted that, in order to minimize the environmental footprint of the campus in Arusha, "a huge proportion of the energy consumed by the campus will be solar, and the plans are to recycle and reuse all the water generated" (Ibid.). He suggested that although these measures would prove expensive, the AKU's commitment to lowering its carbon footprint is driving the designs at its newest campus, a common theme in the AKDN, with its overall concern for creating functional designs that adequately meet the needs of local communities regardless of the costs. As noted by the research of Leanne Bilodeau, Jackie Podger, Alaa Abd-El-Aziz in the experience of the University of British Columbia Okanagan campus, operational efficiencies like cost savings can drive outcomes to bolster sustainability objectives (Bilodeau et al. 2014). Their findings suggest that sustainability initiatives can benefit both the institution in its operations and academic goals of environmental stewardship. Building on this research, the Arusha campus aims to accomplish similar goals in its operations as the campus will be built using local materials, powered by renewable energy, recycling its water supply, and incorporating local artisans reinforces both environmental and cultural sustainability.

The curriculum of the Faculty of Arts and Science, East Africa incorporates an approach of cultural and environmental sustainability. The university aims to provide a liberal arts education within an African context. The four-year undergraduate curriculum will include a core-curriculum that will adopt a "modes of thought and reasoning" framework featuring courses in historical study, studies of civilization, literature and the arts, ethical reasoning, social analysis, as well math and sciences (AKU, n.d.). Students will also be responsible for taking two interdisciplinary seminars focusing on philosophical questions and ideas as well as a course considering the complexity of regional challenges. Dr. Awiti hopes that students will drive the movement towards a greener campus. Dr. Awiti stated, "the Arusha environment is crying out for a green movement" (A. Awiti, personal communication, January 25, 2022). The curriculum at the Faculty of Arts and Science will also be designed in a way to understand the context of the campus. Dr. Awiti's intention is that the curriculum will reflect the context of East Africa and be framed in a way that is environmentally aware and sensitive. As noted by Bilodeau, a framework can provide a method for students to engage the surrounding community in sustainability (Bilodeau et al. 2014). The curriculum at the Faculty of Arts and Science not only

takes the sustainable designs into context, but also introduces students to the ways in which humans understand their local environments, educating the sustainability leaders of the future in the context of East Africa.

The vision of the campus is to inspire "young people to dream bold dreams, developing the skills and confidence they need to realize those dreams, instilling a responsibility to lead and a commitment to service, and imparting a deep understanding of the value of pluralism, the Faculty of Arts and Sciences in Arusha, Tanzania, will change East Africa and the world" (AKU, n.d.). This commitment to service echoes AKU's founding charter from 1983 and furthers its mission as an agent of social development. Additionally, the notion of pluralism is a core fundamental belief of His Highness the Aga Khan to view humanity's diversity as a source of strength. His Highness has established the Global Center for Pluralism, whose mission is "to influence policies and inspire pathways to advance pluralism" (Global Center for Pluralism, n.d.). And this vision is embedded in the curriculum of the Faculty of Arts and Science, East Africa through its core-curriculum in its required courses. By emphasizing the theme of pluralism, the AKU not only provides the means for students to be educated in a university-based in a rural, less-developed country, but also trains them for leadership in a globalized world.

6 Discussion & Conclusions

In their own contexts, UCA and AKU are doing more than just providing an education in the developing world. They are, by design, mission, and vision, improving the quality of life of those attending the institutions and also those living in its surrounding communities. Through their actions, education, research, and future plans, the AKU and the UCA are broadening the definition of sustainability (Brundtland 1987). In Central Asia and East Africa, both institutions are training sustainability leaders as well as improving the lives of the communities neighboring the institutions. The notion of public service and giving back to the communities from which the students come from is also emphasized at both institutions. In his recent address to at AKU's Convocation, the University's Chancellor, His Highness the Aga Khan, remarked to the graduates,

> As you start that journey, this is a day for all of us to renew our commitment to an ever more hopeful future, one that will be richer in the products of human ingenuity, more just in their distribution and more abundant in respect and compassion for one another (Khan 2021).

More than two decades since its inception, the UCA remains a bold undertaking—the only university dedicated to the betterment of mountain societies, as well as the only transnational institution to take up this mantle. The transnational model has been implemented in other settings, such as the University of the West Indies, for example (The University of the West Indies, n.d.). The UCA remains unique as a mountain society-based institution which is acutely aware of the challenges faced by residents of these and other Central Asian countries. The university's three-pronged approach:

Building local educational capacity and knowledge bases, fostering socially and environmentally relevant research, and forming partnerships with other organizations and with the communities in which it is situated, is a model to be emulated by other institutions that wish to address sustainability in thoughtful and meaningful ways. Similarly, the AKU, through its upcoming Faculty of Arts and Science in Arusha, provides a liberal-arts education that is contextualized in East Africa. The campus plans include not only state-of-the-art green designs, but also incorporate traditional methods and patterns to ensure cultural sustainability.

Further research needs to be conducted once the Faculty of Arts and Sciences in Arusha is completed and their curriculum is implemented. Future aspects of such studies might be to compare the initial plans of green design and its further impact in the surrounding community in Tanzania. Once the Faculty of Arts and Science is finished, a future project can be to analyze how its green designs and emphasis in sustainability influence other universities in East Africa. Across its vast array of institutions, the Aga Khan Development Network is committed to the work of knowledge production and dissemination, creating new forms of knowledge, and challenging existing norms. Through their approaches to sustainability, the AKU and the UCA are proving the rectitude of their founding missions.

This collectively synthesized knowledge, and these sets of sustainability practices, will be of interest to other transnational universities seeking to address sustainability (Bramwell-Lalor 2021). Unlike the most other transnational universities, which consist of western, developed countries setting up satellite campuses in developing parts of the world (Chen and Vancay 2021), the AKU and UCA were established as autochthonal institutions focused on improving local educational outcomes and other issues associated with human and natural quality of life. Therefore, other transnational universities, as well as institutions working in environmentally sensitive and remote regions, may benefit from analyzing how these two university systems define and actualize sustainability, and how they advance the third mission in their local, context-driven ways.

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References

Aga Khan Development Network (AKDN). (2007, August 19). Aga Khan announces the East African Community's first regional university to be based in Arusha. https://www.akdn.org/press-release/aga-khan-announces-east-african-communitys-first-regional-university-be-based-arusha

Aga Khan Development Network (AKDN). (2020, March 25). Prince Rahim visits East Africa to evaluate AKDN's response to environmental sustainability and climate change. https://www.akdn.org/press-release/prince-rahim-visits-east-africa-evaluate-akdns-response-environmental-sustainability

Aga Khan Development Network (AKDN). (n.d.) About Us. Retrieved January 18, 2022a, from https://www.akdn.org/about-us/

Aga Khan Development Network (AKDN). (n.d.) Sustainable Development Goals—Climate action. Retrieved January 18, 2022b, from https://www.akdn.org/gallery/sustainable-development-goals-climate-action

Aga Khan University (AKU) (n.d.) Where Hope Takes Root. The Aga Khan University. https://www.aku.edu/academics/Documents/ArushaFinal.pdf

Aga Khan University. (2019, August 6). Extending our impact in Tanzania. https://www.aku.edu/news/Pages/News_Details.aspx?nid=NEWS-001888

Aga Khan University. (n.d.) About Us. The Aga Khan University. Retrieved January 18, 2022, from https://www.aku.edu/about/Pages/home.aspx

Bilodeau L, Podger J, Abd-El-Aziz A (2014) Advancing campus and community sustainability: strategic alliances in action. Int J Sustain High Educ 15(2):157–168

Bjerde, A. (2021, June 26). "Envisioning Central Asia's Green Recovery." The Diplomat. https://thediplomat.com/2021/06/envisioning-central-asias-green-recovery/

Bowser G, Gretzel U, Davis E, Brown M (2014) Educating the future of sustainability. Sustainability 6(2):692–701

Bramwell-Lalor, S. (2021), "Study findings on sustainability research are outlined in reports from the university of the west indies (Project-based learning for environmental sustainability action), ecology, environment, and conservation, 676

Breu T, Maselli D, Hurni H (2005) Knowledge for sustainable development in the Tajik Pamir Mountains. Mt Res Dev 25(2):139–146

Brundtland, G.H. (1987) Our common future: report of the world commission on environment and development. Geneva, UN-Document A/42/427. http://www.un-documents.net/ocf-ov.htm

Carman J (2016) Educating for sustainability in archeology. Archeologies 12(2):133–152

Chen C, Vanclay F (2021) Transnational universities, host communities, and local residents: social impacts, university social responsibility and campus sustainability. Int J Sustain High Educ 22(8):88–107

Compagnucci L, Spigarelli F (2020) The Third Mission of the university: A systematic literature review on potentials and constraints, Technol Forecast Soc Chang, Volume 161

Cornell S (2022, January 23). Kazakhstan's crisis calls for a central asia policy reboot. The national interest. https://nationalinterest.org/feature/kazakhstan's-crisis-calls-central-asia-policy-reboot-199770

Dixon-Woods M, Agarwal S, Jones D, Young B, Sutton A (2005) Synthesizing qualitative and quantitative evidence: a review of possible methods. J Health Serv Res Policy 10(1):45–53

Farooq M, Luchters S, Fatmi K (2020, December) The impact of climate change on global health and an overview of AKU's activities. https://www.aku.edu/ighd/research-programmes/PublishingImages/Pages/climate-change/Climate%20Change%20White%20Paper.pdf

Fazlur-Rahman, (2007) The role of Aga Khan Rural Support Programme in rural development in the Karakorum, Hindu Kush, and Himalayan region: Examples from the northern mountainous belt of Pakistan. J Mt Sci 4(4):331–343

De Four-Gill D (2014) Challenges to the sustainability of the university of the West Indies, dissertation

Global Center for Pluralism. (n.d.), Who we are. https://www.pluralism.ca/who-we-are/

Khan A, (1983, March 16) Charter presentation ceremony. AKDN. https://www.akdn.org/speech/his-highness-aga-khan/acceptance-charter-aga-khan-university

Khan A, (2021, May 22) Address by His Highness the Aga Khan at the Aga Khan University Global Convention. The Aga Khan University. https://www.aku.edu/convocation/global/Pages/chancellor-speech-2020.aspx

Kittredge N, McHale S, Storm K, Shah J (n.d.) Aga Khan university campus master plan. Bayern Linder Bell. https://www.beyerblinderbelle.com/projects/90_aga_khan_university_campus_master_plan

Kostecka J, Cyrankowska M, Podolak A, Kowalska B (2019) Elements of reflection on education for sustainable development 30 years from the Brundtland Report. Studia Ecologiae Et Bioethicae 17(1):5–17

Lozano R, Lukman R, Lozano F, Huisingh D, Lambrechts W (2013) Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. J Clean Prod 48:10–19
Mangas-Vega A, Dantas T, Sánchez-Jara JM, Gómez-Díaz R (2018) Systematic literature reviews in social sciences and humanities: a case study. J Inf Technol Res (JITR) 11(1):1–17
Mossman AP (2018) Retrofitting the ivory tower: Engaging global sustainability challenges through interdisciplinary problem-oriented education, research, and partnerships in U.S. higher education. J High Educ Outreach Initiat, 22(1), pp 35–60
Aga Khan Development Network (AKDN). (n.d.) Sustainable Development Goals—Quality Education. Retrieved January 18, 2022, from https://www.akdn.org/gallery/sustainable-development-goals-quality-education
Purcell W, Henriksen H, Spengler J (2019) Universities as the engine of transformational sustainability toward delivering the sustainable development goals: "Living labs" for sustainability, 20(2)
Stubbs W, Schapper J (2011) Two approaches to curriculum development for educating for sustainability and CSR. Int J Sustain High Educ 12(3):259–268
The University of the West Indies. (n.d.) About the UWI. Retrieved January 10, 2020 from https://www.uwi.edu/about.php
United Nations (2021). Least developed country category: United republic of Tanzania profile. https://www.un.org/development/desa/dpad/least-developed-country-category-united-republic-of-tanzania.html
University of Central Asia (UCA) (n.d.) Mountain societies research institute. Retrieved January 10, 2020 from https://ucentralasia.org/schools/graduate-school-of-development/mountain-societies-research-institute
Vellani F, Nanjee N (2014) Incorporating an ethos sustainability into the conceptualization and development of an academic building, Integr Sustain Sci Eng Curricula, publisher
Vellani F, Nanjee N (2012) Sustainable development in higher education in the Muslim world. New Horizons, publisher, Sustainable Development at Universities
Weaver D (2018) Wakhan: Concomitance of the local and international in marginal boundaries. Geopolitics 25(5):1168–1198
World Bank (2019, June 9). Climate and environment (CLIENT) program in central Asia. https://www.worldbank.org/en/topic/environment/brief/climate-and-environment-program-in-central-asia
Zuankuo L, Li X (2019) Has China's Belt and Road Initiative promoted its green total factor productivity? Energy Policy. Volume 129, 360–369

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GreenBuild and Energy+: Integrative Design of Affordable Sustainable Housing in Education

Lisa D. Iulo and Sarah Klinetob Lowe

1 Introduction

Learning best practices in sustainable design and development, and working with clients and other disciplines, are important to the professional education of architecture and engineering students. Small-scale housing projects (single-family, duplex and attached row homes) are rarely taught in design studio and other accredited architecture and engineering program coursework, but they provide excellent opportunities for students to broaden their worldview beyond what they personally conceive of as "home" to understand shelter in the context of sustainability, long-term affordability, and the community where they attend university.[1]

To address the complex and interrelated UN SDGs, future professionals pursuing sustainability in the built environment must learn to work with more complicated factors in their design decision-making and with more diverse stakeholders in the process. Integrative design regenerative frameworks present lenses for simultaneously addressing whole-building design and leadership skills contributing to sustainable development projects.[2]

[1] https://sdgs.un.org/topics/sustainable-cities-and-human-settlements.

[2] https://www.solardecathlon.gov/event/challenges-design.html.

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This paper presents a multidisciplinary, cross-college curricular and extra-curricular initiative where students, in partnership with project clients and professionals, gain experience with integrative and regenerative design practices for affordable sustainable housing. Community engagement is presented for two initiatives: GreenBuild, new construction of sustainable, affordable duplex housing developed in partnership with the State College (Pennsylvania) Community Land Trust (SCCLT); and Energy+, a housing retrofit program that expands and captures lessons learned from GreenBuild to address the challenge of improving existing housing stock in the Borough of State College to meet objectives of long-term affordability for income-qualified residents and contribute to the region's ambitious goals for reducing carbon emissions. For both initiatives, student engagement is sustained through participation in the DOE Solar Decathlon Design Challenge competition. Integrative Design Regenerative Frameworks are discussed and illustrated using the example projects. Finally, this chapter highlights the mutually beneficial teaching and learning opportunities that real-world relationships bring to *educating the Sustainability Leaders of the Future.*

2 Background: Human Rights, Housing, and UN SDGs

2.1 Global Right to Shelter

> Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control (United Nations 1948: 7).

The right to adequate housing has been specified in the UN Universal Declaration of Human Rights, as well as in regional human rights law and other Declarations adopted by the UN General Assembly and International Labor Standards (UN Human Rights n.d.). "The right to adequate housing is universally recognized by the community of nations…. All nations without exception, have some form of obligation to the shelter sector…." (Fact Sheet No. 21 n.d.). The Habitat Agenda expands responsibility to include governments, the private sector, non-government organizations, local authorities, and all members of a community, stating that "[s]ince a genuine human settlement policy requires the effective participation of the entire population, recourse must therefore be made at all times to technical arrangements permitting the use of all human resources, both skilled and unskilled" (HABITAT 1976). Today, UN-Habitat "promotes transformative change in cities and human settlements through knowledge, policy advice, technical assistance and collaborative action to leave no one and no place behind" to achieve "sustainable urbanization" (UN-Habitat n.d.). This effort is supported by the UN Sustainable Development Goals, most notably SDG 11 *Sustainable Cities and Communities: Make cities and*

human settlements inclusive, safe, resilient and sustainable (United Nations n.d.). However, it is impossible to address any of the UN SDGs in isolation, especially when considering housing (Albrecht da Silveira et al. 2020). For example, "access to drinking water and adequate sanitation facilities (SDG # 6: Clean Water and Sanitation) are additional basic needs directly associated with housing" (Fact Sheet No. 21, n.d.: 3). A local and engaged approach is necessary in order to understand and leverage relationships in service to meeting these complex and interrelated goals.

2.2 Local Context for Housing

2.2.1 Affordable Housing and Housing Cost Burdens

Affordable housing in the United States is defined as "housing on which the occupant is paying no more than 30% of gross income for housing costs, including utilities" (HUD n.d.).

Centre County, located in approximately the geographical center of Pennsylvania, USA, is home to the flagship campus of The Pennsylvania State University (Penn State). Although the demographics and housing market are skewed by the large population of university students and new development of high-end student housing, housing in the Borough of State College—adjacent to the University Park Campus—is not generally considered to be affordable. The median cost of a home in State College is $345,894. The average rental in this region requires an income of approximately two times the wages of the average worker in the market for this housing. This excludes many of the local merchants, teachers, and nurse practitioners on which the community relies. Even the architecture and engineering students we graduate, with a starting salary of a draftsperson, would be excluded from living within proximity of the university and surrounding jobs.

In addition to high mortgage and rent costs, studies have found that energy expenses are a significant housing cost burden (Drehobl and Ross 2016; Fisher et al. 2021). These "home energy burdens" disproportionately affect those with lower incomes. For example, Drehobl and Ross (2016) determined that, while nationwide the average family pays about 3% of their income to utilities, low-income families in Pennsylvania's two largest cities pay about 8–9% of their income to utilities. Fisher et al. (2021) suggest that an "affordable burden" would be 6% of gross income to energy bills.

When families face housing cost burdens, they may be forced to make difficult, even life-threatening, choices. A report by the Centre County Affordable Housing Coalition found that "[w]hen residents experience a housing cost burden, paying more than 30% of their income, several situations tend to occur:

- Residents rent instead of own, thus losing opportunities to experience the financial benefits of owning a home.
- They have less income to spend on items beyond fulfilling their immediate needs.

- They live in less expensive regions in the county, typically a greater distance from employment opportunities, which results in increased transportation costs.
- They live in housing that is substandard or in poor physical condition" (Centre County n.d.: 3).

Reducing energy consumption in the housing sector through energy efficiency improvements has social and environmental benefits, including lowering housing costs and fuel-related greenhouse gas emissions (Healy 2002).

2.2.2 Addressing Existing Housing

While new construction makes a visible impact in a community, improving existing housing has the greatest potential for impacting more families and reducing home energy burdens. In *A Decent Home: Planning, Building and Preserving Affordable Housing*, author Alan Mallach establishes that preserving affordable housing is a critical issue:

> The importance of preservation is brought home by two considerations. First, relatively little new housing for lower income families is being created; second, much of the existing affordable housing is being removed (Mallach 2009: 240).

Mallach describes the private market strategy of "filtering"—that "production of ample amounts new housing can meet the needs of lower income families by making existing housing stock affordable"—pointing out flaws in practice and policy (Mallach 2009: 15). Even if this approach were to contribute to addressing housing cost burden, it might exacerbate energy cost burden, since this approach leaves older, less efficient housing available to those of modest means. In the conclusion of the book, Mallach sets out an agenda for policy and the future of affordable housing that values environmental and energy issues and the right to housing as a "social safety net" (324). Options for homeownership, rental, and transitional housing—located in communities with existing infrastructure and access to jobs, education and amenities—are central to sustainable development and must be holistically considered.

3 An Approach for Housing and Educating the Future

3.1 Intra-University Partnerships

Two Penn State centers, one in the College of Arts and Architecture and another in the College of Engineering, are working to address housing energy inefficiency for both new and existing homes and taking on the challenge of educating future leaders in sustainability.

The Energy Efficient Housing Research group (EEHR) is a research and outreach arm of the Hamer Center for Community Design, housed in the Stuckeman School of Architecture and Landscape Architecture. EEHR is a cross-disciplinary group of faculty members, graduate and undergraduate students working to address "responsible housing," housing that is sustainable, resilient, healthful, and affordable in the long term. The group employs an iterative process to continually improve housing design innovation, building on lessons from community engagement and evaluation and optimization of completed projects. The primary mission of EEHR is linked to all three levels of scholarship in higher education: teaching and learning, research, and outreach/service to our communities (Hamer Center n.d.). The Pennsylvania Housing Research Center (PHRC) is housed in the College of Engineering at Penn State with a mission to "collaboratively engage with the residential construction industry to catalyze advancements in homebuilding through education, training, innovation, research and dissemination" (PHRC n.d.).

The two have been collaborating since 2014 on housing research and education, partnering to advise a team of students on the U.S. Department of Energy Solar Decathlon international collegiate competition.

3.2 Competition Leveraging Housing Education and Innovation

In 2022, the US Department of Energy (DOE) is celebrating two decades sponsoring the international collegiate Solar Decathlon competition, with a goal to "prepare the next generation of building professionals to design and build high-performance, low-carbon buildings powered by renewables". Initially a biannual build competition, judged in ten categories, the Solar Decathlon has been held across the globe, in Washington, D.C, California, and Denver, Colorado (USA), Europe, China, Latin America, Africa, India and the Middle East (Solar Decathlon n.d.). In 2013, the DOE launched a sister design competition to the Solar Decathlon, originally called the *Challenge Home* competition and subsequently *Race to Zero*. These competitions "challenged collegiate teams to apply sound building science principles to create cost-effective, market-ready designs" (Energy.gov n.d.). In 2018, the Department of Energy united the two competitions, establishing options for teams to participate in a one-year design-only competition (Solar Decathlon *Design Challenge*) or a two-year design-build competition (Solar Decathlon *Build Challenge*).

3.2.1 Penn State Solar Decathlon Build Challenge

Penn State participated in the DOE Solar Decathlon Build Challenge competition in 2007 and 2009. For each entry the Penn State team researched, designed, and built a prototype sustainable, affordable home for Pennsylvania. Penn State also worked

with existing partnerships to research, design, and build an affordable, sustainable prototype in Lame Deer, Montana as part of the 2007 competition work.

Student, faculty, and university capacity was catalyzed for the 2007 competition through a university-wide design competition, followed by the integration of the work into several classes and design studios. The 2007 competition engaged over 900 students in its two-year project duration. With this significant institutional knowledge and student enthusiasm, the 2009 competition entry allowed for the project to be primarily completed through an extracurricular club structure, with some independent study credits, rather than through the courses and studios relied upon for the 2007 competition.

Participating in these competitions created invaluable educational and practical experience for students, most notably the skills necessary to thrive on elaborate teams representing multiple disciples. As important as these experiences were towards educating *the sustainable leaders of the future*, limited opportunity existed for transdisciplinary experience that was interactive with and impactful to the communities in which we live and learn.

3.2.2 Penn State Solar Decathlon Design Challenge

The introduction of the Solar Decathlon Design Challenge provided a structured vehicle to systematically address local housing needs, in a way that required significantly less capital cost for the university to participate. For each of the annual design-based competitions, from the initial 2013–2014 design competition to present, the Penn State team was co-advised by the Pennsylvania Housing Research Center (PHRC) and the Hamer Center for Community Design (EEHR). Teams comprise 15–30 students, often both graduate and undergraduate, representing multiple disciplines and colleges at Penn State. Each year's team partners with a local affordable housing provider or developer (see Fig. 1). These partnerships have enriched the students' work by providing real sites, contexts, and collaborators. They also opened opportunities to realize impactful, contextually appropriate high-performance housing designs for the local community that are sustainable and affordable in the long term.

Solar Decathlon Design Challenge competitions have been primarily run as a combination of an extracurricular activity in the fall and a for-credit course in the spring. Activities in the fall include student recruitment, establishing an understanding of partner organizations, ramping up knowledge of building science, researching various details and construction methods, and initial exploration of project concept and design. Each student team member must complete core building science training to establish their understanding of climate-specific high-performance building methods and technologies associated with energy-efficiency, and may elect to take additional courses in sustainable design, development, and collaboration. A single credit course offered in the spring provides students with a common meeting time each week for structured discussions and planning for tasks primarily realized outside of the formal classroom. Figure 2 illustrates how these activities work

Fig. 1 History of the Race to Zero Projects and Community Partners at Penn State. *Image credits* (top, left to right): 2013–2014 Penn State Challenge Home team, 2014–2015 Penn State Race to Zero team, 2015–2016 Penn State Race to Zero team, 2016–2017 Penn State Race to Zero team (bottom, left to right): 2017–2018 Penn State Race to Zero team, 2018–2019 Penn State Solar Decathlon Design Challenge team, 2019–2020 Penn State Solar Decathlon Design Challenge team, 2020–2021 Penn State Solar Decathlon Design Challenge team

together to allow students to maintain momentum and achieve expectations in the Design Challenge competition.

In addition to disciplinary knowledge, students develop extraordinary leadership skills. Team members pass on collective knowledge and experience through identifying, including, and engaging upcoming leaders. Student team leaders prepare and run educational sessions on building science and lessons learned from previous competition entries, presenting them to new student team members in the fall and guiding project development, topic sub-teams and assignments related to project

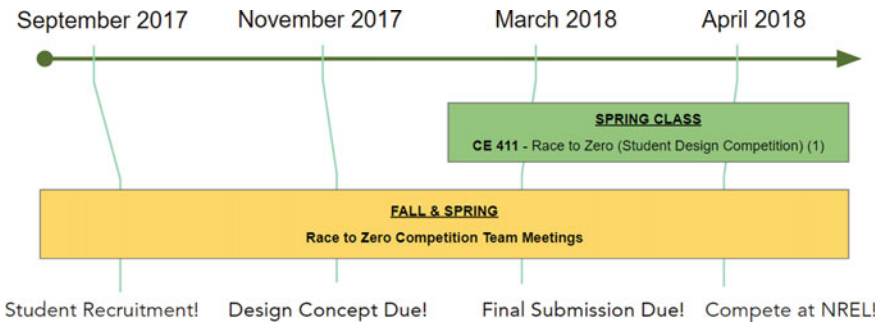

Fig. 2 Example timeline of Penn State curricular (green) and extracurricular (yellow) activities

deliverables in the spring (Hazel et al. 2018). This process builds student leadership confidence and technical expertise while allowing time for training in collaborative skills needed for working across disciplines and with the community to establish iterative, locally appropriate sustainable affordable housing.

4 Integrative Design Regenerative Frameworks and Application to Penn State Design Challenge Projects

Students enter a class or project bringing valid experience informed by several worldviews, including their personal background and training informed by their disciplinary education. While these experiences contribute to the success of a project or initiative, the holistic process that we envision necessitates that those problems are framed, and solutions defined, with input from a broader community and set of relationships. Important to this understanding is the universal debate on the right to housing and the linkages between housing affordability and sustainability as informed by UN SDG 11 Sustainable Cities and Communities, as well as linkages to other SDGs. Contextualizing these relationships locally, with non-academic stakeholders, is essential to knowledge and application.

To facilitate student engagement with these complex relationships, we adopt Integrative Design Regenerative Frameworks as informed by the 7 Group, a Pennsylvania-based leader in sustainable building design, and Bill Reed, founding principal at Regenesis (see Fig. 9). The concepts for these frameworks are discussed in textbooks by these authors (Boecker et al. 2009; Mang et al. 2016) and are used in facilitating sustainable design and development projects, but to our knowledge have not been published as a comprehensive series. We use them as an educational tool to guide students through an integrative transdisciplinary process.

4.1 Integrative Design Regenerative Frameworks

Integrative design regenerative frameworks reflect living systems and build the regenerative capacity for people and buildings to work in and with their environment (human and non-human). They are useful for helping students to reconcile many different experiences (knowledge and biases informed by life, education, etc.) and to participate as co-creators in a larger set of relationships. The Integrative Design Regenerative Frameworks are:

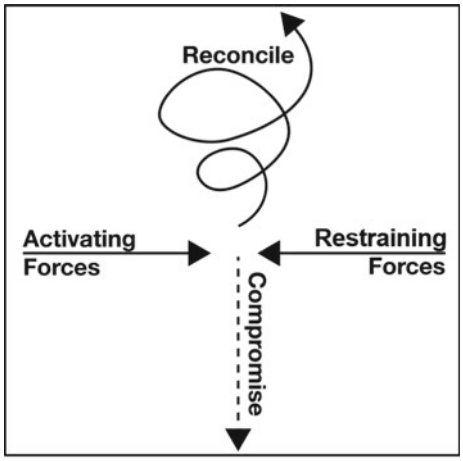

Fig. 3 Law of three. Adapted from Charles Krone. *Image Credit* Chris Hazel

Law of Three

Adapted from Charles Krone,[3] the Law of Three framework (Fig. 3) demonstrates the dynamic tensions that naturally occur throughout any process and shows that restraining forces (e.g., budget, project timeline, etc.) exist on any project. The goal is to continuously reconcile, rather than compromise, throughout the design process to achieve a project's full potential and a fulfilling experience for those engaged in the project.

Levels of Thought (Fig. 4)

Adapted from Carol Sanford,[4] this framework demonstrates the importance of dynamically iterating through three primary questions in any project: "Why? What? How?" Disciplinary education often trains students to focus primarily on the "What?" By opening the door to considering the "Why?" and the "How?" students are invited to broaden their thinking beyond disciplinary boundaries and toward systems-level thinking.

Moreover, conflicts in teams can come from differences (or perceived differences) in belief, philosophy, or principles. This framework thus invites team members to actively explore and articulate individual ideas toward reaching shared team values.

[3] The authors were unable to identify the original source of Charles Krone's contribution to these frameworks. Carol Sanford discusses his impact on her work in an essay "Three Teachers * Three Capabilities" (2018). Pamela Mang and Bill Reed (2012) also acknowledge "Charlie" Krone, citing unpublished transcripts from the Institutes for Developmental Processes, Carmel, CA.

[4] Author and educator Carol Sanford has written several books exploring living systems and regenerative business.

Fig. 4 Levels of thought. Adapted from Carol Sanford. *Image Credit* Chris Hazel

Three Lines of Work (Fig. 5)

This framework, also adapted from Sanford, demonstrates the concept of working within reciprocal nested systems. It provides a means of thinking about self in the context of a larger whole and a "way of working to recognize the transformation we seek to actualize in a particular system" (John Boecker, personal correspondence, 16 February 2022). The lines of work cross physical contexts and timescales from

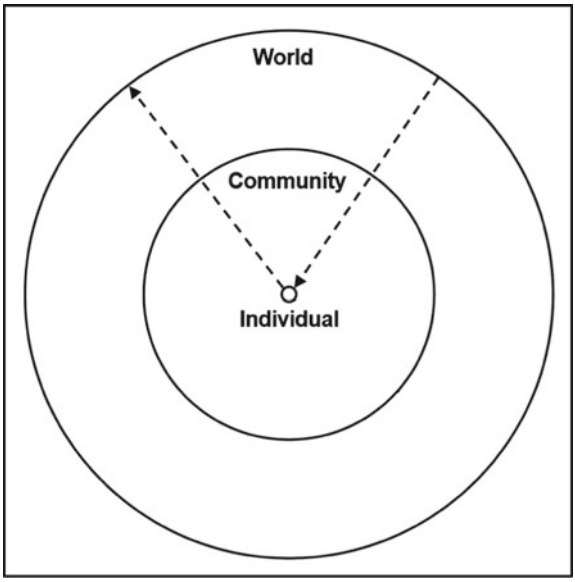

Fig. 5 Three lines of work Adapted from Carol Sanford. *Image Credit* Chris Hazel

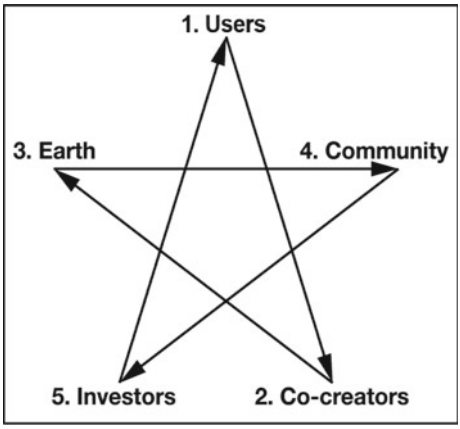

Fig. 6 Living system pentad. Adapted from Carol Sanford. *Image Credit* Chris Hazel

an individual person or building, to systems (group or community), up to the larger region or world, to create an alignment to build capacity.

Living System Pentad

Sanford's stakeholder pentad (2011) illustrates the connected nature of the team and its relationships across lines of work. In the Original Pentad, customers are at the top of the diagram. In Fig. 6, it is replaced with "users," representing a building client (i.e. affordable housing developer) and projected housing residents. It is a system for value adding processes that dynamically considers all stakeholders equally. No one part of the pentad is forgotten or gets more attention than another (e.g., investors). Rather than focusing on things (product, building), the pentad seeks to engage stakeholders in a process to seek what they authentically care about, therefore building capacity to improve and "evolve capacity" (Sanford 2012).

This framework places the Earth as an essential stakeholder in any system, providing critical space for environmental goals, such as energy efficiency, low embodied carbon, or low environmental impact material choices.

Purpose-Product-Process-Preparation Task Cycle

The 7Group and Bill Reed (Boecker et al. 2009) adapted Sanford's task cycle into a framework that adds *purpose* as a critical component to the standard Product-Process task cycle of product development. By incorporating purpose into this dynamic process, students are invited to continuously integrate the "bigger picture Why?" into their projects. Working with a community partner provides broader perspectives and reality to the project goals. Together they establish goals that the team can align around as a means for better communicating and working together towards a targeted outcome (the product). The process (how?) is facilitated by a fourth task, *preparation*, or the "functioning capabilities" to inform roles and determine what needs to be done (John Boecker, personal correspondence, 16 February 2022).

4.2 The Integrative Design Process in Practice

Integrative design, as informed by the Integrative Design Regenerative Frameworks, describes both a method and a process for successful implementation of sustainable building practices. It describes the necessary holistic approach to considering the building and all its systems in relation. Simultaneously, it reconsiders the team of professionals and non-academic stakeholders required to realize regenerative solutions to the interconnected challenges of the UN Sustainable Development Goals.

To ensure stronger coordination, Integrative Design defines a shift in process from a "traditional," linear, task-oriented process to one that is iterative and goals-oriented. This integrative process shifts more of the decision-making that leads to synthesis in design to an early discovery phase that allows teams to thoughtfully prepare, evaluate, and conceptualize the project.

As illustrated in Fig. 7, the iterative integrative design process continually oscillates between the research and work of the individual team members or discipline, and favors time for the team to synthesize and integrate the research and analysis. The integrative team applies a collaborative, iterative approach to design and decision-making that takes place through a series of workshops known as design charrettes. The process engages all stakeholders in the development of the design, in line with a key principle of the integrative design process: "The Four *Es: Everybody, Engaging, Everything, Early*" (Boecker et al. 2009: 62).

Throughout the design process (Fig. 8) students are encouraged to utilize the frameworks to:

- include the voice of the users, community, and earth within their design process ("Living System Pentad")

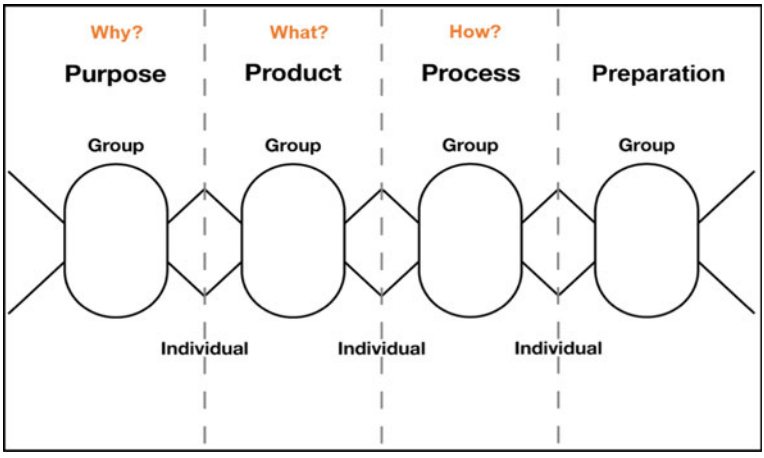

Fig. 7 Purpose-product-process-preparation task cycle. Task cycle adapted from Carol Sanford, Graphic adapted from 7Group/Bill Reed. *Image Credit* Chris Hazel

Fig. 8 2018 Race to Zero Team integrative work session (*Image Credit* Sarah Klinetob Lowe)

Fig. 9 Marcus Sheffer of 7Group teaching integrative design concepts and purpose statement development to an architecture elective class in Fall 2017 (*Image Credit* Sarah Klinetob Lowe)

- reflect on and iterate through the "Why? What? How?" of the design ("Levels of Thought"),
- reconcile rather than compromise through design tension points ("Law of Three")
- think through all scales of impact as they iterate through the process ("Three Lines of Work")

4.2.1 Launching the Integrative Design Process

A commonly used group entry exercise by Penn State teams to launch the integrative design process and introduce the frameworks is a series of three facilitated questions. These questions were adapted from an integrative design workshop co-developed by Penn State, 7Group, and Brent Darnell International (Klinetob 2013).

1. Think of a really fulfilling experience.
2. Think of a really agonizing experience.
3. Without going into the details of either experience, what made the difference?

For questions one and two, students typically draw on a wide range of personal experiences, with stories often centered around school projects (e.g., a group assignment) and extracurricular activities (e.g., participating on a sports team). However, with question three, common themes that consistently emerge concerning what made the difference between these two experiences include:

- Poor communication
- Unclear roles and responsibilities
- Lack of agreement on project goals

This exercise brings to light the opportunities, challenges, and potential of working with others and serves several purposes:

- Serves as a vehicle to introduce integrative design regenerative frameworks in a way that is grounded within and tailored to the students' own experiences
- Invites students to bring their full life experience and worldviews, rather than only their disciplinary education
- Shifts students away from thinking purely in disciplinary tasks and towards transdisciplinary, systems-level thinking
- Begins building trust and common experience within the group of students working on the project.

4.2.2 Developing a Purpose Statement

Equipped with the frameworks, a useful next step in the integrative design process is the collaborative development of a three-part *purpose statement* (Fig. 10) that embodies the process and project.

The purpose of this step is to collaboratively and dynamically work towards alignment and a shared group vision for the project that:

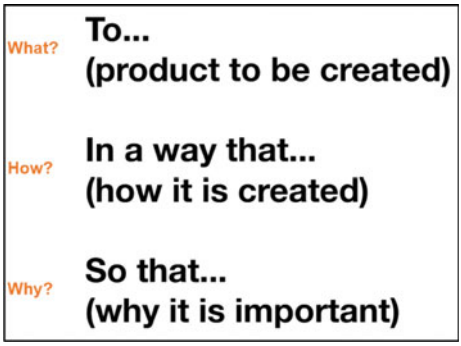

Fig. 10 Purpose Statement. Adapted from Carol Sanford. *Image Credit* Chris Hazel

- Visually captures the multi-dimensional nature of engaging in a community-focused project;
- Allows broad project goals to be articulated and documented; and
- Provides an opportunity to reflect on and identify entities to bring into the design process, based upon articulated goals.

Figure 11 shows the output of the 2018 Design Challenge (Race to Zero) purpose statement development workshop. Some notable points include:

- The multiple stakeholders from the Stakeholder Pentad (Fig. 6) are identified (students, community, earth, family in the home, etc.)
- The "To:" section, or the "What?" of the project, not only shows that the students were interested in designing a sustainable home, but it also reflects the broader goal to "create an educational experience for the homeowners, communities, and students."
- The "In a Way That" ("How?") and "So That" ("Why?) sections identify important project parameters (i.e., be efficient, affordable, and functional) and brings out broader community-focused goals, including:
  - "building relationships with new neighbors and community"
  - "promoting environmental awareness"
  - establishing a "happy community and happy family"
  - "educating all project contributors"

5 Case Study Projects: GreenBuild and Energy+/Old Boalsburg Road

Leveraging experience from early entries to the Solar Decathlon competition set Penn State up for success in addressing more local needs. In this section we illustrate how the integrative approach to two case study projects serve a larger purpose addressing community housing needs in State College Borough (Fig. 12).

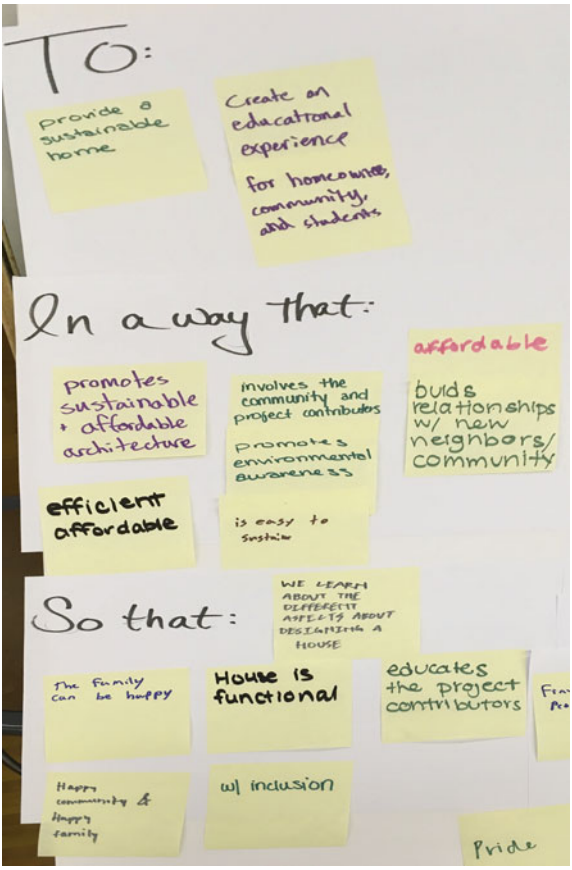

Fig. 11 Purpose statement development. *Image Credit* Sarah Klinetob Lowe

The State College Community Land Trust (SCCLT) GreenBuild project, a university-based research project and new construction duplex built to the Zero Energy Ready Home Standard, was submitted for the 2015 *Race to Zero* competition and was constructed in partnership with a local design/build contractor in 2018. GreenBuild demonstrates opportunities for long-term housing affordability and provides a foundation for *Energy+*, a residential energy retrofit initiative for existing housing. The renovation and retrofit of an existing multifamily rental building on Old Boalsburg Road (OBR) was developed with the Energy+ team for the 2021 Solar Decathlon Design Challenge competition. These projects illustrate a process for community engagement, and result in transferable knowledge that is redefining affordable sustainable housing for the region.

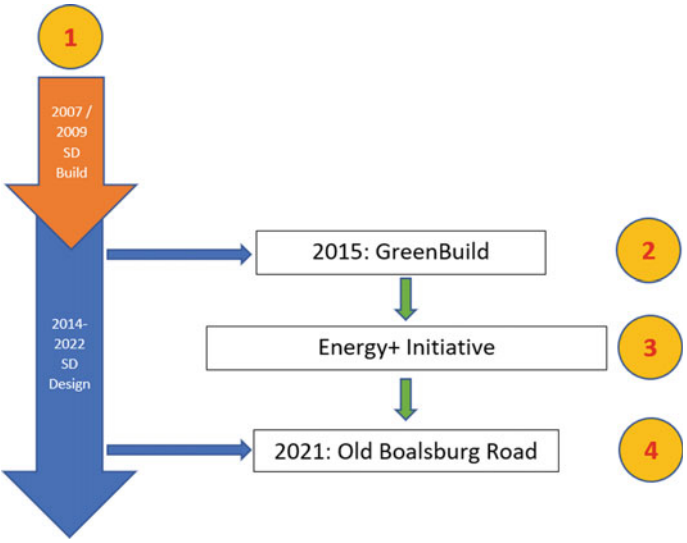

Fig. 12 Diagram illustrating how the knowledge and capacity built by the Solar Decathlon competitions have led to the GreenBuild case study, Energy+ Initiative, and Old Boalsburg Road case study

5.1 New Housing: GreenBuild Duplex

5.1.1 Context

In early 2013, the executive director and a volunteer board member from the State College Community Land Trust (SCCLT) approached Penn State's Energy Efficient Housing Research group (EEHR) to explore how to include energy efficiency improvements into the organization's housing portfolio, which comprised entirely existing housing construction.

SCCLT is a nonprofit affordable housing provider in State College Borough. Its goals are to sustain the character, vibrancy, and diversity of the Borough community by answering the ongoing need for affordable housing and increasing homeownership. For over 20 years SCCLT has partnered with individuals and families allowing them to become successful homeowners in State College Borough. SCCLT acquires homes and land, rehabilitates homes, educates and counsels homebuyers, and promotes the well-being of the neighborhoods.To keep home prices affordable, the SCCLT buys a house and its land, and sells only the house to an applicant who meets income guidelines set by the Borough government. The land is leased to the homeowner in a long-term agreement. This land trust model ensures that the home and property stay affordable in perpetuity; in doing this, a land trust reduces the cost of a home by at least 30%. In exchange, homeowners can sell the house in the future to another qualified family or back to SCCLT, based on a resale formula.

While the initial conversation focused on energy efficiency improvements for their existing housing, shortly thereafter SCCLT was approached with the opportunity to purchase an undeveloped property in the Borough. With no experience in new home development, SCCLT partnered with Penn State EEHR to research and design affordable, sustainable housing that could serve as an example in the community. SCCLT purchased a 20,000 square foot lot with funding provided by the State College Borough. The lot was large enough to accommodate a duplex (two attached homes), consistent with adjacent housing.

5.1.2 Student Design Competition: 2015 Race to Zero Competition

Initial concepts for the GreenBuild project were developed by fourth-year architecture students in a required comprehensive design studio in the fall semester of 2014. In the spring semester of 2015, an elective course was offered to develop the design and in support of the Penn State 2015 *Race to Zero* team.

Thirty students, undergraduate and graduate, primarily from architecture and engineering (civil and architectural, including construction management, lighting/electrical, structural, and mechanical) participated in the class, either for credit as an elective or extracurricularly in the interest of the competition. The student team, their faculty advisors, representative board members and homeowners from SCCLT, and several professional mentors engaged in a co-design process of GreenBuild informed by the Integrative Design frameworks.

Goals for the GreenBuild duplex were defined based on what the 2014–2015 Race to Zero team dubbed the "Triad of Interests"—those of the SCCLT (client), the design team (co-creators) and the performance expectations for a highly energy-efficient building, consistent with the Department of Energy Zero Energy Ready Home program and *Race to Zero* competition (see Fig. 13). These were refined based on a series of community design charrettes, workshops facilitated by the students with input from the public and invited guests (Figs. 14 and 15). They included programming and financial requirements set by the client, SCCLT; performance goals for long-term affordability through reduced utility bills, improved home durability, and a healthful living environment with metrics consistent with the Department of Energy Zero Energy Ready Home program; and desires for the positive impact of the homes in the community and environmentally, set by the student team members.

Representatives of the student team flew to Golden, Colorado in April 2015 and presented the project, building science research, financial analysis, and marketability study, based on the community engagement process, to judges at the DOE National Renewable Energy Laboratory. The team's project was highly regarded by the judges, a panel of global experts, winning awards for Design Excellence and Integration Excellence, including highest marks for climatically appropriate building enclosure design. This professional feedback provided the team with validation that the innovative strategies proposed for the construction of GreenBuild would be successful, avoiding the risk of appearing experimental at the expense of the community (Iulo et al. 2016).

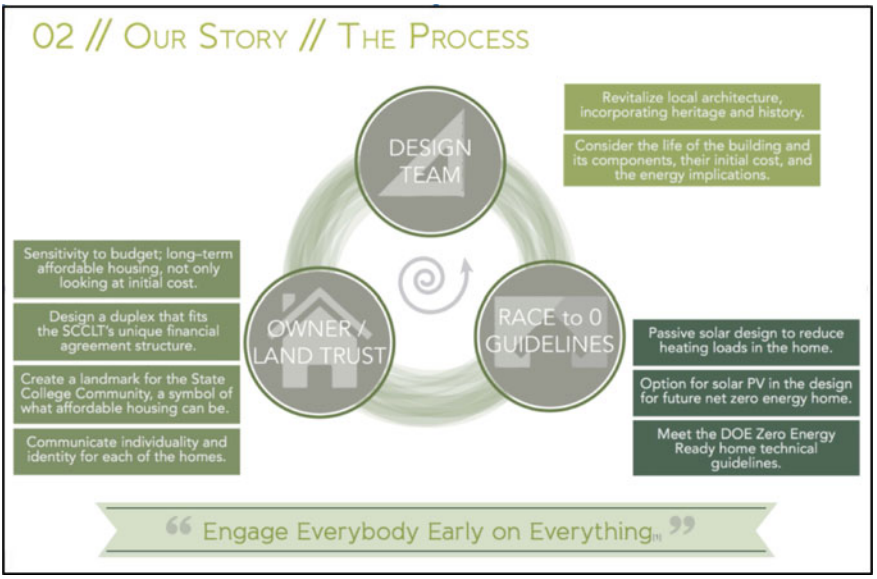

Fig. 13 2015 Race to Zero Stakeholders. *Image Credit* 2015 Race to Zero Team

Fig. 14 2014 GreenBuild Design Charrette with community members, representative homeowners, and building professionals (*Image Credits* EEHR)

Fig. 15 2014 GreenBuild Design Charrette with community members, representative homeowners, and building professionals (*Image Credits* EEHR)

5.1.3 Post Competition: Refining the Design and Construction

Following the competition, the student team refined the design, confirming compliance with local zoning and codes. In the interest of replicability, the process and decisions for GreenBuild—including agendas and outcomes from community design charrettes, concept drawings, and building systems analysis—were documented in a downloadable resource: *The Design of GreenBuild.* Additionally, several graduate students who participated in the competition team continued as graduate assistants in the Hamer Center for Community Design to refine the project documentation, detail material selections and rationale, and carefully document decisions and building science details, again establishing a free downloadable resource: *Building Science Report.*[5] The drawings and other documentation were shared with the State College Community Land Trust and served as a bid package to hire a professional design/building contractor to implement construction of the GreenBuild Duplex.

The winning firm, Envinity Inc., respected the co-design process and continued to engage the SCCLT and the university team in the final development of the project, including the permitting and construction documents (Fig. 16). Throughout construction, tours of GreenBuild were available and progress was tracked on a project blog site maintained by EEHR and available on its website. GreenBuild's "educational footprint" comprises hundreds of students, homeowners, community volunteers, and

[5] Both of these resources are available on EEHR's GreenBuild website: https://sites.psu.edu/eehr/projects/greenbuild/.

professionals, engaging participants in paramount issues of housing affordability and evaluation measures for low energy, environmentally responsible housing.

GreenBuild enhances human experience by providing affordable, durable, healthy homes that contribute to environmental awareness and stewardship for residents. It is especially compelling in that it demonstrates that comfortable, meaningful, and sustainable living can be attainable regardless of income. Researchers with EEHR and PHRC continue to work with volunteers, housing providers and decision-makers to apply lessons learned from GreenBuild to existing affordable housing in the Borough of State College.

The GreenBuild project represents the Integrative Design Regenerative process outlined in the Levels of Thought Framework (Fig. 9). An early discovery phase, including community engagement, set forth the "Why?"—beliefs, philosophies and principles—of the project; a rigorous "What?" phase established climatically- and culturally-appropriate concepts, strategies and designs for GreenBuild; and finally, "How?" the project achieves its goals was monitored through performance testing during construction and evaluation by auditors and experts as part of the building certification process. Too often, projects—even high-performance building projects—are handed over to the owner without follow-up. Therefore, as important as the discovery phase is to integrative design, it is equally important to maintain relationships and ensure project satisfaction for the residents and the community (Dulaney 2013; Iulo et al. 2014; Quale 2017). This is approached by continuing to monitor the GreenBuild project performance and occupant satisfaction, and by generalizing lessons learned to inform future projects.

5.2 Existing Housing: The Energy + Initiative

5.2.1 Context

Partnerships forged and lessons learned from GreenBuild inform the Energy+ Initiative. In 2018, following the completion and success of GreenBuild, State College Community Land Trust (SCCLT) and Penn State's Energy Efficient Housing Research group (EEHR) resumed the early 2013 conversation on how to include energy efficiency improvements into their rehabilitation program for existing housing. Shortly thereafter, the partnerships expanded to include the State College Borough, the HOME Foundation (THF), and the Pennsylvania Housing Research Center (PHRC).

The Energy+ Initiative is a program to design, implement, and evaluate residential energy efficiency-focused capital improvements specifically for existing housing in the State College area. Development of the project goals, as a systematic set of relationships informed by the Stakeholder Pentad diagram, was an important step in establishing this initiative. The numbered sequence of the Pentad, starting with the users (in this case affordable housing providers and representative homeowners) and the co-creators (the university design and research team), is essential to the success

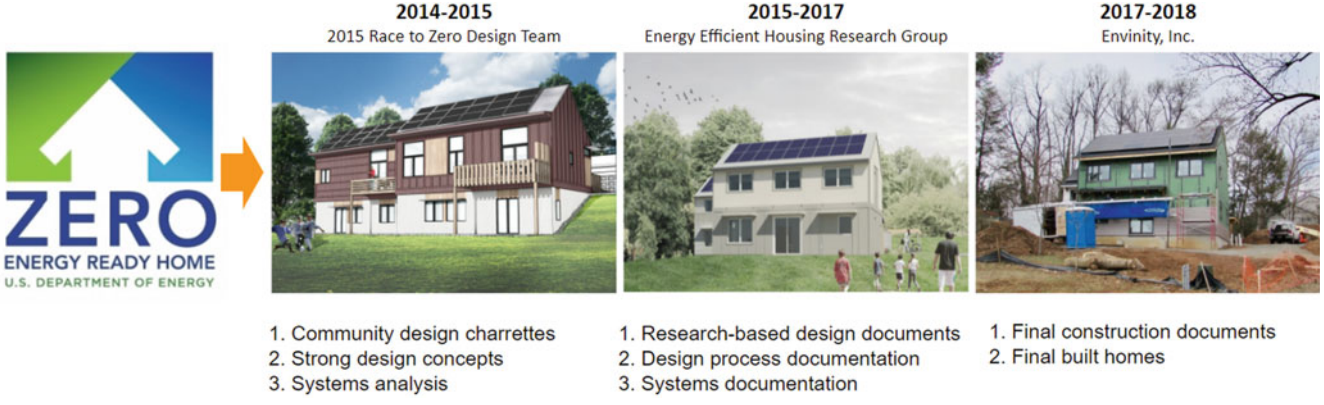

Fig. 16 Evolution of the GreenBuild Duplex design from competition to construction. *Image Credits* 2015 Race to Zero Team (left); EEHR (middle and right)

of the system. Working in reverse, starting with investors/capital, would lead to a very different outcome, compromising the regenerative capacity of the project to "be ecologically-evolving and to keep the community healthy" (Sanford 2012).

Although raising resources to procure additional affordable housing in the Borough and renovate in a way that is energy-efficient and sustainable was essential to the success of the project, existing knowledge, programs, and resources were leveraged and enhanced in the process.

5.2.2 Pilot Phase—Energy+ 1.0: Addressing Energy

For the first full year from July 2018 to July 2019 the Energy+ Initiative centered around collaboration meetings to collectively explore energy efficiency goals, review existing housing rehabilitation processes, and identify possible funding sources for the energy efficiency work.

From these meetings, a shared vision of permanent affordability of the existing affordable housing stock emerged, and the following goals were developed:

1. Lessen resident energy burdens
2. Reduce the environmental impact of existing housing stock
3. Enhance the public investment in housing affordability

Given the existing administrative and funding structures, it best served the community partners to align Energy+ with the existing housing rehabilitation program, rather than creating an entirely new program (Fig. 17). The existing housing rehabilitation program ensures the health, safety, welfare, and appeal of the home, and includes projects such as addressing building code violations, lead remediation, and kitchen and bathroom remodels. Given the challenges of retrofitting homes with occupants in place, it was decided to begin the pilot phase focusing on newly acquired SCCLT and THF units, rather than on the already acquired and occupied existing homes within their housing programs.

With these two strategies in mind, a primary addition to the housing rehabilitation process was the inclusion of obtaining an energy audit report shortly after home acquisition, as well as a commitment to include energy efficiency projects from the energy audit report during the typical housing rehabilitation work. Finally, several possible funding sources were identified to fund the proposed energy efficiency work.

To build on the "educational footprint" established by GreenBuild within the community, in July 2019 the team hosted an open house and retrofit tour for a home acquired by the SCCLT that had extensive energy efficiency work completed on it.

Following the success of these collaboration meetings and outreach work, in 2019 and 2020 SCCLT, THF, and the Borough of State College successfully secured funding for energy efficiency improvements on 32 affordable housing units. In 2019 the SCCLT also secured funding from the West Penn Power Sustainable Energy Fund (WPPSEF) for EEHR and PHRC to document best practices, including energy modeling and case study write up, as a resource for the project partners and other developers.

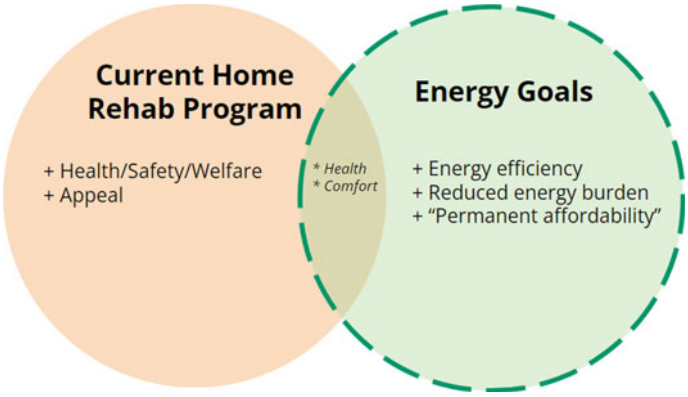

Fig. 17 Energy+ 1.0: Pilot phase diagram

5.2.3 Next Phase—Energy+ 2.0: Addressing Equity

During a recent focus group informing a Community Needs Assessment, stakeholders identified housing, diversity, and equity concerns to be top priorities for the community. Building and expanding on goals of establishing "permanently affordable" and sustainable homes, a core research component of the next phase of the Energy + Initiative ("Energy+ 2.0") addresses racial and socioeconomic barriers to affordable housing (Fig. 18). By engaging in this next phase of Energy+ , the team will continue to develop the dimension of inclusivity within SDG 11, in addition to the dimensions of safety, resiliency, and sustainability.

In February 2020 the Energy+ team was invited to apply for, and ultimately selected to participate in, the 2020 Reinventing Our Communities Conference (ROC) Cohort Program hosted by the Federal Reserve Bank of Philadelphia. With a program theme of "Equity InSight" the program engaged the team in a six-month training process to develop an equity framework to further local equity work in housing.

5.2.4 Student Design Competition: 2021 Solar Decathlon Design Challenge

The success of the Energy+ Initiative was further strengthened by SCCLT and THF being awarded funding towards the acquisition and energy efficiency retrofit of an 8-unit townhome building on Old Boalsburg Road in State College, PA. In 2021, at the height of the COVID-19 global pandemic, the Penn State Solar Decathlon Design Challenge team partnered with Energy+ to demonstrate the potential for high-performance, zero-energy living in existing multifamily rental housing with the Old Boalsburg Road (OBR) project. Despite limits to in-person engagement, the integrative approach and interactive co-design process were employed.

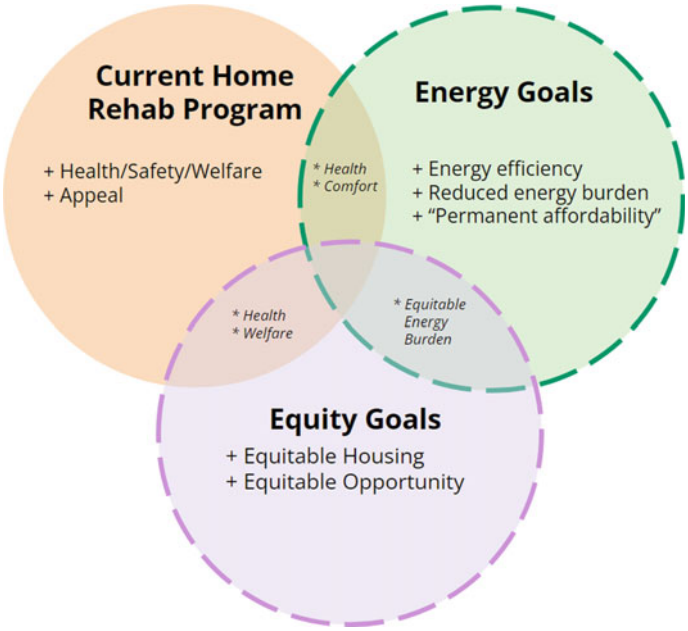

Fig. 18 Energy+ 2.0: Current phase diagram

The 2021 Solar Decathlon Design Challenge student team was composed of 22 undergraduate students from architecture, architectural engineering, and civil engineering backgrounds. The student team, along with faculty advisors, professional mentors, and staff, board members, and volunteers from the Energy+ Initiative, engaged in co-design of the OBR townhomes. With the ongoing COVID-19 disruption, engagement between team members, the Energy+ partners, and the professional mentors was entirely virtual, utilizing tools such as PollEV and ConceptBoard for collaboration, and Zoom, Google Docs, and GroupMe for communication.

Concepts and goals for the Old Boalsburg Road townhomes were collaboratively developed between the 2021 Solar Decathlon Design Challenge student team and Energy+ Initiative partners via a series of virtual design charrettes and feedback sessions (Fig. 19).

The articulated design goals for the project were:

1. Performance: Utilize south-facing rooftop for solar PV and meet the Zero Energy Ready Home requirements to achieve a net zero energy design using energy modeling.
2. Appearance: Aesthetic improvements to create a sense of diversity in the units; design is integrated into the landscape. Final design is aesthetically pleasing and creates a beautiful example of how net zero energy designs can work in the State College area.

Fig. 19 2021 Energy+/Old Boalsburg Road Design Charrette: screenshot of answers by members of SCCLT, THF, and Borough of State College (*Image Credit* 2021 Penn State Solar Decathlon Design Challenge team)

3. Experience: Improved interior environment; use of high quality, low carbon materials; tenants feel that they are individuals within a community. Create a safe and welcoming space for students and professionals to live within walking distance of the University campus, schools and recreation, downtown amenities, and jobs.

The students also worked with active industry professionals to learn the latest on deep energy retrofit techniques and best practices, to ensure what was presented could be feasibly applied to other buildings in the State College area.

The team was invited to participate in the Solar Decathlon competition as an exhibition team and presented their final submission to the Penn State President during Earth Week 2021 (Fig. 20). In addition to informing the actual retrofit work of the Old Boalsburg Road townhomes, this work is informing other deep energy retrofits in State College Borough, including a Passive House[6] retrofit to a SCCLT duplex on the same block as the GreenBuild duplex as well as a Passive House retrofit design of a 9-unit townhome owned by THF.

[6] Passive House is a certification system for a rigorous level of energy efficiency projects that are durable, comfortable and resilient. Learn more about the two Passive House standards at www.phius.org and www.passivehouse.com.

Fig. 20 2021 Energy+/Old Boalsburg Road Student Design (*Image Credit* 2021 Penn State Solar Decathlon Design Challenge team)

6 Conclusion

> When designers partner within communities, we step into a living context, one defined not only by the historical dynamic of residents, land, and policies, but also by an entirely new dynamic, created by the virtue of our presence. In delving into our own identities, we build a framework for our own identities, we build a framework for evaluating our inevitable missteps and cultivate sensibilities that help us avoid further errors. Finally, we set the stage for an ongoing self-reflective practice, with results and outcomes responsive to the infinitely broad range of community-designer partnerships (Clark and Agrawal 2019: 121).

GreenBuild and the subsequent Energy+ initiative were co-developed by Penn State students and faculty from multiple disciplines with diverse representatives from the community. The collaboration was mutually beneficial, building capacity to provide affordable, sustainable housing and imperative training in high-performance building design and construction for students and practitioners. The transdisciplinary approach informing this work brings together multiple disciplines and perspectives around compelling and essential issues. It establishes place-based problem definitions with input from the affected community and informs relevant research questions. The resulting housing solutions work across scales, benefiting both individuals and communities. Learning through dialogue and engagement (different disciplines, undergraduate and graduate students, community representatives) builds mutual respect, allowing for sharing of new ideas and evolving best practices.

This chapter highlights the mutually beneficial teaching and learning opportunities that real-world relationships bring to *educating the Sustainability Leaders of the Future.* Although the example competition and projects presented are limited to housing, the framework and iterative/integrative engagement approach presented has application in all fields and discourse—expanding connections across lines of work, worldviews, and relationships to train future professionals with the capacity to address the complex and interrelated UN SDGs.

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References

ACEEE (2018) Understanding energy affordability. American Council for an Energy-Efficient Economy. https://www.aceee.org/sites/default/files/energy-affordability.pdf. Last accessed 01 March 2022

Albrecht da Silveira C, Correna Carlo J, Iulo LD, Buckland P (2020) International transdisciplinary approach to sustainability in research related to place: sustainable, affordable homes and ecosystem services in the U.S. and Brazil. In: Leal W, Tortato U, Frankenberger F (eds) Universities and sustainable communities: meeting the goals of the agenda 2030. Springer, Springer International Publishing, Switzerland, pp 187–202

Boecker J, Horst S, Keiter T, Lau A, Sheffer M, Toevs B, (7Group), Reed B (2009) The integrative design guide to green building: redefining the practice of sustainability. Wiley, Hoboken, New Jersey, U.S.A.

Clark M, Agrawal S (2019) Preparing to design with IMPACT orientation. In: Abendroth LM, Bell B (eds) Public interest design education guidebook. Curricula, Strategies and Seed Academic Case Studies. Routledge, Taylor & Francis Group, New York and London

Centre County Affordable Housing Coalition (n.d.) Homes within reach toolkit: a source of options for centre county municipal officials and developers. https://content.civicplus.com/api/assets/1f504a1a-b631-450b-8bde-ef41baaedc8a?version=0&q=4eb91a8e-b695-fb63-7289-8b0bde76e8b1. Last accessed 01 March 2022

Solar Decathlon (n.d.) About. https://www.solardecathlon.gov/about.html. Last accessed 09 March 2022

United Nations Department of Economic and Social Affairs, Sustainable Development (n.d.) Goals: 11 sustainable cities and communities, make cities and human settlements inclusive, safe, resilient and sustainable. https://sdgs.un.org/goals/goal11. Last accessed 01 March 2022

Drehobl A, Ross L (2016) Lifting the high energy burden in America's largest cities: how energy efficiency can improve low-income and underserved communities. American Council for an Energy Efficient Economy (ACEEE). https://aceee.org/research-report/u1602. Last Accessed 09 March 2022

Dulaney R (2013) The low-income single-family house and the effectiveness of architects in affecting affordability. ARCC J 9(1):24

Energy.Gov (n.d.) U.S. Department of Energy Race to Zero Student Design Competition, Buildings. "What is the Race to Zero." https://www.energy.gov/eere/buildings/us-department-energy-race-zero-student-design-competition. Last accessed 09 March 2022

Fact Sheet No. 21 (n.d.) The human right to adequate housing. United Nations. https://www.un.org/ruleoflaw/files/FactSheet21en.pdf. Last accessed 09 March 2022

Fisher S, Colton (2021) The home energy affordability gap 2020 (2nd Series). Published April 2021. http://www.homeenergyaffordabilitygap.com/03a_affordabilityData.html. Last accessed 09 March 2022

HABITAT: United Nations Conference on Human Settlements, Vancouver, 31 May–11 June (1976) United Nations, New York, 1976. https://documents-dds-ny.un.org/doc/UNDOC/GEN/N76/967/11/PDF/N7696711.pdf?OpenElement. Last accessed 09 March 2022

Hamer Center for Community Design (n.d.) Energy efficient housing research group. https://sites.psu.edu/eehr/. Last accessed 10 January 2022

Hazel C, **Klinetob Lowe S**, Hanna T, Copeland S (2018) 2016–2017 race to zero competition: a case study design for zero energy ready townhomes. In: Memari AM, Lowe SK (eds) 4th Biennial residential building design and construction conference proceedings. Department of Architectural Engineering, Department of Civil & Environmental Engineering, The Pennsylvania State University, University Park, PA USA, pp 319–333. https://www.phrc.psu.edu/assets/docs/Publications/2018RBDCCPapers/2018-RBDCC-Whole-Proceedings.pdf. Last accessed 09 March 2022

Healy JD (2002) Housing conditions, energy efficiency, affordability and satisfaction with housing: a pan-European analysis, Volume 2 of Environmental studies research series (University of Dublin, Department of Environmental Studies). 02/02 working papers. ISSN. 1393-9335, 53 pp

HUD (U.S. Department of Housing and Urban Development) Archives, Glossary of terms to affordable housing. https://archives.hud.gov/local/nv/goodstories/2006-04-06glos.cfm. Last accessed 09 March 2022

Iulo LD, Fadaei S, Macht K, Rahimian M, Riley D, Kimel RA (2014) Innovate–Evaluate–Learn-: the importance of iterative research in housing design/build. Working Out—thinking while buildings. In: 2014 ACSA fall conference paper proceedings, ACSA Press, 15 April 2015, 11 pp

Iulo LD, Duriez C, Macht K (2016) Co-design of a sustainable affordable housing demonstration project. In: Proceedings of the 3rd residential building design & construction conference—2–3 March 2016. Penn State, University Park. https://www.phrc.psu.edu/assets/docs/Publications/2016RBDCCPapers/Iulo-2016-RBDCC.pdf. Last accessed 18 January 2022

Klinetob S (2013) Integrative design leadership short course, January 10–11, 2013. Report of the Energy Efficient Buildings Hub, 24 January 2013. Re-energizing buildings for the future. A U.S. DOE Energy Innovation HUB. Philadelphia, PA, U.S.A. Unpublished whitepaper

Mallach A (2009) A decent home: planning, building, and preserving affordable housing. The American Planning Association, Washington, D.C, U.S.A

Mang P, Haggard B, Regenesis (2016) Regenerative development and design: a framework for evolving sustainability. John Wiliey & Sons, Inc: Hoboken, New Jersey; Published simultaneously in Canada

Mang P, Reed B (2012) Designing from place: a regenerative framework and methodology. Build Res Inf 40(1):23–38

PHRC (Pennsylvania Housing Research Center) PHRC Mission and Goals. https://www.phrc.psu.edu/About-PHRC/Mission-and-Goals.aspx. Last accessed 09 March 2022

Quale J (2017) Design/build/evaluate: connecting with actual humans. In: Chapter: Kraus C (ed) DesignBuild education. Taylor & Francis Group, Informa UK, 15 pp

Sanford C (2011) The responsible business: reimagining sustainability & success. Jossey-Bass, San Francisco, CA

Sanford C (2018) Three teachers * three capabilities. https://carolsanford.medium.com/three-teachers-three-capabilities-24d10b475e75. Last accessed 01 March 2022

Sanford C (2012) Interview—The Pentad Framework. 23 March 2012. https://www.youtube.com/watch?v=ljWeypOklzQ

UN Human Rights Office of the High Commissioner (n.d.) International standards on right to housing. https://www.ohchr.org/en/issues/housing/pages/internationalstandards.aspx. Last Accessed 09 March 2022

UN-Habitat (n.d.) A new focus for UN Habitat. UN Habitat for a better urban future. https://unhabitat.org/about-us. Last accessed 10 January 2022

United Nations, Universal Declaration of Human Rights (1948) Article 25.1, General Assembly resolution 217A, Paris, France. https://www.un.org/sites/un2.un.org/files/udhr.pdf. Last accessed 09 March 2022

College-Community Environmental Collaborations: Guidance for Successful Community-Based Projects and Research

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1 Introduction

Environmental Science curricula have evolved from being primarily natural science-oriented to being inclusive of social sciences (Filho Leal and Zint 2016, Focht et al. 2018) and humanities (e.g. LeVasseur 2014; Sörlin 2012; Filho Leal and McCrea 2019) with recognition that solving environmental problems requires not just scientific understanding and application of technical solutions, but also an awareness

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of political, social, and behavioral realities. Although different disciplinary viewpoints have been included in examining and addressing environmental issues, with curricula often providing courses with disciplinary perspectives, the need to assist students in integrating these different disciplinary perspectives to understand issues and to move toward sustainable solutions is increasingly recognized (Vincent 2010). Despite realizing the importance of this educational integration, however, there still exists uncertainty in determining the best pedagogical approach to teaching students to become problem-solvers, with a tension between approaches that are information-based and dictate appropriate thinking and behavior, versus allowing students to develop their own perspective by using knowledge gained in experiences that address environmental sustainability (Wals 2011). Nonetheless, despite numerous challenges, the Public Engagement with Science model suggests positive outcomes when the research community enhances its public engagement experience (Hopfensperger et al. 2021).

Lecture-format courses have traditionally been the staple of higher education, but it is now generally acknowledged that learning needs to be more than simply knowledge-based (Wals 2011); hands-on approaches are more effective in helping students to learn than traditional approaches that rely on "teaching by telling" (Brame 2016; Jones and Washko 2021). Increasingly, faculty members are looking to blend in-class learning with civic engagement projects that help students develop a sense of place that contributes to environmental sustainability (Orr 2004). Doing so is not easy, however, as institutions struggle to become good stewards of places, provide structure that supports academic-community partnerships, and offer guidance for faculty to engage in this pedagogical approach (AASCU 2002). Nonetheless, progress is being made. For example, the Association of American Colleges and Universities

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includes community engagement projects as a "High Impact Practice" that provides meaningful educational benefits for students by modeling the practice of partnering with communities and providing "good preparation for citizenship, work, and life" (AACU 2022).

Relevant issues approached with hands-on activities are essential for active learning, have gained much traction in sustainability programs, and are increasingly considered to be important if not essential components of sustainable development curricula (Bootsma et al. 2014). These kinds of courses, though rewarding, are challenging, especially given the complexity of sustainability-based projects (Seater and Ceulemans 2017). Nonetheless, studies of active learning show that it works; a meta-analysis of 225 studies found that students in lecture-based classes were 1.5 times more likely to fail than students in classes that included active learning (Freeman et al. 2014).

Environmental sustainability studies are solution-oriented, educating students to become leaders and problem-solvers, not merely students of environmental problems. Despite this stated approach, the means to engage students in hands-on projects with community partners are not always clear. There is a large body of pedagogical literature that describes best practices for lectures, laboratory exercises, and class discussions, but relatively little on the best approaches for developing academic-community collaborations on projects or research conducted within courses. Incorporating hands-on, active learning projects has been a key feature at Allegheny College for three decades, with undergraduate research and interdisciplinary work woven into the curriculum. Our purpose in this paper is to share our experiences in community-based faculty-student projects, and to highlight benefits, challenges, and lessons learned as we have employed this approach in numerous faculty-student-community course-based projects. We describe and evaluate practices that enhance opportunities for students to gain experience and skills in collaborative work, project planning and execution, individual responsibility, responsible partnership, and leadership, all of which are necessary for developing future leaders in environmental sustainability.

2 Methods

We have examined a wide range of our college-community collaborative projects, including a broad range of community partners and a diverse array of projects (Table 1). Partners have come from local, regional and international locations, government agencies at the local, state, federal and international levels, businesses, and not-for-profit organizations. Projects have been initiated in a variety of ways, including initiation by faculty members, requests by community partners, or sometimes collaboratively when faculty members and community partners are in communication about issues or potential projects. Using these experiences, we have gleaned relevant approaches that we have found to be important in ensuring successful collaborations, by which we mean projects that provide benefits to the community partner, as well as a rich educational experience for students.

Table 1 Partners of sustainable projects undertaken in Allegheny College faculty-student collaborations. Private (P) partners are businesses or non-for-profit organizations. Government (G) partners are local, state, federal, or foreign government agencies

Geographic Location	Partner	Local Govt (GL) State Govt (GS) Federal Govt (GF) International Govt (GI) Non-profit (NP) Business (B)	Project
Local	City of Meadville	GL	Biodiesel production
			Street tree maintenance
			Climate action plan
	Meadville Medical Center	NP	Waste reduction
	Meadville Area Recreation Complex	GL	Community garden
	Meadville Area Middle School	GL	Edible walking path
	Grow Meadville	NP	Community gardens
	Ernst Biomass	B	Switchgrass ecology
			Switchgrass field leasing site suitability
			Switchgrass pellet assessment
	Common Roots	NP	Homeowner energy conservation
	Conservation Compost	B	Compost siting study
	Morehead Farms and Mazza Winery	B	Vineyard/Winery siting analysis
	French Creek Valley Conservancy	NP	Deer browse study
			Trail optimization
			BioBlitz

(continued)

Table 1 (continued)

Geographic Location	Partner	Local Govt (GL)	Project
		State Govt (GS)	
		Federal Govt (GF)	
		International Govt (GI)	
		Non-profit (NP)	
		Business (B)	
	Meadville Area Recreation Complex	NP	Nature trail design
	Local farmer	C	Wetland delineation
Regional	US Fish and Wildlife Service	GF	Invasive plant assessment
			Invasive plant treatment alternatives
			Stream quality assessment
			Invasive fish surveys
			Vernal pools evaluation
			River otter survey
			River otter conservation
			Black-legged tick abundance
			Land use history analysis

(continued)

Table 1 (continued)

Geographic Location	Partner	Local Govt (GL)	Project
		State Govt (GS)	
		Federal Govt (GF)	
		International Govt (GI)	
		Non-profit (NP)	
		Business (B)	
	Crawford County Conservation District	GL	Farmland preservation ranking
	Foundation for Sustainable Forestry	NP	Forest education material
			Member satisfaction survey
			Land use history analysis
			Forest landowner analysis
			Habitat biodiversity evaluations
	Northwest PA Woodland Association	NP	Website development
	PA Fish and Boat Commission	GS	Stream diversity indices
			Invasive fish surveys
	Elementary and high schools	GL	Environmental education
	Wilderness Lodge Cross-Country Ski Area	B	Environmental education

(continued)

Table 1 (continued)

Geographic Location	Partner	Local Govt (GL)	Project
		State Govt (GS)	
		Federal Govt (GF)	
		International Govt (GI)	
		Non-profit (NP)	
		Business (B)	
	Pennsylvania Dept of Conservation and Natural Resources	GS	Aquatic nutrient loading study
	PA State Senator	GS	Lake Erie wind turbine suitability study
	Pennsylvania Game Commission	GS	River otter conservation
International	Saudi Arabia	GI	Raptor conservation
	Bosnia & Herzegovina	GI	Aquaculture assessment
	Georgia environmental group	NP	Dam siting assessment
	SOIL Haiti	NP	Carbon sequestration/composting toilets
	Haiti Tree Reintroduction Program	NP	Forest information

3 Who is Allegheny College?

Allegheny is a liberal arts college of approximately 1500 students. The college has notable environmental sustainability accomplishments on campus, including carbon neutrality, on-campus solar energy production, organic food production, in-vessel food waste composting, and resource reduction. In the last decade, paper consumption has been reduced 30% and water consumption has decreased 40%. Installation of water refill stations on campus has drastically reduced single-use plastic bottle consumption (Bethurem et al. 2021). Recent building construction or renovations have been LEED-certified, including use of geothermal heating and cooling systems.

All students complete a year-long senior research project as part of their graduation requirements, supported by a curricular plan with deliberate scaffolding that begins with first-year seminars, continues through sophomore and junior year seminars, and culminates in the required senior project. In recognition of our strength in this area, the Council on Undergraduate Research presented Allegheny with the inaugural Award for Undergraduate Research Accomplishment in 2016. Recently, the Allegheny Strategic Action Plan has included the idea of the "applied liberal arts," recognizing the apprehension of students and their families about post-graduate outcomes. In this vision, students engage critically and creatively with "real-world" situations and problems, and engage in hands-on and community partnerships.

The Environmental Science and Sustainability curriculum is very flexible, and enables students to pursue environmental interests across from myriad perspectives, with a core curriculum of courses taught within the department, elective ESS courses, and courses taught in departments across the campus (e.g. religious studies, art, political science, economics). A critical feature of core courses is the interdisciplinarity within each course, teaching students that environmental issues must be approached from multiple perspectives, and that no single discipline or mode of thinking can alone result in solutions. For example, the introductory course examines climate change not only from an atmospheric chemistry or ecosystem effects perspective, but also addresses national and international political structures, behavioral psychology, religious perspectives and artistic contributions to climate action. Most courses within the core, as well as many elective offerings in the department, also provide opportunities to engage in hands-on activities with real partners. The introductory course begins this process by requiring students to conduct a mini-project that addresses some element of sustainability on campus, whereby the issue is identified, solutions are proposed, and challenges to implementation are addressed. This exercise enables beginning students to apply in-class learning to real world issues. Other courses often address on-campus issues as well, but many courses also collaborate with community partners in faculty-student projects that are conducted as part of course requirements. The sophomore-level environmental research methods course pursues one or possibly two research projects where the information acquired is of benefit to a community partner. Similarly, the junior seminar often embarks on a semester-long project with community stakeholders. The senior seminar is the venue in which students conduct their year-long senior project. Students can choose their own project, are guided by

a faculty mentor, and projects that students conduct are often done in collaboration with community partners.

4 Allegheny College-Community Projects

Most college-community collaborative projects have been incorporated into courses, either as the main effort or as one component of course requirements. For example, the waste reduction project was the primary focus of a junior-level seminar in sustainability, with students spending the majority of the course working on the effort. In contrast, the land use study for the US Fish and Wildlife Service resulted from a laboratory exercise in a forest ecology course. In some cases, projects result from faculty members working with a select group of students interested in the project. For example, the environmental education project with the Wilderness Lodge Cross Country Ski Area was done with research assistants working in the laboratory of a faculty member, and resulted following a series of conversations between the faculty member and the owner of the ski area.

Operation of the projects varies among professors and courses. In some cases, particularly in laboratory exercises within courses, the project may be more clearly defined by the professor, with less planning input by students. This occurs especially if the laboratory exercise is designed to reinforce or augment concepts being taught in lecture components. In other courses, particularly the research methods course or the junior seminar, part of the course plan is to intentionally engage students in the research design process. In this case, the input of the community partner may vary—the partner may interact with the students in the early design phase, or the partner and professor may have had prior conversations about project goals, with the professor then informing students of the direction of the project. In either case, students are then intimately involved in information or data collection, data analysis or project completion, and final report writing.

Students are viewed as young professionals; professors guide students on the journey so that they learn what they need to know to proficiently work on the project. We have often heard the argument that there is a tension between the material that needs to be taught, and the process of conducting the project, and we appreciate that tension. A course rich in lecture clearly has time to provide more information, but less time to show students how it is acquired or applied. A project-based course can risk spending a lot of time on tasks, but be lean on material that students learn. We find, however, that students DO learn material in the process of the projects that we select. Some projects may have a fair amount of tedious field collection and subsequent laboratory analysis, for example, but the process teaches the reality of meaningful research, and confronts the notion that research can be conducted in a three hour period. Furthermore, we give assignments that require students to learn the background material pertinent to the project, and that is also necessary for presentations and report writing. In our view, this is a critical life skill. Interactive techniques are generally preferred by students (Chilwant 2012), and even though some students by

nature are more suited to very explicit knowledge delivery, open-ended approaches, often with appropriate guidance, provide positive learning outcomes (Berg et al. 2003). Ultimately, students will use a tiny fraction of the material they learn in college, however to be successful, they need to learn to be life-long learners. Experiential approaches teach a learning process that can be widely applied in many areas of life (Kolb and Kolb 2017).

Work conducted in the projects usually results in presentations to the partners at the end of the semester, and when appropriate, in written documents provided to the partner. In some cases, preparation of a final, polished written report cannot be completed within the semester. In these instances, interested and capable students have been asked to serve as editors of the final report, working closely with the faculty member to produce a professional-level document. When appropriate, reports have undergone peer-review by Allegheny faculty or by faculty from other institutions, and have been published as reports (https://sites.allegheny.edu/envsci/student-resources/), akin to general technical reports published by the US Forest Service or the US Geological Survey.

5 Results and Discussion

5.1 Benefits of Community-Based Partnerships

5.1.1 Faculty Perspective

Realizing the importance of applied problem-solving in addressing environmental issues, we strive to incorporate hands-on experiences through real-world research projects involving local stakeholders into as many courses as possible. For example, over the years, students in the introductory mapping courses have worked on projects involving farmland preservation, stream health and biodiversity, commercial composting facility siting, black-legged tick abundance, nutrient loading in watersheds, forest management, vineyard expansion, switchgrass cultivation, and more. Through a wide array of partnerships, including those with the Crawford County Conservation District, French Creek Valley Conservancy, PA Fish & Boat Commission, PA Department of Conservation and Natural Resources, Erie National Wildlife Refuge, Moorehead Farms and Mazza Vineyards, Ernst Conservation Seeds, the Meadville Climate Action Plan working group, and international partners including political activists in the Republic of Georgia and elsewhere, students are better able to connect theory to practice by taking what they learn in class and applying it to real life scenarios with organizations that benefit from the collaboration.

Students gain necessary written and oral skills when communicating results from either course projects or independent research to these local stakeholders, aligning with our department's central learning objectives. For example, when a course project

focused on improving both the conservation value and improving the public's experiences at a French Creek Valley Conservancy property, students designed, executed and provided written and oral results to colleagues and members of the Conservancy, including trail optimization and protocols for biological surveys. Students in another course collaborated with Allegheny's Sustainable Design Team to summarize their research and apply for a grant from the PA Department of Environmental Protection to realize the permaculture education project they had designed. Such course experiences can occasionally relieve pressure on faculty to set aside significant time to explain complex concepts such as the social embeddedness of scientific research and expert accountability as students must develop this knowledge in practice.

As an instructor, it can be daunting to facilitate this approach to learning. It would be much easier to develop "canned" exercises with predetermined outcomes that can be repeated on a routine basis. Instead, we choose to develop somewhat "ad-hoc" projects that consider current topics and trends, approaches and technologies, and the needs and availability of stakeholders. Occasionally, project ideas originate from the community partner themselves, but more often we seek out partners and initiate conversations about potential research experiences.

While this approach typically requires more effort on our part and often increases anxiety about desired outcomes, it does have distinct benefits. It allows us the freedom and flexibility to be creative and curious about those things that interest us, advancing and influencing our own research agendas in the process. It relieves the burden of repetitive, mundane tasks and adds a level of excitement to the course. It also helps to ensure that our teaching pedagogies evolve to adapt to changing conditions rather than remaining stagnant. It also provides an authentic teaching/learning experience for both instructor and students. For example, the collaboration with stakeholders and political activists in the Republic of Georgia had to shift research direction when the proposed dam project they were studying was suddenly canceled halfway through the semester. Midstream shifts such as this require faculty and students to troubleshoot problems together and develop new plans to keep moving forward or to determine what might be done differently next time.

When students graduate and apply for internships and jobs they very often find that these experiences give them an advantage in both job or graduate school interviews, prestigious research grant and scholarship applications, as well on resumes and cover letters. For example, one student commented:

> These partnership experiences prepared me for graduate school because we completed the entire problem-solving process, coming full circle with a project. We learned how to approach a project, design it, complete all the steps, and create the final product, like a graduate student does with a thesis or dissertation.

5.1.2 Student Perspective

Gaining, and wrestling with information is crucial to development of the kind of deep understanding that students studying complex environmental problems want

and need. However, gaining knowledge strictly through a theoretical lens in a classroom setting can limit the ability of students to apply the knowledge they have acquired, and can minimize the ability to identify appropriate and effective solutions to problems. We strive not to simply give students material in a lecture format that they must memorize and later regurgitate for exams—instead, the classroom content that students learn is also applied, through projects and activities, to real-world issues that students care about, and they are able to see the impacts of their choices and actions as a project develops. Experiential projects with community partners allow students to connect and apply knowledge learned in the classroom to problem-solving outside of a textbook in ways that can have tangible positive impacts. This makes the material they have learned more meaningful and important, and minimizes the possibility that students feel like they engage only in theoretical exercises that do not fit the reality of the problems they see unfolding every day. As one student related:

> Being part of a college-community partnership was an invaluable real-world experience for me during my college career. I believe being stuck in a college "bubble" of students not interacting with their greater community does a disservice to both students and the community. Students have fresh energy and new ideas to contribute to the community and the community has new perspectives and knowledge to give to the students. With one of my college-community partnerships, I worked with my lab team and a local cross-country ski lodge to help make nature signs for cross-country ski trails. This experience was very rewarding for me to feel like I contributed my skills to produce something tangible for the local community. This also helped me to learn skills such as working with my team, working with other organizations, and communicating science to the public, that I use in my non-profit professional work today. I would recommend all students to try to incorporate college-community partnerships into their college experience to make them more well-rounded and ready for the real world.

As teachers, we have seen the impact of such experiences with regard to the level of excitement, engagement, and follow-up that students exhibit during and after such projects. Students often later build upon their participation in a course-based community project with internships linked to that same community partner, and frequently orient their year-long senior research project around an aspect of a project that they experienced in a class during their first three years at Allegheny College.

In addition to gaining "on the ground" professional competencies and experiences (e.g., natural resource survey techniques, installation of solar panels, policy writing), community-based projects and research also promote skills of professional communication, and thinking through complex, real-life problems. One student commented:

> Partnerships with the community outside of the college strengthen communication skills that are essential for adequately relaying the importance of scientific findings and ecosystem conservation. The experience I gained with explaining scientific concepts to community members and nonscientists while at Allegheny College was critical in my job with the U.S. Geological Survey. Part of my job was educating recreators in the importance of desert biodiversity and how off road vehicles degrade the ecosystem. My prior experience in communicating with nonscientists influenced our ability to foster a respectful working relationship between the government and the community members in a desert town.

By learning from community members, who serve as informal educators, students are also able to understand that a vast majority of learning occurs outside of the classroom. Students see that they can acquire important information on their own, hopefully instilling in them a "life-long" learning mentality that extends beyond their four-year college experience.

In cases where the community partner adopts a practice or a specific outcome of the research project, student performance is validated beyond a letter grade that is the classic assessment of student experience. This can provide a sense of pride and purpose for the students. For example, following a semester-long research project studying the use of goats to control invasive multiflora rose in the Erie National Wildlife Refuge, refuge managers adopted the use of goats. Common Roots, a nonprofit organization, has partnered with a variety of ESS courses to research the impacts and install solar panels to better create sustainable housing in Meadville. A further student outcome to these community-based projects is a greater understanding of local culture and community. Ultimately, this investment in the local community can create a more motivated student citizen who can become active in their communities beyond the college experience.

5.1.3 Institutional Perspective

From the perspective of the institution, community collaborations that are done properly work to reduce typical and classic tensions between the college or university and the surrounding community. The stereotype is often that the institution of higher education is not relatable to the community members living in the same town or city as the institution. When authentic relationships are formed through community-engaged learning, and students work together with community partners to establish goals and set an agenda, those individuals become partners with the institution. As those partnerships grow and thrive, the college and the community partner may work together on future endeavors to solve issues that both encounter. Community businesses and non-profits may not have the resources to tackle issues that are imperative for their mission, thus partnering with these groups can allow them to conduct research and pursue projects that would not be possible otherwise.

5.2 Challenges of Partnerships

New challenges are inevitable when introducing the alternative educational approaches and learning environments we have outlined. Several common challenges that we discuss in detail can be organized into three general themes:

(1) Challenges to the execution of projects that meet stakeholder expectations,
(2) Time and workload demands placed on the instructor, and

(3) Adjustment of student expectations to unpredictable and realistic project outcomes.

Real world training experiences are often developed to produce project deliverables and/or services for stakeholders, but the primary objective of these activities is always to provide opportunities for student learning, growth, and exploration. Maintaining stakeholder co-benefits while prioritizing educational outcomes can be a difficult balancing act when facilitating classroom-community collaborations. Classrooms may lack the resources and equipment required to carry out project work in the most efficient manner. In addition, students often need to be trained before they are able to carry out project work or as they are carrying out their work. As a result, student projects often take longer to accomplish their objectives than similar work carried out by experienced professionals.

Work is also constrained by the length of the semester where students have several courses and extracurricular activities competing for their time and attention. Even with the people power provided by an entire class, it can be difficult to produce deliverables and services with real-world value on such a limited timeframe. Meanwhile, stakeholders have their own goals and interests in mind and may not fully understand the available resources, capabilities, and timelines that are required when framing real-world work as an educational experience. For this reason, it is essential that instructors are capable of conducting the work required for each project and that they have an understanding of the limitations of student-directed work in each scenario. Realistic expectations must be communicated to community partners and stakeholders at the onset of a new project, and those expectations must be regularly revisited or revised throughout the duration of the collaboration.

The stakeholder communication example also highlights the difficulty and complexity for instructors to coordinate real-world learning experiences for undergraduates. Although traditional courses are regularly taught at a set time and in a regular location, experiential learning environments often require coordinating with partners in a variety of settings outside of regular course meeting times. Even before the course begins, an instructor must plan and coordinate with stakeholders so that students are quickly able to identify and carry out project contributions. Often, this requires planning field trips, reserving vehicles, coordinating guest lectures, and preparing software and other tools that are essential to project completion. Times available to community partners may not coincide with those times that classes meet or when students are available. Moreover, progress on projects is often messy and unpredictable. It is not uncommon for instructors of experiential courses to constantly revise and update goals, syllabi, and course documentation regularly throughout the duration of a course; such changes can be unsettling for some students. When unexpected barriers make a project impossible to complete, instructors must be willing to develop alternative plans and projects that are still able to meet the same learning outcomes. All of these responsibilities create significant demands on instructor time and workload.

Finally, engaging students in real-world projects can lead to trade-offs in the student learning experience. Learning in the field is less predictable than learning

in the classroom. Even the most experienced educators cannot control the weather or the actions of community partners. Consequently, students must be flexible and adapt in order to thrive in these learning environments. Students that prefer the well-defined syllabi and predictable routines more suitable to a traditional classroom may experience significant discomfort when they lack complete control of a project outcome. Project outcomes can also challenge the expectations of students with grand ambitions. Progress in the real world is not linear, is rarely rapid, and it may take several setbacks or failures before one experiences success. This variability and uncertainty can also lead to feelings of disappointment and disempowerment when students lose sight of the bigger picture in the longer timeframe that exists beyond the end date of a particular course or project. However, this reality, when framed properly and embraced in a healthy manner, can cultivate resilience and creativity.

5.3 Limitations and Constraints

We acknowledge that our experiences are limited to a single institution, that of a small, liberal arts college operating in the global north. Our community, Meadville, PA., USA, in northwestern Pennsylvania is a relatively small town (approximately 13,000), and is about two hours from major metropolitan centers. Its economy is driven by a few medium-sized industries, many small tool and die shops, and a hospital and the college. Poverty rates are relatively high (nearly 20%), and less than 25% of the population has completed a college degree. The ability of colleges and universities to collaborate with community partners is undoubtedly influenced by the history of collaboration efforts and community willingness for engagement. In addition, course sizes, the culture of the college, academic resources, institutional support and faculty expertise, as well as student enthusiasm for these projects, all will affect the ease of conducting projects. Although we have focused primarily on ways to proceed once projects are identified and planning and execution proceed, we believe that our lessons learned are broadly applicable.

6 Conclusions and Recommendations

6.1 Have Realistic Expectations

Community partners need to know from the outset what is actually possible to achieve in an academic setting, that the courses are not hired consulting firms, and that students are not full-time employees. Partners to be aware that the course has academic objectives that must be met, and that those objectives may not be related directly to the project. Faculty members also need to communicate to partners that the initial learning curve may be steep as students are learning about the project,

and students need to develop an appropriate level of understanding before progress can be made. Setting expectations with the community member at the start of the collaboration is important to ensure that they understand constraints created by the length of the semester and student skillsets.

Students also need to have realistic expectations of the course project. Students typically have lofty and expansive goals, and are not aware of the work it takes to accomplish even a limited project. Faculty members will need to guide students toward realistic expectations without dampening enthusiasm. Students need to be aware of what community partners can genuinely provide, particularly with limited time and personnel.

6.2 Plan for Uncertainty and Messiness

Faculty will need to guide students between defined project goals and the messiness of actually getting things done when there are no prescriptions or blueprints on moving forward. Establishing the expectation that the schedule for the course will change or be modified throughout the semester is necessary. Often working through a schedule for the next week with the course reduces student uncertainty about how the course will proceed. Students often think that projects have predefined paths toward success, and are not aware of the uncertainties in advancing toward a goal.

6.3 Be Flexible

Projects may take unexpected turns if initial plans are not viable or if different opportunities appear to be better choices. This may not be novel for faculty members who have experience with sustainability projects, but this is usually new territory for students. Course syllabi rarely undergo radical mid-semester shifts and students have limited experience in working on large-scale projects. Faculty will need to navigate students through these turbulent waters so that they still feel a sense of direction and accomplishment, even though the initial journey has changed. It can also be useful to allow students to explore areas related to the project, even if you know that they are not likely to be fruitful. Students will likely be more inclined to learn that something is not feasible if they discover it themselves.

6.4 Not All Faculty Members Are Right for Project-Based Courses

Working with community partners may not be a good fit for all courses and for all faculty members. For a variety of reasons (a lack of appropriate projects, unavailability of participating partners, class size), some courses might not be suited for community-based projects. Importantly, the faculty member needs to be able to meet the needs of students and community partners, have the ability to incorporate designed chaos into a course, and provide a meaningful educational experience.

6.5 Treat Students as Equals in the Project

Students are almost invariably more interested in projects that have real-world outcomes, thus they rise to meet the challenge of the project. Treating them as less experienced, but nonetheless respected equal partners, fosters solid ownership in the project. Letting students embrace the full gamut of the project—planning, frustrations, failures, and successes, gives them a real world view of the effort, and an invaluable classroom experience.

6.6 Treat Community Partners as Professionals

Community partners have expertise and experiences that are likely to be very different from what is presented within an academic setting or within theoretical frameworks. These kinds of knowledge and occurrences need to be recognized for the value that they provide to the student learning experience, and hence community partners need to be treated as professionals whose collaboration enriches educational approaches. Teaching students the value of various ways of knowing, focusing on how to approach conversations with the community partner as collaborative is important to ensuring that the partner's needs are being served and they want to continue working with the institution.

6.7 Teaching is the Ultimate Goal

As much as we wish for our projects to be successful, the ultimate goal for students is to learn; learning will occur even if the project does not pan out as hoped or planned. Faculty need to temper their own desires so that the success of the project does not overshadow course learning objectives and sound pedagogical approaches. It is important that faculty help students to see that what they have learned in the

process of the project is most important, and that a "failed" project is still successful learning.

6.8 Make It Fun

There's obviously a lot of work to do in preparing these collaborations and projects, and in the learning and work that students need to do. And doing things right requires a lot of serious effort. But, make it fun. Embrace the exploration. Laugh through the tribulations. Celebrate the progress. Dance to the victories. As written by Pete Singer, and sung by the Byrds,

> To everything, …
>
> There is a season …
>
> And a time to every purpose …

References

AACU (2022) High-impact practices. Association of American Colleges and Universities. https://www.aacu.org/trending-topics/high-impact. Last Accessed 26 Jan 2022

AASCU (2002) Stewards of place: stepping forward as a guide for leading public engagement at state colleges and universities. American Association of State Colleges and Universities. www.aascu.org. Last Accessed 26 Jan 2022

Berg CAR, Bergendahl VCB, Lundberg B, Tibell L (2003) Benefiting from an open-ended experiment? a comparison of attitudes to, and outcomes of, an expository versus an open-inquiry version of the same experiment. Internat J Sci Educ 25:351–372. https://doi.org/10.1080/09500690210145738

Bethurem M, Choate B, Bramwell S (2021) Stop piling on: assessing efforts to reduce single-use water bottles at Allegheny College. Sustainability 13:8864. https://doi.org/10.3390/su13168864

Bootsma MC, Vermeulen WJV, van Dijk J, Schot PP (2014) Added value and constraints of transdisciplinary case studies in environmental science curricula. Corp Soc Responsib Environ Mgmt 21:155–166. https://doi.org/10.1002/csr.1314

Brame C (2016) Active learning. Vanderbilt University Center for Teaching. https://cft.vanderbilt.edu/active-learning/. Last Accessed 18 Jan 2022

Chilwant KS (2012) Comparison of two teaching methods, structured interactive lectures and conventional lectures. Biomed Res 23:363–366

Filho Leal W, Zint M (eds) (2016) The contribution of social sciences to sustainable development at universities, 321 pp. Springer International Publishing, Switzerland. ISBN-13: 978-3319268644

Filho Leal W, McCrea AC (2019) Sustainability and the humanities. Springer International Publishing AG, Switzerland, 924 pp. ISBN-13: 978–3319953359

Focht W, Reiter MA, Baressi PA, Smardon RC (Eds) (2018) Education for sustainable human and environmental systems: from theory to practice. Routledge Press, London, 296 pp. ISBN-13: 978–0815399520

Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, Wenderoth MP (2014) Active learning increases student performance in science, engineering, and mathematics. Proc Nat Acad Sci 111:8410–8415

Hopfensperger KN, Larson EI, Washko SE, Mood SK (2021) Elevate your work through incorporation of public engagement. Freshwater Sci 40:221–227. https://doi.org/10.1086/712607
Jones JC, Washko S (2021) More than fun in the sun: the pedagogy of field trips improves student learning in higher education. J Geosci Ed. https://doi.org/10.1080/10899995.2021.1984176
Kolb AY, Kolb DA (2017) Experiential learning theory as a guide for experiential educators in higher education. Experient Learn Teach Higher Educ 1:7–44
Le Vasseur T (2014) Teaching sustainability via the environmental humanities: Studying water, studying ourselves. J Sust Educ 7. December 2014. ISSN: 2151–7452
Orr DW (2004) Earth in mind: on education, environment, and the human prospect. Island Press, Washington, DC
Seatter CS, Ceulemans K (2017) Teaching sustainability in higher education: pedagogical styles that make a difference. Can J Higher Ed 47:47–70
Sörlin S (2012) Environmental humanities: why should biologists interested in the environment take the humanities seriously? Bioscience 62:788–789. https://doi.org/10.1525/bio.2012.62.9.2
Vincent S (2010) Interdisciplinary environmental education on the nation's campuses: elements of field identity and curriculum design. National Council for Science and the Environment. 1101 17th Street, NW, Suite 250, Washington, DC 20036
Wals AEJ (2011) Learning our way to sustainability. J Ed Sustain Develop 5:177–186

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The Role of Outreach Programs at HEIs: Promoting Sustainability Training Among Future Leaders Through Design Thinking

Mariana Alvarenga, Felipe Fernandez, Ricardo Lemos Thomé, Ana Regina de Aguiar Dutra, Ivone Junges, Nei Antonio Nunes, and José Baltazar Salgueirinho Osório de Andrade Guerra

1 Introduction

The term sustainable development proposes an integrated and global response to poverty and environmental degradation; hence, the construction of development paths

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that aim to guarantee the well-being of all humanity without negatively impacting the limits of the planet (United Nations 1987; Wiesmann and Dayer 2019).

For Berchin, de Aguiar Dutra and Guerra (2021, p. 1) "higher education institutions lead the path towards sustainable development" because through their three missions—teaching, research and outreach—and the creation and dissemination of knowledge, these institutions "have a fundamental role in transforming societies". In addition to the growing understanding that higher education institutions (HEIs) integrate sustainable development into their institutional missions (Blanco-Portela et al. 2017; Ali et al. 2020).

Among the different strategies to promote education for sustainable development in HEIs, outreach programs are highlighted, as they encourage students to share and practice the knowledge acquired in class, besides integrating the academic community with other stakeholders in the search for solutions to local problems. (Bacon et al. 2011; Berchin et al. 2018).

Outreach programs encourage students to seek creative and innovative solutions (Berchin et al. 2018) and the methodological approach of design thinking can help in this process, as it has been an increasingly used tool to face complex socio-ecological problems (Buhl et al. 2019).

Design thinking, according to Liedtka (2015), is an iterative and human-centered problem-solving tool, involving diverse stakeholders in a flexible labor framework using practical tools and techniques in addition to seeking a deep understanding of people's needs, desires and experiences (Giacomin 2014).

For Novy et al. (2021, p. 3) the design thinking process has been one of the bases for the development of a pedagogical and curricular model for the development of a "new leader" at Stanford University. For the authors, the new leaders would be agents of change capable of facing complex and important challenges in the field of sustainable development. They would be future sustainability leaders.

The objective of this article is to discuss how outreach programs linked to HEIs can promote the teaching of specific skills, found in the literature, for the development of future sustainability leaders, using the tools proposed by design thinking.

This work presents a methodological and pedagogical tool, design thinking, as an alternative to teaching practical and emotional skills, characteristics of future sustainability leaders. Some characteristics of the method are the human-centered design, the search for creative, effective and lasting solutions to the actual problems faced, in the case of this work, by the community surrounding the HEI. The result is the students' direct contact with the community, a situation in which they are encouraged to find solutions to the problems presented, requiring the development of different skills in such a process.

Finally, the methodological approach is based on a literature review and document analysis, including videos, interviews with the subjects involved as well as reports of an outreach project linked to a Brazilian HEI.

2 Outreach Activities and Education for Sustainable Development

There are great expectations that HEIs will be protagonists in promoting sustainable development at the local level, as they are central players in the regions where they operate in addition to their regional economic importance (Groulxet al. 2020; Leal Filho et al. 2019). Berchin, by Aguiar Dutra and Guerra (2021) presents a detailed review of the literature on how HEIs promote sustainable development and, in the discussion of their findings, they highlight four main characteristics of outreach programs in HEIs:

1. Outreach activities are academic initiatives aimed at local communities.
2. Through outreach operations, HEIs engage different stakeholders, increasing "their potential to promote effective initiatives within the community, which results in lasting changes" (p. 5).
3. Outreach programs can be developed in two ways: with practical interventions in the community or opening the HEI structure to the service of the community.
4. HEIs can share knowledge with public policymakers to assist in decision-making.

Likewise, academic works on the topic were separated into two topics: local development and cooperation with stakeholders, to help public policymakers in decision-making processes.

For Russo et al. (2007), chances that the impacts of HEIs be positive in the operation region depend on the balance of the different interests of three players: the host community and its institutions, the local business community and the student and academic population in general. The authors also highlight the importance of students receiving flexible training, local needs-oriented, highlighting the importance of HEI partnerships with governments, companies and the community.

On the other hand, partnerships with communities help to achieve one of the institutional objectives of HEIs, aligning the institutions' functions with the community's needs (Groulx et al. 2020), in the search for the co-production of local knowledge that promotes sustainability, democracy, improving community quality of life (Loh 2016; Berchin et al. 2018).

For students, outreach programs provide the opportunity to practice the knowledge acquired in the classroom, stimulate creative thinking and generate experiences and knowledge to be used by students throughout their lives (Berchin et al. 2018). Another important point for students is the opportunity for experiential learning since students live in a different world and the experience requires dialogue and diverse adaptations (Groulx et al. 2020).

3 Design Thinking

Design thinking is a methodology that combines a range of innovation activities with human-centered design (Brown 2008). The purpose of the method is to obtain a deeper understanding of people's needs, desires and experiences, with emphasis on communication techniques, interaction, creation of empathy and stimuli for the people involved (Giacomin 2014).

Hassi and Laakso (2011) state that there are many representations of design thinking and there is no defined list of characteristics, but three characteristics are common to authors who discourse on the topic: human-centered, collaborative and holistic. The design thinking proposal is to promote innovation through a complete diagnosis of what people, or users, want, need and like, or not, of a particular product or service (Brown 2008; Glen et al. 2014) and develop better solutions to social and environmental problems (Brown and Wyatt 2010; Syed et al. 2021).

As for the application methodology, Brown and Wyatt (2010) propose a classic model of analysis and implementation of the design thinking process divided into what the authors call the three spaces: inspiration, ideation and implementation. Figure 1 presents the spaces and their elements.

Carlgren et al. (2016) divide the application of the method into five central themes: user focus, problem framing, visualization, experimentation and diversity. Figure 2 presents the central themes and their elements.

The authors argue that the design thinking process is the result of an interaction of these spaces and is not a sequence of coordinated steps, as it is not always possible

Space	Elements
Inspiration	It arises from the problem or the opportunity to seek a solution, the starting point in this space would be the briefing. The objective is to seek information about that problem, the basic data to start structuring the project. After completing the briefing, it is necessary to know people's needs and creatively go beyond what people say, through experience, observation and not just asking people what they want. During inspiration, empathy also develops.
Ideation	After the observations and considerations of the field research, a synthesis of the collected ideas is made that can lead to new solutions or opportunities. Comparing and testing some ideas helps start the brainstorming process. At this stage, divergent thinking is the way to observe the problem situation from other angles and a multidisciplinary team with different experiences is important in the construction of this new look and in the creation of new ideas and possibilities. In the end, the ideas are grouped and classified by the team.
Implementation	At this stage, the best ideas are transformed into a concrete action plan. Here the prototyping process turns ideas into real products or services that are tested, iterated and refined. Prototyping helps in the process of discovering implementation challenges, facing unforeseen and unintended consequences. The target audience is an active part in the prototyping and testing process, the product or services must meet the expectation of that individual or group; this would be the feedback phase. After prototyping, the project must be communicated and disseminated to all interested parties in the solution sought.

Fig. 1 Design thinking spaces and elements. *Source* Adapted from Brown (2008) and Brown and Wyatt (2010)

Central theme	Elements
Focus on the user	Empathize with users to understand latent needs through the use of specific qualitative approaches. Interaction with users through interviews, ideation and idea testing.
Setting the problem	Describe and reformulate the initial problem, to expand the solution space, through different synthesis activities that include pattern discovery and ideation.
Visualization	Transform ideas into visual and tangible perceptions, to externalize knowledge, communicate and create new ideas, through, for example, visual structuring techniques, models and dramatization.
Experimentation	Prototyping (simple and rough representations). Testing prototypes with users. Interactive work, at this stage failure is expected.
Diversity	Diverse work teams, with a climate where every opinion counts and decisions are made together. Collaboration with external entities and seeking diverse perspectives from a variety of fields. democratic spirit

Fig. 2 Central themes and their elements. *Source* Adapted from Carlgren et al. (2016)

to proceed linearly within the spaces. The two methodologies presented overlap and complement each other. Figure 3 shows this overlap.

The methodological proposal of design thinking is viable to solve complex issues. Particularly when there is ambiguity about the problem and its solutions, the method emerges as an alternative to rational or economic approaches, which often do not provide the best solution for more complex problems (Brown 2008; Von Thienen et al. 2018).

Previous studies on the topic can be separated into three analysis dimensions. The first dimension, aiming at education for sustainable development, is the inclusion of the design thinking tools, promptly, in courses or training that seek to develop new

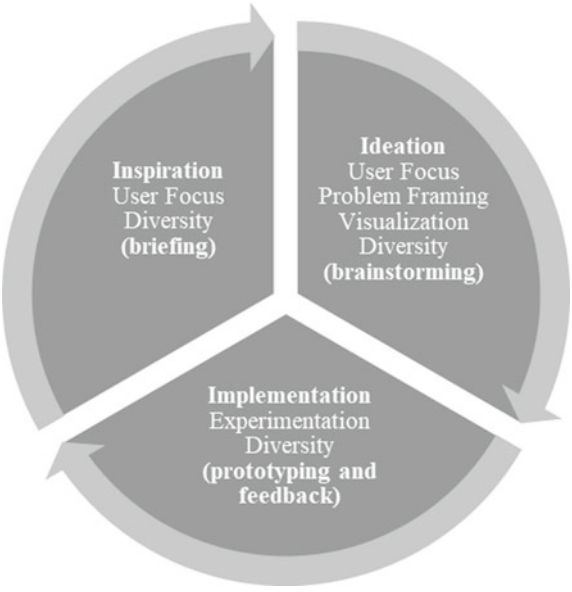

Fig. 3 The design thinking process and its spaces. *Source* Prepared by the authors based on Brown (2008), Brown and Wyatt (2010) and Carlgren et al. (2016).

capacities and skills in students, to develop a greater reflection on the economic, social dimensions. and environmental aspects of their projects, or to seek innovative solutions to difficult-to-solve problems (Bodisco and Palmer 2020; Díaz-Pareja et al. 2021; Khanduja et al. 2017; Lande and Leifer 2010; Nyemba et al. 2020; Oxenswärdh and Persson-Fischier 2020; Pata et al. 2021; Phi and Clausen 2021; Stiver 2010).

The second dimension is teaching design thinking in the design courses themselves, recognizing a failure of these undergraduate courses to work with the theme of sustainable development using the tools of design thinking. The studies also address the teaching of these disciplines in other frameworks within HEIs, aiming at sustainable development (Cassim 2013; Hsieh 2020).

A third dimension would be the use of design thinking as a learning process, a pedagogical approach focused on sustainability. Studies in this field have used design thinking tools in the context of curricular change in the teaching of subjects in the search for ways of teaching/learning that include the development of new skills for problem-solving (Acharya et al. 2021; Nobre 2015; Nobre et al. 2017; Vintere 2019).

It is possible to conclude that part of the academic studies involving design thinking, sustainable development and HEI builds a focus on the use of design thinking tools to allow students to be more reflective, creative, motivated and work with a diverse team and solve difficult problems.

4 Sustainability Leadership in HEIs

According to Ayers et al. (2020), HEIs play a significant role in developing graduates' skills and competencies to face the challenges of sustainable development. Over the past 15 years, the field of sustainability leadership has grown rapidly, with HEIs developing specific programs, especially graduate programs, to meet the needs and demands of society and the students themselves (Burns and Schneider 2019; Novy et al. 2021). This type of training is also significant for the world of work for these students, when they will face the challenges of sustainability, both in the public and private sectors (Burns and Schneider 2019; MacDonald and Shriberg 2016).

The field of study of sustainability leadership in HEIs is divided into two approaches. The first considers HEIs as leading institutions in sustainability by promoting sustainable development policies, involving a broader institutional analysis of their role, in addition to teaching, research and outreach activities considering their operation, environmental impacts and the like (Leal Filho et al. 2020). The second would be the aspect of teaching skills, abilities and competences of future sustainability leaders, since studies in this field are more linked to curricular structures. Our study focuses on this second aspect.

MacDonald and Shriberg (2016) highlight that sustainability leadership programs in HEIs arise from the need to train leaders with different skills from those taught in traditional leadership training. Furthermore, for the authors, the teaching of traditional leaders (for example, transactional and transformative) is not oriented towards

facing complex realities involving the economic, social and environmental dimensions. The authors argue the need for specific courses for the development of this type of leadership that takes into account the peculiarities of sustainability leadership.

Other studies analyzed leadership training programs for sustainability, highlighting the pedagogical approaches and characteristics of such programs offered by HEIs. Shriberg and MacDonald (2013) found that while there was a great variation in the programs, some characteristics were common: focus on building networks, system thinking, project-based and experiential learning, effective communication, self-assessment, and self-analysis. The authors also emphasized the two most effective components of programs: peer-to-peer learning and diversity of participant perspectives.

The Canadian study by Savage et al. (2015), when evaluating the students' perspective on the leadership sustainability training program, highlighted the importance of self-knowledge and self-awareness in the development of sustainability leaders. Students reported that the time and space devoted to personal reflection and exploration was a significant part of learning.

The research by Burns and Schneider (2019, p. 1), also conducted with former students of a leadership sustainability training program, presents suggestions on how future editions could improve student learning, through "paradigm and perspective shifts; the culture of support and care; holistic personal growth and development; experiential community-based learning opportunities; and leadership tools and skills that students can practice and use." The study also underscores the importance of training for students' training and work positions.

Novy et al. (2021), present the historical construction of the curricular structure of the Change Leadership for Sustainability Program at Stanford University, and similar to the findings of Savage et al. (2015) highlight the importance of developing essential elements of the leader's personality, such as the identity, perspective, capability and agency of these new leaders.

For these authors, identity represents the mental model of oneself in terms of values and purposes, including the understanding of one's own identity and the identity of others. In perspective, it would be the holistic way of seeing the world, a way of finding opportunities in the face of problems and driving transformative actions. The capability would be knowledge, skills, working with stakeholders, building trust, and others. Agency would be the ability to act and encourage the collaboration of others towards a single objective.

Figure 4 summarizes the skills that sustainability leadership training courses should work with students, divided into two categories, developing practical and personal skills.

The authors suggest that teaching sustainability leadership requires a different approach compared to other types of leadership and that training should prepare the student to handle complex situations of great magnitude.

Category	Elements	Authors
Skills development	Focus on network building, systems thinking, and project-based, experiential learning, communication, systems thinking, peer-to-peer learning and diversity of participant perspectives	Shriberg& MacDonald (2013)
	Systems thinking, dealing with complexity, facilitation, public speaking, and coalition building.	MacDonald &Shriberg (2016)
	Systems-thinking and strategic-thinking, interpersonal, and intrapersonal competencies, integrated problem solving, futures-thinking, and competencies implementation.	Novy, Banerjee e Matson (2021)
Personal skills development	Self-assessment, and self-analysis	Shriberg& MacDonald (2013)
	Self-reflection	MacDonald &Shriberg (2016)
	Self-care as contributing to self-awareness and growth in feeling empowered	Savage et al. (2015)
	Identity, perspective, competency, and agency	Novy, Banerjee e Matson (2021)

Fig. 4 Practical and personal skills. *Source* Prepared by the authors, 2021

5 Theoretical Model

After presenting the literature on the sustainability outreach, design thinking and leadership constructs, the following theoretical model was elaborated for the promotion of outreach programs in HEIs involving the worked constructs, Fig. 5.

HEIs, by promoting education for sustainable development, seek to enable students to take a more proactive attitude towards the sustainability challenges, providing knowledge, values and developing new skills, including emotional ones.

This is the type of learning that design thinking provides, putting the student in direct contact with a situation/community, facing a real problem and that through its methodological proposal seeks an innovative solution centered on the human being, built and developed with the participation of those individuals experiencing the problem. During the methodological stages of design thinking, some sustainability leadership skills can be improved such as systemic thinking, communication,

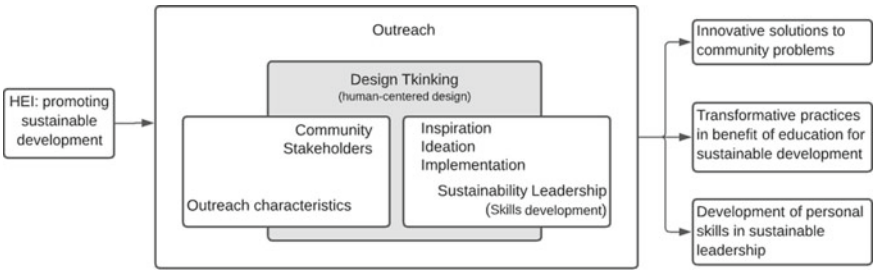

Fig. 5 Theoretical model. *Source* Prepared by the authors, 2021

strategic thinking, intrapersonal skills, working together with a diversity of people with different thoughts and goals, among many others.

The results of this process would be countless, from achieving the purposes of outreach programs, such as bringing the HEI closer to the local community, different learning for students and staff, in addition to providing an innovative solution to a community problem (Brown 2008, Brown and Wyatt 2010, Carlgren et al. 2016), putting students in front of transformative learning practices (problem-solving, research and experiences) (Savage et al. 2015) and developing practical, personal and emotional skills characteristic of sustainability leadership (MacDonald and Shriberg 2016; Shriberg and MacDonald 2013; Novy et al. 2021).

In the research by Burns and Schneider (2019), former students of a sustainability leadership training course reported that personal skills such as self-reflection improved, in addition to the feeling of love and belonging that stemmed from the experience. Here in this model, it is understood that the development of personal skills (self-assessment, self-reflection, growth in feeling-empowered identity) would be the result of the process, after students experience a deep interaction with the community, with a workgroup, with teachers and mentors, following the design thinking methodology.

6 Method

The first phase of the study was a review of the literature on the topics covered in Sects. 3 and 4 from 11/01/2021 to 11/25/2021, as shown in Fig. 6. The review of Sect. 2 was based on Berchin's research quoted by Aguiar Dutra and Guerra (2021) resulting in 17 articles.

The selection of the project, object of assessment occurred as follows: first, extensive research was carried out in the annual results reports published on the website of the main Brazilian private educational groups. After the preliminary selection of these

Section	Search terms	Basis	Retrieved articles	Selected articles	Exclusion criteria
3	"Design thinking" AND education AND (sustainability OR "sustainable development") AND ("higher education" OR university)	Scopus e Science Direct (Review articles)	51 and 67	17	Research that did not involve HEIs and/or did not associate design thinking to sustainable development.
4	"Sustainability Leadership" AND ("higher education" OR university)	Scopus e Science Direct (Review articles)	33 and 54	9	Research that did not involve HEIs and/or research that did not involve teaching of students.

Fig. 6 Bases and search terms. *Source* Prepared by the authors, 2021

Interviewee	Position/Institution (2019)	Male/ Female	Role in the Project
A1	University Unit Director	M	Coordinator
A2	Personalization Director	M	coordinator
A3	Outreach Activities Director	F	Coordinator
A4	Coordinator – Politize!	M	Management and planning
A5	Mentor – Civicus	F	Mentoring
A6	Coordinator - Civicus	M	Articulation between partners
A7	Student	F	Go team
A8	Student	F	ELO team
A9	Student	F	UFPM team

Fig. 7 Interviewees' profile. *Source* Prepared by the authors, 2021

reports, the results of the outreach projects were sought. A single project was found, published in a report, which used design thinking tools as a methodological proposal. The *Escola de Inovação Cidadã* (EIC, School of Citizen Innovation) outreach project was chosen after a detailed analysis of the Anima Education Sustainability Report (AESR 2020) by Ânima Group.

After selecting the project coordinators, they were contacted and a formal request was made for the research authorization and permission to access the project data directly with the HEI. All project files were organized in a virtual folder and all content was made available to the authors for review.

Secondary data were collected from access to all documents related to the project such as handouts, schedules, minutes of meetings, student presentations, photos, videos, action plans, interview files, institutional websites and social media. Nine files of recorded interviews were selected, covering three representatives of the HEI, three of the partner organizations and three students. The interviews were carried out at the end of the project, in 2019, archived in image and sound format and recorded the perceptions of the players involved concerning the project. The interviews were all transcribed and analyzed using the NVivo software. Figure 7 presents the profile of respondents.

Data analysis was performed through content analysis proposed by Bardin (1993) and interpretation from the literature.

7 School of Citizen Innovation

The *Escola de Inovação Cidadã* (EIC, School of Citizen Innovation) project was launched in 2019, through a partnership between Politize!, a civil society organization, Civicus, a consulting company, and *Universidade São Judas* (USJ, São Judas University) located in the State of São Paulo, and members of the Ânima Group (São Judas 2019).

The University's motivation to develop the project arose from a demand from the students themselves who entered in 2019, who, when asked what their expectations regarding the University were, the recurring answer was that the institution could

help them in social engagement (A1, interview, December 5, 2019). Based on this identification of the students' desire and willingness to develop and exercise social engagement, USJ implemented, together with partners, the EIC project.

The proposal was offered as an outreach course and any student linked to any USJ unit could enroll. The purpose of the course was to promote direct contact between students and the local community to map the needs of that public, while students would apply essential concepts and practices for the development of a professional capable of implementing future changes in the local, regional and global framework (São Judas 2019).

The difference was the use of innovation looking for solutions to collective problems using the Feeling's[1] methodology. The methodology was developed based on design thinking, playful processes and extensive visual communication, its main characteristic being that of placing the human being at the core of the process (Feeling 2021; São Judas 2019). The method gains relevance by promoting three design thinking tools that are basic in the search for solutions to social, economic and environmental problems: innovation, collaboration and empathy (São Judas 2019).

The students who participated in the project were monitored for five fortnights, and during this period they received materials and guidance so that they could seek solutions to the problems presented by the selected communities. The schedule was divided into modules aimed at: (1) identifying a collective problem, (2) exercising empathy with a community, (3) co-creating ideas playfully and collaboratively, (4) creating prototypes, (5) testing proposals and (6) implementing them in practice. The students were also accompanied by mentors; they participated in lectures, received printed reading material and videos with examples of other actions that used the Feeling methodology (São Judas 2019).

The eight teams with the best results were invited to participate in the Feeling camp, a 24 hours immersion to improve student proposals with a focus on intensive prototyping of the solutions developed. The best projects participated in the academic exhibition Expo São Judas.

7.1 Project Phases

Participating students had access to the Google Classroom, as well as five handouts and ten printed field guides. Interaction with mentors was performed through the Google platform, emails, WhatsApp and telephone. The project phases were implemented and monitored by USJ in partnership with Civicus. USJ provided the physical and financial structure, besides the teachers, coordinators and directors involved in that project.

[1] The Feeling method was built collaboratively by 22 designers from the city of Nariño (Colombia) inspired by Latin American countries. The feeling is an open-source social technology that has been consolidated in Latin America through several projects implemented in partnership with civil society, companies and governments (Feeling 2021).

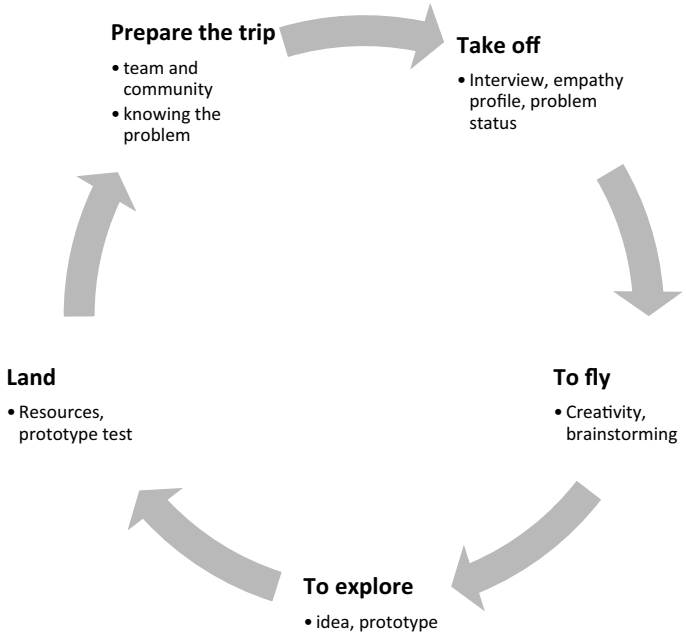

Fig. 8 A feeling methodology based on design thinking. *Source* Prepared by the authors, 2021

The Feeling methodology is structured in five steps, as shown in Fig. 8, and nine field guides. The steps were correlated and fed cyclically. The field guides were activities developed by the teams, within each stage, and when completed, they were evaluated by Civicus mentors and USJ professors, at which time the necessary improvements and changes were discussed.

Figure 9 summarizes the work stages and the skills developed.

7.2 Results and Discussion

The subjects worked by the finalist teams were:

- Two projects elected the USJ itself as an analysis community, one of which was the proposal for an outreach project linked to sustainability.
- Two addressed the health topic.
- One worked on the inclusion of women in the labor market and
- One proposed a solution to an environmental problem.

All projects were prototyped, tested with the community and proved to be feasible.

From the perspective of USJ representatives, students were able to achieve the objective of the EIC by contributing to some communities around the university in

Stage	Summary of activities	Skills developed
1. Prepare the trip	Definition of the work team, with students from different undergraduate courses. Construction of a briefing with the needs of the community chosen by the group.	Communication, empathy, collaboration, experimentation, creativity, self-knowledge, teamwork, joint-creation, systemic vision, systems thinking, engagement, multi-stakeholder involvement, strategic thinking.
2. Takeoff	Application of interviews in the community, with the objective of mapping that group's desires and dreams. Immersion in the community and we sought to map perspectives and limitations. Empathy exercises are based on contact with that reality. Definition of the four main problems faced by the community.	
3. To fly	Exercises for creativity and brainstorming. The initial design of potential interventions in that community.	
4. To explore	From the selected ideas, prototypes were developed to be tested with the target audience, in a joint process of co-creation and dialogue with the community. Mapping of strengths and weaknesses through prototype testing. If necessary, the process goes back to previous steps, until the most appropriate solution for the community is reached.	
5. Land	Finalization of the prototype after testing with the community, search for possible resources to sponsor the solution.	

Fig. 9 Summary of activities. *Source* Prepared by the authors, 2021

the search for viable solutions to their needs, besides consolidating the innovative profile of the USJ (A1, interview, December 5, 2019). For A2 (interview, December 5, 2019) the project, besides providing an experience for the participants' professional curriculum, was a transformative experience for teachers and students alike and helped with the training of future leaders concerned with building a fairer society.

A3 (interview, December 5, 2019) highlighted the multidisciplinary perspective of the project—the teams were made up of students from different courses, different campuses—and the transformative appeal of the EIC in connecting students with the community. For the interviewee, the participants had a unique experience of transforming themselves on account of the interaction with the community, and as a result, becoming transforming agents trained to cooperate actively with society.

On the other hand, from the perspective of the EIC partners, Politize! and Civicus, the highlight of the project lies in the experience of using innovation tools to solve social issues, a skill that helps students both in their professional careers and in the exercise of their citizenship (A4, interview, December 5, 2019). They also highlighted the importance of prototyping ideas, testing with users, user validation, in the search for a creative and effective solution to the problems of the selected communities (A5, interview, December 5, 2019).

For A6 (interview, December 5, 2019) the importance of the EIC is its focus on sustainability and educational innovation, through different ways of generating learning, generating ideas and connecting the University's knowledge to problem-solving in the communities surrounding the university institution itself.

The participating students highlighted the structure provided by the USJ, both in terms of equipment, as well as teachers and administrative technicians who gave all the necessary support to the students (A7, interview, December 5, 2019). They also reported a feeling of empowerment from the materialization of their ideas and how EIC helped to demystify the difficulty of looking for social solutions, which are often complex because, with the delivery of works divided into stages, they realized that with planning it is possible to seek alternatives (A6, A7, A8 interview, December 5, 2019).

For students, other positive aspects of EIC were to exercise empathy with the community, create ideas and work in cooperation with students from different undergraduate courses (A7, A8 interview, December 5, 2019).

Given the positive evaluations of the EIC, in 2020 the project was improved and was institutionalized under the name of *Academia de Inovação Cidadã* (AIC). The partnership with Civicus is maintained and in this new format, students in the first semester of undergraduate courses are already immersed in the methodology and the objective is to reap the results of the experience over the years of graduation.

8 Final Considerations

The findings of the survey showed that the design thinking methodology favors the search for innovative solutions to complex problems involving different stakeholders in a creative and co-creation process (Brown 2008; Brown and Wyatt 2010, Carlgren et al. 2016), which is one of the challenges of sustainable development (Berchin, by Aguiar Dutra and Guerra 2021).

EIC students worked with diverse and current themes, such as environmental problems, health, the inclusion of people with disabilities, the inclusion of women in the labor market and others, in a bottom-up process, once the needs were presented by the community in the first stage of the methodology or briefing.

Implemented in an outreach program, design thinking contributes to the experimental and transformative learning of students, due to the very characteristics of the method's practical approach (Savage et al. 2015), besides developing different skills that are associated with the development of future sustainability leaders (MacDonald and Shriberg 2016; Shriberg and MacDonald 2013; Novy et al. 2021).

The methodology also favors approximation with the community and can help with regional development and the quality of life of the people involved in the projects (Loh, 2016; Berchin et al. 2018). The research concludes that the design thinking methodology can be a great ally in the formation of specific competences for future sustainability leaders by promoting a real experience for students, including challenges in relationships—between students and between the community, budgetary challenges, operational challenges, human resources, among many others.

Leadership in sustainability has received attention from academia due to its current and future importance for society. HEIs should seek possible alternatives that, in addition to promoting the necessary learning, also generate student engagement, and

the outreach programs plus the design thinking methodology have proven to be a viable alternative in this case.

The main limitations of the study were: the analysis of an experience only in a private educational institution and the analysis of a single project. For future research, studies in Brazilian public HEIs involving other outreach projects in different regions of the country are suggested, as well as a survey of the perception of communities about outreach projects and how these projects are favoring the sustainable development of these communities.

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References

Acharya S, Bhatt AN, Chakrabarti A, Delhi VSK, Diehl JC, Mota N, Jurelionis A, Subra R (2021) Design thinking as a strategy to inculcate problem-based learning (pbl) in undergraduate education across South Asian Universities. Smart Innov, Syst Technol 222:547–559

AESR (2020) Anima education sustainability report (2019/2020). https://animaeducacao.com.br/apresentamos-nosso-relatorio-de-sustentabilidade-com-mais-de-40-iniciativas-desenvolvidas/. Accessed 2 June 2021

Ali M, Mustapha TI, Osman SB, Hassan U (2020) University social responsibility (USR): an evolution of the concept and its thematic analysis. J Clean Prod 286:124931

Ayers J, Bryant J, Missimer M (2020) The use of reflective pedagogies in sustainability leadership education—a case study. Sustainability 12(17):6726

Bacon CM, Mulvaney D, Ball TB, DuPuis E, Gliessman SR, Lipschutz RD, Shakouri A (2011) The creation of an integrated sustainability curriculum and student praxis projects. Int J Sustain High Educ 12:193–208

Bardin L (1993) Content scanning, 7th edn. Presses Universitaires de France, Corrected, Paris

Berchin II, de Aguiar Dutra AR, Guerra JBSOA (2021) How do higher education institutions promote sustainable development? a literature review. Sustain Dev 29(6):1204–1222

Berchin II, Sima M, de Lima MA, Biesel S, dos Santos LP, Ferreira RV, Guerra JJBSOD, Ceci F (2018) The importance of international conferences on sustainable development as higher education institutions' strategies to promote sustainability: a case study in Brazil. J Clean Prod 171:756–772

Blanco-Portela N, Benayas J, Pertierra LR, Lozano R (2017) Towards the integration of sustainability in higher education Institutions: a review of drivers of and barriers to organisational change and their comparison against those found of companies. J Clean Prod 166:563–578

Bodisco TA, Palmer S (2020) Presentation and evaluation of a new graduate unit of study in engineering product development. Sustainability (Switzerland) 12(14):1–14, art no 5749

Brown T, Wyatt J (2010) Design thinking for social innovation. Stanford Soc Innov Rev Winter 31–5

Brown T (2008) Design thinking. Harv Bus Rev 84–92

Buhl A, Schmidt-Keilich M, Muster V, Blazejewski S, Schrader U, Harrach C, Schäfer M, Süßbauer E (2019) Design thinking for sustainability: why and how design thinking can foster sustainability-oriented innovation development. J Clean Prod 231:1248–1257

Burns H, Schneider M (2019) Insights from Alumni: a grounded theory study of a graduate program in sustainability leadership. Sustainability 11(19):5223

Carlgren L, Elmquist M, Rauth I (2016) The challenges of using design thinking in industry—experiences from five large firms. Creativity Innov Manage 25:344–362

Cassim F (2013) Hands on, hearts on, minds on: design thinking within an education context. Int J Art Des Educ 32(2):190–202

Díaz-Pareja EM, Llorent-Vaquero M, Cámara-Estrella ÁM, Ortega-Tudela JM (2021) Sustainable education: using social networks in education for change. Sustainability 13:10368

Feeling (2021) Explore the methodology. Feeling. https://feeling.com.co/

Giacomin J (2014) What is human centred design? Des J 17(4):606–623

Glen R, Suciu C, Baughn C (2014) The need for design thinking in business schools. Acad Manage Learn Educ 13:653–667

Groulx M, Nowak N, Levy K, Booth A (2020) Community needs and interests in university–community partnerships for sustainable development. Int J Sustain High Educ 22(1):274–290

Hassi L, Laakso M (2011) Making sense of design thinking. In: Karjalainen TM, Salimaki M (eds) International design business management papers 1. IDBM Program, Aalto University, Helsinki, Finland, pp 50–63

Hsieh HCL (2020) Integration of environmental sustainability issues into the "game design theory and practice" design course. Sustainability (Switzerland) 12(16), art no 6334

Khanduja GS, Bihola K, Dave J (2017) Infusing design thinking mindset in engineering education—a pioneering step towards excellence and sustainability. Smart Innov Syst Technol 66:1017–1026

Lande M, Leifer L (2010) Difficulties student engineers face designing the future. Int J Eng Educ 26(2):271–277

Leal Filho W, Eustachio JHPP, Caldana ACF, Will M, Lange Salvia A, Rampasso IS, Anholon R, Platje J, Kovaleva M (2020) Sustainability leadership in higher education institutions: an overview of challenges. Sustainability 12:3761

Leal Filho W, Vargas V, Salvia A, Brandli L, Pallant E, Klavins M, Ray S, Moggi S, Maruna M, Conticelli E, Ayanore M, Radovic V, Gupta B, Sen S, Paco A, Michalopoulou E, Saikim F, Koh H, Frankenberger F, Kanchanamukda W, Antonio da Cunha D, Akib N, Clarke A, Wall T, Vaccari M (2019) The role of higher education institutions in sustainability initiatives at the local level. J Clean Prod 233:1004–1015

Liedtka J (2015) Design thinking. J Prod Innov Manag 32:925–938

Loh P (2016) Community–university collaborations for environmental justice: toward a transformative co-learning model. New solutions. J Environ Occup Health Policy 26(3):412–428

MacDonald L, Shriberg M (2016) Sustainability leadership programs in higher education: alumni outcomes and impacts. J Environ Stud Sci 6:360–370

Nobre FS (2015) Sustainability-centric learning: a case study in management. Int J Sustain Educ 11(3):1–10

Nobre FS, Arevalo JA, Mitchell SF (2017) Sustainability learning processes: concepts, benchmarking, development, and integration handbook of sustainability in management education. In: Search of a multidisciplinary, innovative and integrated approach, pp 242–261

Novy JW, Banerjee B, Matson P (2021) A core curriculum for sustainability leadership. Sustainability 13(19):10557

Nyemba WR, Chikuku T, Chiroodza JR, Dube B, Carter KF, Ityokumbul MT, Magombo L (2020) Industrial design thinking and innovations propelled by the Royal Academy of Engineering in Sub-Saharan Africa for capacity building. Procedia CIRP 91:770–775

Oxenswärdh A, Persson-Fischier U (2020) Mapping master students' processes of problem solving and learning in groups in sustainability education. Sustainability (Switzerland) 12(13), art no 5299

Pata K, Bauters M, Vesikivi P, Holvikivi J (2021) Agile and lean methods with design thinking. Lect Notes Educ Technol 13–30

Phi GT, Clausen HB (2021) Fostering innovation competencies in tourism higher education via design-based and value-based learning. J Hosp Leis Sport Tour Educ 29:100298

Russo AP, Van Den Berg L, Lavanga M (2007) Toward a sustainable relationship between city and university: a stakeholdership approach. J Plan Educ Res 27(2):199–216

São Judas (2019) Acontecena São Judas. São Judas. https://www.usjt.br/politize/

Savage E, Tapics T, Evarts J, Wilson J, Tirone S (2015) Experiential learning for sustainability leadership in higher education. Int J Sustain High Educ 16(5):692–705

Shriberg M, MacDonald L (2013) Sustainability leadership programs: emerging goals, methods and best practices. J Sustain Educ 5:1–21

Stiver W (2010) Sustainable design in a second-year engineering design course. Int J Eng Educ 26(2):378–383

Syed F, Shah SH, Waseem Z, Tariq A (2021) Design thinking for social innovation: a systematic literature review & future research directions. In: Proceedings of 1st international conference on business, management & social sciences

United Nations (1987) Report of the world commission on environment and development. United Nations, New York. Recovered on May 12, 2021, https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

Vintere A (2019) Pedagogical approaches to problem solving in higher education. Res Rural Dev 2:255–259

Von Thienen JPA, Clancey WJ, Corazza GE, Meinel C (2018) Theoretical foundations of design thinking. Part I: John E. Arnold's creative thinking theories. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: understanding innovation. Springer, Heidelberg, Germany, pp 13–40

Wiesmann U, Dayer O (2019) Research for sustainable development goals: introduction. GAIA Ecol Perspect Sci Soc 28:88–89

Healthful, Sustainable Design in Community-Engaged Architecture Education

Clarissa F. Albrecht and Lisa D. Iulo

1 Introduction

Chronic diseases are the number one cause of death and disability, while being increasingly prevalent across all ages and demographics. However, they are often preventable, in part through lifestyle management. Community and building design have a role to play in allowing for lifestyle choices that can improve human health, including physical environments that encourage regular exercise or improved nutrition.

According to the World Health Organization (WHO 2021), "climate change affects the social and environmental determinants of health—clean air, safe drinking water, sufficient food and secure shelter". Therefore, "reducing emissions of greenhouse gases through better transport, food and energy-use choices can result in improved health, particularly through reduced air pollution".

Moreover, effects of the increasing frequency of severe weather events due to climate change are augmented in river communities by the changes in land use patterns. Increases in impervious area disrupt the natural water balance and reduces infiltration. Increases in runoff leads to higher flood peaks and volumes, even for short duration low intensity rainfall (Swan 2010; Villarini et al. 2010; Suriya and Mudgal 2012). The combination of the need for new development in these communities and the expanding reach of floodplains put valuable resources (hospitals, schools, agriculture) as well as vulnerable populations (low-income, the elderly) in harms

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ways. Climate change disaster has been dubbed the "ultimate gentrification" with low-income residents disproportionally affected (Zachs 2016; Mock 2015).

Principles for simultaneously addressing issues of sustainability and resilience are closely related and linked to the United Nations Sustainable Development Goals (SDGs) at the heart of the 2030 Agenda for Sustainable Development. The SDGs "recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth—all while tackling climate change and working to preserve our oceans and forests" (United Nations 2022).

Some early twentieth century architects in North America worked explicitly to create buildings that promoted harmony with the natural world. The work attempted to be uniquely American and specifically appropriate to geology and climate. The ideas for designing with nature connected back to nineteenth century thinkers and designers and eventually influenced twentieth century modernism globally. This paper brings together architectural aims to design with nature in conjunction with sustainable development and its social and economic approach in addition to the environment and human health and well-being. In this context sustainable development design criteria from certification systems are presented as educational tools through which architecture students can begin to understand and address these goals. Moreover, meaningful learning happens through thoughtful application of concepts driven by real-world issues faced by communities and community members.

This paper describes three class projects and partnerships, the tools and approaches applied in an architectural design education for sustainability and resilience at The Pennsylvania State University. Emphasis in the class, a fourth-year architectural studio in a five-year NAAB accredited Bachelor of Architecture program, is placed on developing a holistic architecture—recognizing interconnected and life-sustaining relationships between food, energy, and water, people, and their environment.

The aim of this paper is to discuss and promote an architectural design education pedagogy. This pedagogy includes sustainability design criteria while facing real world issues. In the architectural design studio, community representatives interact face to face with students at project presentations and discussions and the students visit and interact with them at the project site. As prospective leaders of the future, students learn through practice to embrace the complexity of designing for sustainability in its three dimensions—environment, economic, and social, and are motivated by the responsibility to solve design problems affecting and important to partner communities.

This paper is a contribution to architectural design and sustainability education. The cases presented herein are successful design studio experiences based on local community issues with engagement of their representatives to introduce the problems and discuss solutions based on student work proposals.

2 Methodology

This paper consists of a qualitative research based on case studies and combined strategies. Its core is structured on the presentation and discussion of three architectural design projects in a studio course offered at The Pennsylvania State University in the Fall of 2016, followed by Spring and Fall of 2017, respectively. These comprehensive architectural design studios integrate sustainability criteria to solve design problems of regional community partners. The community partners are from three Pennsylvanian Communities (1) Muncy where the issue of resilience related to flooding was the main concern; (2) Bellefonte that had a demand for a sustainable agriculture education center for its school district; and, finally, (3) Pottstown where the focus was based on health and wellness for a community-centered facility including fitness and pediatric practice.

Among the certification systems adopted as part of the design process proposed to the students are the USGBC LEED® (U.S. Green Building Council, Leadership in Environmental and Energy Design), ILFI (International Living Future Institute) Living Building Challenge™, and the International WELL Building Standard™. The scope, dynamics, and methodology of the studio course is described below and followed by the case studies of the courses considered for this paper.

2.1 Architecture Design and Sustainability Education

> *Making the simple complicated is commonplace; making the complicated simple, awesomely simple, that's creativity.* Charles Mingus 1977

A key strategy related to sustainable, environmentally conscious building design is integrative design, which relates the integration of building systems and the process through which integrated projects are designed. Integrated buildings synthesize the building site, program, structural, and environmental systems, building assemblies and envelope, life-safety provisions, and principals of sustainability with the project *parti*—thus, simplifying the complex. The integrative design process establishes common goals and objectives for the building project that all members of the multidisciplinary team coordinate around. To achieve this simple, poetic result the architect serves as both visionary and facilitator.

Design studio in an architecture program is a class in which students receive instruction and practice architectural design. In this context, an integrative design studio reinforces the emphasis placed on the comprehensive nature of design, accentuates synthesis in architecture—stressing the integration of abstract and material elements of design into a coherent schema.

Additionally, as a design research studio based on sustainability principles and integrative process, students are encouraged toward active exploration, information

collection, analysis and synthesis. Instruction consists of faculty input through interactive critiques, in-class discussions and workshops, and guest and instructor presentations, and reviews of design projects. Students participate in research assignments, analysis of information, site visits, interviews, topical lecture and discussions, interim presentations, and documentation. Providing a real-world context to this studio experience, projects are developed and pursued with input from community partners. Several project development workshops are realized with community partners and professional consultants.

The design studio emphasizes the development of students' ability to:

- Assess the implications of patterns and conditions on a subsequent design;
- Relate technical and material aspects of a building design to spatial and performance intentions;
- Integrate multiple issues simultaneously to develop a logical ordering system;
- Develop the continuity of the design logic across the scales of a building;
- Cooperate and collaborate in research and design;
- Demonstrate an understanding of the comprehensive nature of the design and decision-making process.

For attending sustainability criteria in design, student projects followed the standards set forth by The International Living Future Institute Living Building Challenge™ (LBC). To be certified under the Challenge, projects must meet a series of performance requirements. Net positive water and net positive energy are standards for which there is no LBC compromise. All public and workspaces must be humanely designed incorporating access to exterior views, controlled day-lighting and natural ventilation whenever possible. All spaces may be open to the public and are to be fully ADA accessible and Universal Design compliant. Egress and building design must be International Building Code compliant. In specific contexts, U.S. Green Building Council LEED® and the International Well Building Institute™ WELL Building Standard were also considered.

Building skills fundamental to integrative design and necessary for professional practice, this studio is based on collaborative teamwork. Thus, students work in groups throughout the semester. Architecture is a social art; even the simplest project entails a client and architect. Most projects require management of both a complex client group and a complex design team. To be a successful architect, it is vital to learn to manage and participate in productive groups. Collaboration is essential to integrative design and an integral part of the architecture curriculum (Arch 431 and 432, 2016, 2017).

3 Results and Analysis

3.1 Design Studio, Technical System Integration, and Community Engagement

In the architecture profession, approaches to complex design challenges requires the attention of a diverse design team. This integrative approach was central to the pedagogical goals of the studio course presented. Students worked in teams and were co-instructed, encouraging collaboration. Concurrently, they took a technical systems integration course where passive and active sustainable design practices and performance simulation tools were introduced. Expectations for the studio and seminar were for students to demonstrate understanding of integration of technical systems in their studio design project. Although enrollment was limited to architecture students' multidisciplinary collaboration was simulated in regularly scheduled "integration workshops" where students interacted with professionals, ecology/sustainability specialists, and engineers. Designs benefited from student interaction with community members and project partners throughout the 15-week project duration.

In this context, three design studio projects completed in consultation with communities' representatives in Pennsylvania, USA, are presented. These projects are: (1) Resilient PA: Model Community and Resource Center—in Muncy (2) Roots to Results: Bellefonte Area School District Sustainable Farm, and (3) Community-Centered Wellness: Medically Integrated Fitness Facility & Pediatric Practice—in Pottstown.

3.1.1 Resilient PA: Model Community and Resource Center

> *Flooding is the preeminent natural disaster threatening Pennsylvania's rural communities. The harmful effects of flooding include destruction of property, economic loss, public safety concerns, and the erosion of a community's sense of place.* PA DCED 2016

Over the past five decades, climate change has had a profound impact on the weather patterns of the Northeast of the United States of America. The science on climate change and severe weather predicts increases in more intense and frequent rainstorms, putting many communities in Pennsylvania at risk for devastation from floods. Rising air temperatures allow the atmosphere to absorb more moisture and hold it for longer periods of time, which has resulted in a growing amount of severe weather events. For Pennsylvania, this means a rising trend in heavy precipitation, hurricanes and storms of increasing intensity and duration, and a heightened risk of high magnitude flooding. With the high percentage of Pennsylvanians living in floodplains, riverfront communities become increasingly more vulnerable due to continued development and overworked stormwater systems, runoff pollution, rising flood insurance costs, and damaged infrastructure.

Pennsylvania is one of the most flood-prone states in the US, second only to Alaska. Only 186 of Pennsylvania's 2,571 communities are regarded by the U.S. Geological Survey as safe from high water due to the nearly 83,000 miles of rivers and streams in three major watersheds encompassing most of the state. Pennsylvania's topography creates conditions that are susceptible to unpredictable, localized flash flooding as well as large scale sustained flooding. These flooding types are increasing in both magnitude and frequency, and often cause major property destruction and fatalities.

With 67 counties and over 2000 municipalities, Pennsylvania faces a unique challenge in terms of coordination, unnecessary competition, and lack of strategic use of resources. To pursue state-wide resilience, PA must "set and follow its own course in floodplain and stormwater management and flood hazard mitigation based on its needs and unique political structure" (PAFPM 2016). Strategies for communication and sharing of innovative concepts need to be implemented to foster cooperation throughout government agencies and support wider adoption and employment of proven best practices.

The goal is to take a holistic approach to the stresses facing the Commonwealth through a targeted approach, sharing of best practices, scientific study, and other approaches in order to create more flood resilient communities. Toward this end, a community-university initiative was established to address climate change impact and community degradation. Moreover, a centrally located community threatened by recurring flooding was identified for a "resilient make over" (Fig. 1). Partners included governmental organizations from state, county, and local levels.

> *The Greater Muncy Area, like many of Pennsylvania's established communities, meets most of the criteria of a livable community, but, also like many of these established communities, it is at a crossroads and its future resilience and sustainability is uncertain.* PA DCED 2016

Fairly central and generally representative of communities and conditions in Pennsylvania, the greater Muncy area of Lycoming County was identified for a holistic study resulting in a plan of action that includes specific details for implementation of best practices for community resilience. The desired outcome is for Muncy to

Fig. 1 1936 Flood, Muncy Borough, Lycoming County PA

serve as the model for community resilience to showcase how small-scale, rural communities can successfully leverage a whole community approach and incorporate best practices of resiliency in developing their long-term recovery plans (PA DCED 2016).

Central to this plan is The Pennsylvania Resiliency Center of Excellence (RCoE). "RCoE will serve as a non-partisan center for research and leadership training on resiliency and related disaster prevention, recovery and mitigation issues in Pennsylvania" (PA DCEC 2016). The site, identified for an 'extreme makeover,' is at the heart of Muncy Borough where Water Street and Main Street intersect; the cross-street's name is indicative of its location within the flood plain (Fig. 2). The site comprises a historic opera house and a former theater of cultural value to the community, a brownfield lot, and an unpaved parking area adjacent to the theater (Fig. 3).

The RCoE will serve as a regional destination, a repository for sharing of knowledge for community organizers, government officials, researchers and academics, and others with the intend of establishing "*a network of national experts to bear on issues related to resilient planning, hazard mitigation, transportation and public health, housing and community development, and urban development*" (Allen 2016). The main RCoE program includes interactive exhibition space, teaching and event spaces, research incubator, archive and library, and administration areas. Additionally, the project is envisioned as an example for historic structure preservation and green infrastructure. Equally important, but less defined, was RCoE's role as a local community resource.

During the Fall 2016 Semester, twenty-three (23) fourth-year architecture students responded to the challenge posed for the RCoE. Working in teams of two or three

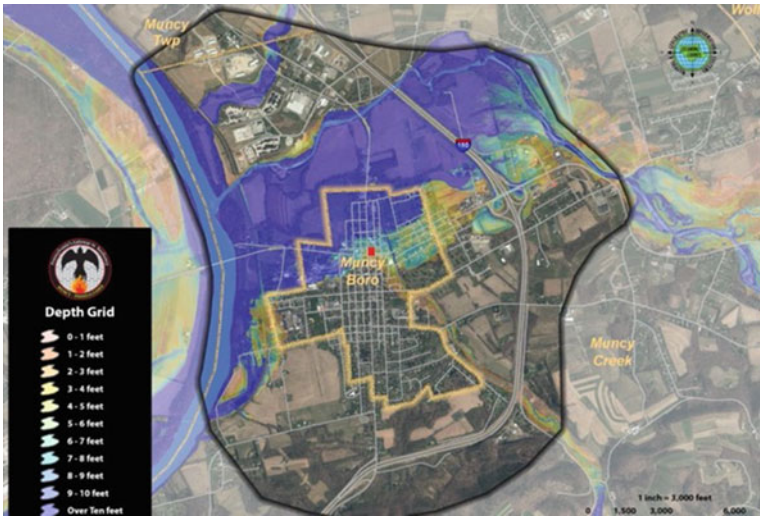

Fig. 2 Flooding in Muncy Borough, Lycoming County PA and surrounding area—red dot indicates location of the RCoE site

Fig. 3 Mozley Opera House (circa 1901) and interior of the Opera house mezzanine today (left to right)

Fig. 4 The late September site visit and community design workshop in the unoccupied and powerless Opera House proved the viability for passive solar design, specifically natural light and ventilation

students, they explored resiliency design and community solutions for the site at the heart of Muncy Borough (Fig. 4). Design was at the center of this initiative, specifically retrofit and new construction combined with green and renewable energy infrastructure solutions. Moreover, the students had to respond to realistic regulatory and safety constraints.

Halfway through the semester environmental designer, educator, and author (*Design for Flooding*, 2010) Don Watson gave a public lecture on 'Designing for Climate Change' and provided students with feedback on their projects. Designs also benefited from student interaction with community members and project partners throughout the project duration.

Projects had to integrate strategies/best practices for resilient and sustainable buildings (RSB) and provide for the necessary infrastructure to buffer the site from storms and power outages. In addition to strategies for "Passive Survivability", designs were to showcase Green Infrastructure, sustainable storm water and flood management solutions. All public and workspaces were to be humanely designed incorporating access to exterior views, controlled day-lighting and natural ventilation. Public spaces were to be ADA accessible and Universal Design compliant,

adhering to applicable International Energy Conservation Code (IECC) 2009 or higher, International Building Code (IBC), and local regulatory requirements.

Students were provided with a U.S. Army Corp of Engineers report, establishing BFE (base flood elevation) information and providing them with guidance for flood-proofing of the Opera House and adjacent properties (U.S. Army Corps of Engineers, 2016). The National Flood Insurance Program defines minimum requirements for floodproofing of non-residential buildings (FEMA/FIA 1993). Compliance includes:

- Assuring that buildings are watertight or substantially impermeable to the passage of water to the floodproof design elevation.
- The building's utilities and sanitary facilities, including heating, air conditioning, electrical, water supply, and sanitary sewage services, must be located above the BFE, completely enclosed within the building's watertight walls, or made watertight and capable of resisting damage during flood conditions.
- The building's structural components must be capable of resisting specific flood-related forces" outlined in a technical bulletin provided to the students.

The eight resulting designs explore design for new construction, historic building renovation and retrofit, and flood protection that inform and are informed by the community. The projects demonstrate strategies for sustainability and resilience through diversity of use, simultaneously serving as a premiere State-wide destination and a community asset for the Borough of Muncy. Emphasis is placed on the following issues:

- Incorporation of resiliency measures;
- Whole community approach;
- Green Infrastructure (including site design and sustainable development best practices and renewable energy production);
- Showcase government/non-gov. cooperation and partner agency efforts;
- Address impacts on vulnerable populations, economic impacts and environmental impacts;
- Examine ways to encourage action of individuals and communities.

The projects highlighted below present three approaches to design for flooding: infrastructure and urban approaches, sectional solutions with vertical zoning, and material solutions to inundation. Recognizing that many properties, suffering recurring floods of 12' or more, were valued far below the cost of flood-proofing, one team posed reclaiming property as a public park. Green infrastructure implementation on this buffer land was shown to reduce flooding in Muncy by 40 percent, eliminating flooding at the project site. Another project celebrated water for supporting life and power generation (Fig. 5).

The three projects illustrated in Fig. 6 flood-proof the existing building and proposed renovations built at levels above risk of flooding. The manipulation of 'ground' engages and educates the public about strategies for building in flood-prone areas.

The remaining three projects are defined with uses for community program that address an identified need in the community while simultaneously responding to

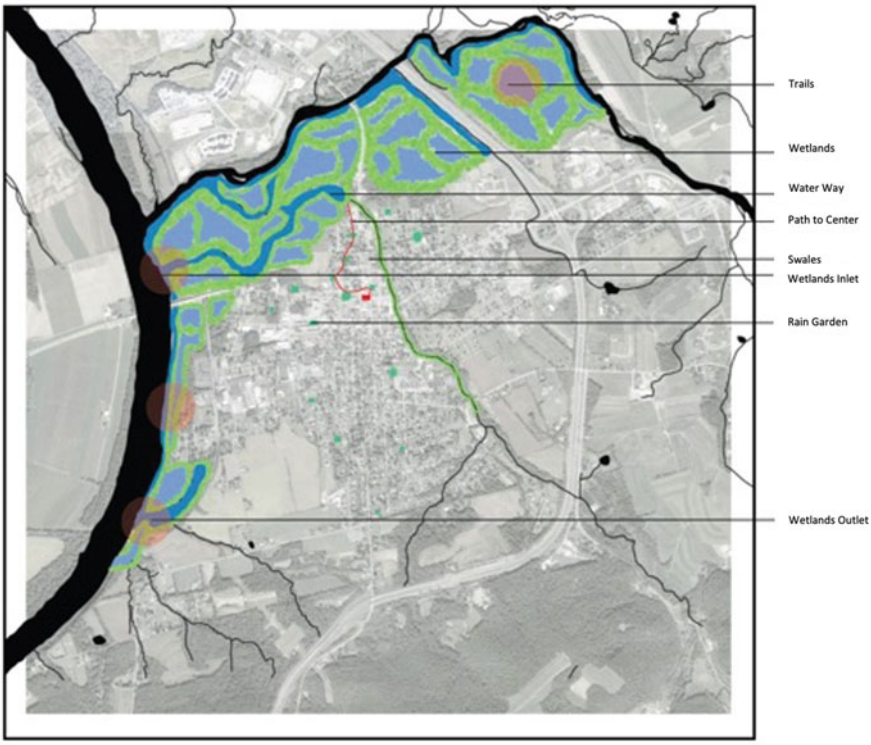

Fig. 5 Project incorporating ecosystems services to address flooding. Site plan and diagrams by Chin Hsu, Samuel Oztan and Lindsay Krause

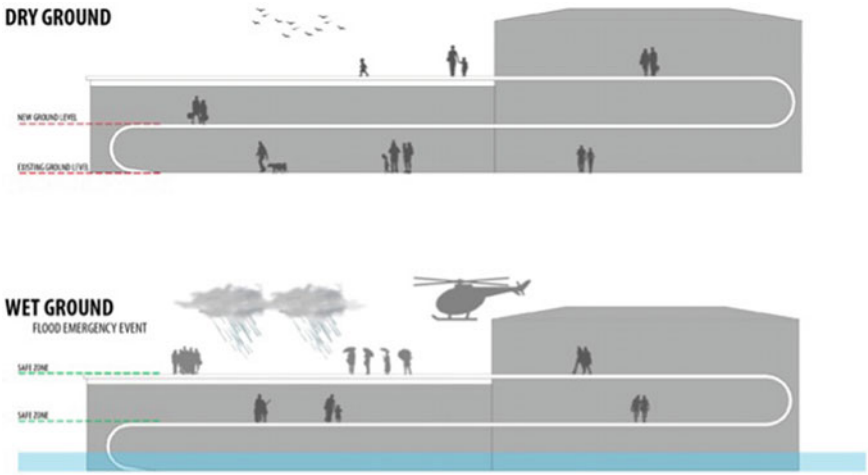

Fig. 6 Projects exploring ground plain. Section diagrams by Justin Chen, Veronica Landron and Bridget Novielli

Fig. 7 Use of space to address wet- and dry- proof approaches to flood design. Left to right: market square by Lojean Alali, Christopher Scalzo and Savannah Cranford, mixed-use with potential for growth by David Ackerman, Allana Kapcsos and John Shinogle, and local vendor and research destination by Darius Hopkins and Jomar Santiago

flooding by paralleling uses with wet- and dry-proof material strategies. Market space (a former use for the open lot on the site), entrepreneurial incubator spaces with resident researcher accommodations and support; and a mixed-use destination building housing a regionally appropriate specialized tourist center with Muncy-specific commercial space, are some of the innovative program spaces suggested in projects in Fig. 7.

3.1.2 Roots to Results: Bellefonte Area School District Sustainable Farm

> *Many of us yearn for experiences that take us out of the narrow human world and reconnect us with the less constrictive, richer and in a sense more hopeful world of Nature. The Green movements emerging today testify to this need, as do trends in architecture that emphasize sustainability and the pre-eminence of the organic. It is a mistake to consider them as strictly pragmatic.* Lebbeus Woods

The project brief in this design studio was a result of a community-university initiative between the Bellefonte Area School District, specifically the high school, The Sustainability Institute Sustainable Communities Collaborative (SCC) and a Penn State fourth-year architecture class. Students were encouraged toward active exploration, information collection, analysis and synthesis of the paramount relationship between food, water, and energy.

The project site is located on farmland recently purchased by the Bellefonte Area School District (Fig. 8). The site includes a small existing farmhouse that is over 100 years old and an index of the agricultural and geological history of the region. Ideas were generated, with the high school students, for a sustainable agriculture education center. Thinking of design with nature in the early twenty-first century, students worked in teams of 2–3 to design a project that celebrates and tells a story of building with nature: a living, working lab for the public, students, farmers, school aged children, and learners of all ages.

The architectural implications of Community Supported Agriculture (CSA) were considered. CSA is a farming model in which community members pledge support to

Fig. 8 Site panoramic photo montage, showing farmland and existing farmhouse

the farm at the beginning of the season. In return, they receive a share of the harvest. The growers and members provide mutual support in their food production and share in the risks and rewards of small-scale farming (e.g. weather, disease, pests vs. fresh, nutritious and bountiful veggies). CSA restores the lost connection between people and agriculture by providing an opportunity for members to be directly connected to how their food is grown.

The students were challenged to propose program (uses) and architecture that would allow the community to interact with and benefit from this project, extending its use beyond class and school schedules. Some possibilities include a produce stand or market, event spaces, performance spaces, small business, or production or studio space.

Two workshops celebrated the project development and community engagement, including: (1) School Visioning and Site Visit Workshop, and (2) Project Development Workshop. In the first, students, faculty and representatives from the Sustainable Communities Collaborative (SCC) visited Bellefonte High School to hear school and community perspectives on the future vision for the student farm education center and to share initial design ideas (Fig. 9). Following the workshop, students visited and documented the project site and existing stone farmhouse. Then, the second workshop, had the High School teacher and some of her students, and representatives from SCC visit the architecture studio at Penn State to further collaborate on the design for the school garden education center. The eight student design teams presented site designs and models of their respective projects for comparison and discussion. Guests then circulated to student teams' work areas to further discuss project designs and brainstorm ideas (Fig. 10).

Modules were created to introduce the students to the International Living Future Institute *Living Building Challenge* and students presented solutions related to each petal—place, water, energy, health and happiness, materials, equity and beauty (ILFI 2019). Selected solutions of approaches to the historic building in association with the program for the agricultural educational center that incorporates these sustainable design strategies are indicated (Figs. 11 and 12).

Fig. 9 Project visioning workshop at Bellefonte High School, and tour and documentation of the existing farmhouse and property

Fig. 10 Photos of SCC and Bellefonte High School community partners at Stuckeman School

Fig. 11 Different approaches in relation to the existing building and the new proposed one. Left: Building around the existing farmhouse, the building arrays a set of timber gates and forms a protective layer around it. Project by Tyler Corbley, Paige Geldrich and Andrew Cacchio

3.1.3 Community-Centered Wellness: Medically Integrated Fitness Facility & Pediatric Practice

Working in teams of two or three students, the challenge in this project was to design a building that would engage community members of Pottstown in the pursuit of health and physical fitness. Emphasis was placed on developing a holistic architecture—recognizing interconnected and life-sustaining relationships between food, energy, and water, people and their environment. Again, students considered strategies associated with the rigorous Living Building Challenge ‘imperatives” for sustainable

Fig. 12 Section demonstrating building performance and sustainable design strategies by Elizabeth Rothrock and Mark Yeakey

design and development. Additionally, students were introduced the International Well Building Institute™ standard concepts for healthful buildings and living.

Pottstown was once one of Southeastern Pennsylvania's major employment centers. Today economic development is a pressing need. The borough is a waterfront town, and the Schuylkill River, and adjacent Schuylkill River Trail, are significant recreational and economic assets, which can play a vital role in the re-development of the area. Additional assets that can contribute to economic re-development is an affordable housing stock and a historic downtown, with popular architectural styles, that are both in need of revitalization.

An additional need is to improve the health outcomes of the area's residents since Pottstown's residents are more likely to be in poor health and experience barriers to healthcare relative to surrounding areas. Of particular concern is how socio-economic characteristics can have adverse behavioral health outcomes for children and the health of the community. There is currently a collective movement to promote and enhance the behavioral health of the youth population. In 2005 a public private partnership called PEAK (Pottstown Early Action for Kindergarten Readiness) was forged to address the great need the school district saw in trying to best serve its children and families. With an unwavering mission that says: "every child in Pottstown will enter kindergarten ready to learn and achieve", PEAK has designed and implemented strategies that focus on community outreach, family engagement, quality improvement, kindergarten transition and health and wellness. The Pottstown School District, reaching 3,200 children and their families, is pushing the envelope to

incorporate resilience and social emotional learning as cornerstones in their teaching practice.

The community partner in this studio aimed to help people improve their health and well-being by enthusiastically embracing a healthier lifestyle and thus, create a healthy dynamic community. They strive to achieve their mission by providing education, funding, resources and programs that motivate people to adopt healthy lifestyles. Neighborhood connections enhance physical and emotional health by encouraging recreational opportunities and providing resources such as healthy recipes. A Health and Wellness District contiguous with Pottstown's significant park system, to be realized in cooperation with regional educational, medical and community organizations, was envisioned to:

- Improve the health of the community;
- Positively impact the image and reputation and economic growth of downtown Pottstown;
- Support recreational tourism initiatives.

The Borough of Pottstown is located in the northwest corner of Montgomery County, Pennsylvania along the Schuylkill River. The character of the Borough is primarily urban residential with commercial and industrial lands located adjacent to railroads, highways, and riverfront lands. The Pottstown heyday is evidenced by a number of National Register Historic Sites and Districts from this period. The Pottstown Parks and Recreation Department operates and maintains sixteen (16) facilities including a community center. The parks throughout the borough encompass 108 acres, with Riverfront and Memorial Parks comprising 89 percent of the area. (Masterplan, January 2003). This region, part of the historic town, comprises Pottstown's GATEWAY Tourism & Recreation District (TREC). Attractions include the Colebrookdale Railroad Secret Valley Line, mini golf, The Carousel of Pottstown, and several downtown restaurants and eateries. Other activities include a children's "spray ground," ball fields, and a BMX track where community events are held. A train station was going to be constructed for Colebrookdale Railroad and would include a community space.

The TREC area master plan includes a Medically Integrated Fitness Center and Interactive Family Wellness Education and Pediatric Practice. There is an opportunity for this district to spark economic development and draw visitors, businesses, and future residents to Pottstown through continued design and planning that incorporates beauty, sustainability, and active living. A site to the west of the Memorial Park baseball fields, currently home to a hotel and diner, has been identified for the Medically Integrated Fitness Center. The TREC district would provide facilities for special programs throughout the year for various ages of youth, college students, families and senior citizens. The district is envisioned to be inclusive; however, mixing of populations can be intimidating in this environment. Three sites located between Riverfront and Memorial Park hold potential for the interactive Wellness Education and Pediatric Practice and were presented to the students for their consideration and subsequent design proposals.

> *An integrated wellness center is a destination of the community to access clinical services as well as wellness and prevention services, including exercise programs offered by a medical fitness component (…). In short, the medical fitness center embodies the concept of "exercise is machine".* Business Plan 2014, 17

The role of medical fitness centers in preventing and managing chronic health conditions and improving long-term clinical outcomes is increasingly critical. The primary components of the wellness center include a fitness center, office space for health-related businesses or organizations, a sports performance training area, education and conference space, and a healthy food and beverage area or café. The fitness area may also serve other area businesses, such as a student center and classrooms for the local community college and outpatient physical and occupational therapy and medicine clinics for local health centers.

The Medically Integrated Fitness Center (MIFC) should support local goals and objectives to improve the health of the community in a comprehensive facility that offers a variety of fitness, recreational and health education programs to community residents and area businesses, addressing the unique needs of a wide variety of individuals and fostering confidence in the community, especially "at-risk" populations.

The suggestion program for the MIFC included the following uses:

- Medical Fitness/Recreation Center exercise equipment areas, indoor track, exercise studios;
- Indoor Aquatic Facilities with a 25 m ($24' \times 83'$) lap pool, and $20' \times 42'$ warm-water exercise pool;
- Outpatient Clinical Services: physical therapy and occupational health with check in/out;
- Educational/Conference Space: classrooms;
- Lease Spaces for sports performance retail, PAHWF and health services offices, babysitting services, and healthy food and beverage retail.

The proposed Pottstown Family Wellness Center and Pediatric Practice should be similar to the Byrnes Health Education Center. Unlike the MIFC, which is centered on fitness, the Family Wellness and Pediatric Practice is centered on preventative and sick-child care.

There is a higher percentage of children under 5 years of age in Pottstown than in Pennsylvania and the United States as a whole (Census 2010). A new collaboration between Pottstown Memorial Medical Center and Nemours Children's Health System has enhanced the pediatric care to borough residents in Pottstown, PA. Parks and recreation settings have become increasingly recognized as an important part of the healthcare delivery system. There is an interest in building a pediatric care facility that is located adjacent to a large urban park in the borough. Children would not only have increased access to pediatric care but have access to open green space at Memorial Park during their visit, providing additional positive health outcomes to children. This facility would also incorporate evidence-based design features to create a healing environment. As the healthcare industry has shifted from a treatment-based approach towards a more preventative and holistic approach to healthcare, there is

increasing consideration for incorporating access to nature in the design process of healthcare facilities, and prescribing engagement in parks and recreation facilities and services, in order to improve health outcomes of patients.

Suggested program for the Family Wellness and Pediatric Practice included the following uses:

- Wellness welcome area with strong connections to the park. Design space for active and passive/quiet play, and a library with reading areas for individuals and small groups;
- Interactive children's health museum engaging and educating children about their bodies, health and wellbeing in an interactive and fun environment;
- Education and e-learning facility including teaching theaters that integrate interactive learning and teaching exhibits for youth programs and adult education classes and conference spaces for tutoring and literacy/language services;
- Pediatric clinical and child abuse services in a secure and nurturing environment; pediatric preventative, sick-child and wellness care;
- Great hall for nutrition and fitness helping visitors make healthy lifestyle choices by providing a place to eat and exercise in a fun and educational environment.

In addition, the wellness center is supposed to integrate best practices for Resilient and Sustainable Buildings (RSBs) and provide for the necessary infrastructure to buffer the building from storms and power outages, serving the community as a place of shelter during disaster events. In this sense, the projects adopt LEED Resilient Design Pilot Credits.

The WELL Certification by the International Well Building Institute is also considered in the projects, as "the leading tool for advancing health and well-being in buildings globally". Consistent with goals for the wellness center, "WELL fosters a holistic formula for better health and wellness outcomes, leading to improvements". The WELL Building Standard (WELL) consists of features across seven concepts—air, water, nourishment, light, fitness, comfort, mind, and innovation—comprehensively addressing "the design and operations of buildings, but also how they impact and influence human behavior related to health and well-being" (WELL 2020).

Therefore, all public and workspaces were humanely designed incorporating access to exterior views, controlled day-lighting and natural ventilation. All public spaces were fully ADA accessible and Universal Design compliant. Buildings comply with local zoning requirements, including those for lot coverage. Egress and building design must adhere to applicable International Energy Conservation Code (IECC) 2009 or higher; International Building Code (IBC) and local regulatory requirements. The sites identified for development have the potential for flooding. Therefore, all equipment and materials had to be protected from flooding and habitable spaces located above the FEMA designated base flood elevation (BFE).

Nineteen fourth-year architecture students worked in teams to research the community, analyze needs, and propose integrated solutions for the Pottstown Wellness District, the MIFC, and the Pediatric Practice. These designs were realized through an interactive partnership with the community representatives. This project was supported through a collaboration between the Pottstown community partner

Fig. 13 Site visit (left) and community workshop at Penn State (right)

organization and the Hamer Center for Community Design at Penn State (Hamer Center).

Students and faculty visited the project site and attended a workshop in Pottstown to hear the Pottstown community partners' perspectives on the vision for the community center and to share the initial design ideas. The Pottstown Foundation made a public presentation at a Hamer Center coffee hour lecture on health, wellness, and community. The presentation was followed by a research development luncheon with interested faculty members and a project workshop conducted with the architecture studio course students. The semester began with a workshop with Pottstown representatives in Pottstown and included a walking tour of the downtown, park system and proposed project sites. More than thirty Pottstown professionals, decision-makers, and community members attended presentations of projects by the student teams and participated in discussions to provide the students with feedback on their work (Fig. 13).

Selected projects illustrate results of this design studio course. For example, a greenhouse serves as an emphasis point for the public and for water retention. The roof is sloped inwards to direct rainfall towards a series of gutters, which then collect in the greenhouse's interior pools.

One of the projects was designed in a way to make wellness a fun and interactive experience for the whole family throughout the building (Fig. 14). The project in Fig. 15 aims to activate Pottstown's existing features and resources by developing an environment that induces active living while maintaining the town's historical identity. In addition, the urban scale of the design creates an environment where users can learn, eat, and heal. Finally, the urban scale is again proposed for a wellness park (Fig. 16).

4 Conclusion

This paper presents three architectural design studio projects, all of them employing comprehensive architecture and an integrated design process that respects and envisions sustainable development through its strategies and solutions. They deal with high complexity problems and involve real life demands defined by their respective communities.

Fig. 14 Fun and interactive building for children and the whole family as a means for wellness. Project by Alyssa Clayburn, Kaila Hanlin and Suzanne Varnell

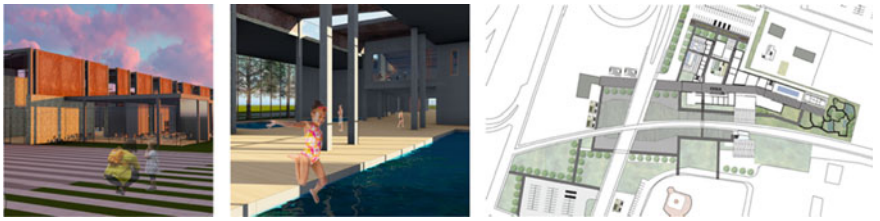

Fig. 15 Design with historic material references and urban scale solution by Connor McGowan, Lucia Chamorro and Maria De Fatima Vela

Fig. 16 Wellness park by Audrey Krieman, Grant Davis and Nathan Myers

The architectural solutions are limited in the sense that a multidisciplinary team would be required to tackle the design problems proposed. Nonetheless, as an education activity this limitation does not diminish the learning process for both students and community. The validation of the resulting architecture projects was done through a process for constructive review by professionals and community representatives.

Dealing with a different community and issue each semester makes the course dynamic and innovative. More importantly, it allows the partnership of different community groups and members to engage with the university activities. In this process, not only are students educated in sustainability practices, the partners engaged participate of the discussions and proposals developed by the students learning and sharing their knowledge in the process.

Design studio can have a significant impact on sustainability education for students and community while tackling social and environmental problems as motivators for

student work and development. This approach of engaging community in education is a potential source of ideas for raising awareness for both design issues and potential solutions that may attract investors and expand community horizons of sustainable design and development possibilities. Therefore, education and student work are seen as a mechanism for social and environmental change.

The student work is informing governmental partners and fueling fundraising efforts. Through this initiative, future designers, builders, and policymakers are embracing challenges posed by environmental realities and the process for long-term thinking and problem solving. Central to the initiative are academic connections, engaging researchers and students in on-going collaboration. A need moving forward will be to foster implementation of architecture and urban design projects, while supporting research and dissemination of results for broader impact toward sustainable development and leadership.

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References

7group, Reed W (2009) The integrative design guide to green building: redefining the practice of sustainability. John Wiley & Sons Inc. Hoboken, New Jersey

Allen E, Iano J (2012) The architect's studio companion: rules of thumb for preliminary design. John Wiley & Sons Inc., Hoboken, New Jersey

Allen J, Schnitzlein J (2017) Greater Muncy Area Resiliency. PA DCED (Pennsylvania Department of Community & Economic Development). https://muncyboro.org/wp-content/uploads/2017/02/Muncy-Resiliency-Newsletter-Jan-2017.pdf. Last Accessed 21 March 2022

Arch 431 and 43 (2016, 2017) Course syllabus. Department of Architecture, The Pennsylvania State University. Page 1

FEMA/FIA (Federal Emergency Management Agency/Federal Insurance Administration) (1993) Non-residential floodproofing—requirements and certification for buildings located in special flood hazard areas. Techn Bull 3–93. FIA-TB-3, 4/93

ILFI (International Living Future Institute) (2019) Living Building Challenge 4.0: a visionary path to a regenerative future. http://living-future.org/wp-content/uploads/2019/08/LBC-4_0_v13.pdf. Last Accessed 21 March 2022

International WELL Building Institute (2020) WELL Building Standard™ version 2 (WELL v2™). https://v2.wellcertified.com/en/wellv2/overview. Last Accessed 21 March 2022

Keeler M, Vaidya P (2016) Fundamentals of integrated design for sustainable building, 2nd edn. John Wiley & Sons, Inc., Hoboken, New Jersey; Kibert C (2022) Sustainable construction: green building design and delivery, 5th edn. John Wiley & Sons, Inc., Hoboken, New Jersey; Kwok A, Grondzik W (2018) The green studio handbook, environmental strategies for schematic design, 3rd edn. Routledge

Mock B (2015) Climate change is the ultimate gentrifier. Grist. https://grist.org/living/climate-change-is-the-ultimate-gentrifier/. Last Accessed 21 March 2022

PAFPM (Pennsylvania Association of Floodplain Managers) (2016) Toward a commonwealth floodplain management plan: PAFPM policy and legislative committee. http://www.pafpm.org/files/Toward_a_Commonwealth_Floodplain_Management_Plan_2014.pdf. Last Accessed August 2016

Simone Jaffe Collins Landscape Architects Urban Partners (2003) Waterfront and memorial parks master plan borough of Pottstown. https://www.pottstowncitizens.org/2010boropdf/Plans/Parks%20Master%20Plan%20Jan%202003.pdf. Last Accessed 22 March 2022

Sinclair B, Furlan R (2016) Comprehensive studio, architectural accreditation, cultural diversity: considering conditions, respecting context and pursuing competence. In: 9th international symposium on architecture of the 21st century: In Search of New Paradigms, Germany

Suriya S, Mudgal BV (2012) Impact of urbanization on flooding: the Thirusoolam sub watershed: a case study. J Hydrol 412:210–219

Swan A (2010) How increased urbanization has induced flooding problems in the UK: a lesson for African cities? Phys Chem Earth 35:643–647

U.S. Army Corps of Engineers, Planning Division, Baltimore District (2016) Nonstructural flood risk management economic assessment for Lycoming County, Lycoming County, Pennsylvania. http://muncyboro.org/wp-content/uploads/2016/10/USACE-Lycoming-Final-Complete-Report-Apr2016.pdf. Last Accessed 22 March 2022

USGBC (U.S. Green Building Council) (2019) LEED v4 for Building Design and Construction. U.S. Green Building Council, Washington D.C. https://www.usgbc.org/sites/default/files/LEED%20v4%20BDC_07.25.19_current.pdf. Last Accessed 22 March 2022

United Nations, Department of Economic and Social Affairs, Sustainable Development (2022) The 17 goals: history. https://sdgs.un.org/goals. Last Accessed 22 March 2022

Villarini G, Smith JA, Baeck ML, Sturdevant-Rees P, Krajewski WF (2010) Radar analysis of extreme rainfall and flooding in urban drainage basins. J Hydrol 381:266–286; WHO (World Health Organization) (2021) Climate change and health. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health. Last Accessed 22 March 2022

Zacks S (2016) Sink or swim? climate change displacement is becoming the new gentrification—here's how to stop it. The Architect's Newspaper. https://archpaper.com/2016/12/climate-change-displacement-gentrification/. Last Accessed 22 March 2022

Academic and Non-profit Environmental Organization Collaboration: A Case Study on Forest Conservation with Allegheny College and the Foundation for Sustainable Forests

Richard D. Bowden, Terrence Bensel, Guy Dunkle, Bailey Kozalla, and Annie Maloney

1 Introduction

Many academic courses employ hands-on approaches to learning, hence faculty members frequently seek partnerships with local businesses, non-profit organizations, and government organizations to provide educational opportunities for students. Hands-on activities and college-community collaborations have been increasingly used (Brame 2016) and are considered to be the best practices to enhance student learning (Jones and Washko 2021; AACU 2022), with studies showing that active-learning courses are far more successful than more passive, lecture-based courses (Freeman et al. 2014). Importantly, these collaborations can model partnership approaches that students will undoubtedly encounter once they enter the workforce and become leaders in environmental problem-solving. Developing college-partner relationships can be tricky or difficult, however, and managing projects can

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butt up against challenges in meeting educational goals and organizational needs (AASCU 2002; Bowden et al. 2022). Nonetheless, institutions of higher education increasingly seek to develop and enhance these relationships, and thus efforts are underway to describe best practices for these kinds of relationships (AACU 2022).

The purpose of this paper is to describe an on-going collaboration between Allegheny College and the Foundation for Sustainable Forests, illustrating lessons that demonstrate implementation of best practices for developing a university-organization partnership that enhances student learning and provides benefits to the organization. We examine benefits from perspectives of the college, the foundation, and former and current students. Additionally, we point out challenges and lessons learned so that other higher education institutions can learn from our experience in developing meaningful experiences in environmental sustainability.

2 Methods

Our approach is that of an evaluative case study. We first describe Allegheny College so that other institutions of higher education will have a basis for understanding the advantages or challenges of our institution. Then, we describe the environmental landscape of our forested region so the reader will understand the importance of forests and forestry in our region, appreciate the rationale for Allegheny's use of nearby forests as a teaching tool, and comprehend the environmental and social complexity of this forested region. We describe the Foundation for Sustainable Forests (FSF), documenting its mission and activities that provide for fruitful collaborative work, especially from the viewpoint of providing important environmental sustainability learning opportunities for students. We then describe activities and partnerships in which we have engaged so that we can portray the range of activities that are possible to include in our collaborations.

We evaluate this partnership and these activities from perspectives of the authors of this study; faculty members, a current student, a former student, the larger academic institution, and the community member. From each perspective we highlight benefits and challenges that we have perceived through our experiences, linking our experiences to findings within the literature. For context, Bowden and Bensel provide perspectives as Professors of Environmental Science and Sustainability, with training in forest ecology and forest economics, respectively; both have been active in local forest management and sustainability organizations. Kozalla is a senior undergraduate student majoring in Environmental Science and Sustainability, with strong interests in forests, who has had a variety of experiences with FSF. Dunkle is an Allegheny alumnus who is a professional forester and serves on the board of FSF. Maloney has training in forest ecology and biogeochemistry, and is the executive director of FSF. She is also an adjunct faculty member of Allegheny.

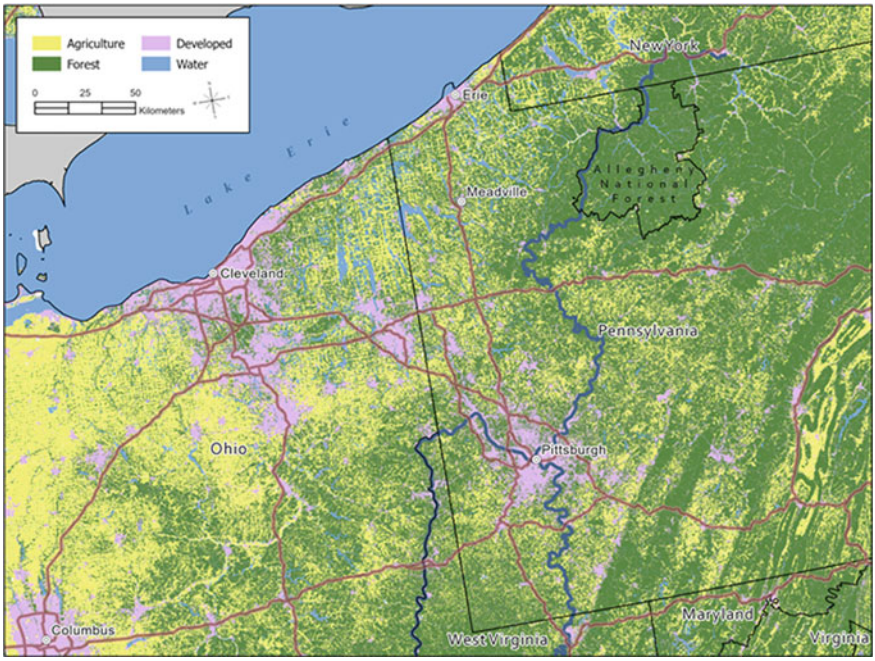

Fig. 1 The forested region of Allegheny College, Meadville, PA

2.1 Allegheny College and Hands-On Learning

Allegheny College is a liberal arts college situated in northwestern Pennsylvania (Fig. 1), with approximately 1,500 students. Allegheny students have numerous opportunities to learn about forests in courses or projects that occur within several departments, including Biology, Communication, Film, and Theater, Environmental Science and Sustainability (ESS), Economics and Geology. There are no majors specifically in forestry or ecology; students with interests in forests typically major in Biology or ESS, and take forest ecology and related courses. A number of students have gone to graduate schools to pursue interests in forest studies. The ESS department has been particularly active in seeking and developing college-community collaborations in courses (Bowden et al. 2022), and has worked closely for more than fifteen years with the Foundation for Sustainable Forests (FSF).

2.2 The Forested Region

The college is located in the eastern temperate hardwood forest region, dominated by oak-hickory, and maple-beech-birch groups (USFS 2022), with a notable component

of black cherry and sugar and red maple. Climate is temperate, with 112.5 cm y^{-1} of precipitation, mean daily temperatures of −4.1 °C in January and 23.6 °C in July, a four-month growing season, and approximately four months of snow cover (Bowden et al. 2014).

The forests of PA are a function of historical land use, land use legacies, and the economy of the region. "Penn's Woods" were nearly entirely covered in forest prior to settlement of European settlers (Whitney 1996), with forest cover in 1630 estimated to be 90% (PSU 2022). At that time, human forest disturbances were limited to Indigenous settlements (Black et al. 2006), as well as forest burning by Indigenous peoples (Nowacki and Abrams 2008).

The forested landscape changed, however, as the forest was removed for agriculture, lumber, and the chemical wood industry (Whitney 1996). By the early twentieth century, most of the land base was converted to agriculture, with forest cover in Pennsylvania reduced to 32%, or 3.7 million ha. By the middle of the twentieth century, however, farms were increasingly abandoned, and Pennsylvania forests have rebounded dramatically since then, with forests now covering nearly 60% of the state (in 2019), or 6.7 million ha (US Forest Service 2020). Forest land cover has been relatively stable over the last two decades, with losses of forest due to development being about equal to agricultural lands reverting to forest cover (Albright 2018). Recently, however, forestland and timberland have been in slight decline; annual forest land conversion to non-forest uses is now about double the conversion of land back to forest (US Forest Service 2020).

Here in northwestern Pennsylvania, land use generally matches the pattern that is reported statewide, with loss of the original forest (beech and sugar maple), and replacement with opportunistic post-agricultural disturbance species, such as black cherry and red maple (Whitney and Decant 2003). Presently, land cover in the county is approximately 52% forest, 28% agriculture, 12% wetlands and open water, and 8% developed areas.

With forests occupying large swaths of Pennsylvania's land base, the forest industry is an important contributor to the state's economy. Pennsylvania is noted for its production of high-quality hardwoods, especially black cherry, generating $21.5 billion in direct and $36 billion in indirect annual economic contributions (PA Dept. of Agriculture 2022). More than 65,000 PA residents Pennsylvanians—ten percent of the state's manufacturing workforce—are employed in the forest products industry.

Land ownership is an important driver of forest health. Statewide, the majority of forested land is privately owned, with 71% of forest land in private ownership (family, corporate, misc. private) (Butler and Butler 2016). The 4.7 million ha of non-industrial forest land are owned by 497,000 private forest owners (USFS 2021). In Crawford County, home of Allegheny, nearly all land is privately owned. State lands (Parks, Forests, Gamelands) and municipal holdings are a small fraction of the total. Interestingly, reasons for landownership and activities actually conducted on lands owned by private landowners are in sharp contrast. Among landowners, timber is the eleventh most important reason given for owning land, with approximately 20% of landowners stating this as a reason for forest ownership. However, when

asked about past activities on their land, cutting trees for personal use or for sale are the first and third most numerous reasons, respectively.

Locally, the forest industry is dominated by small-scale operations occurring primarily on private lands, which constitute most of the land base in the county. Harvesting is often done directly by loggers and not mediated by professional forest consultants. As a result, many if not most of the harvest operations use various forms of high-grading, taking out the most valuable species (commonly maple, oak, and cherry) and leaving behind trees of lesser value or in poorer form that are unlikely to be of much commercial value when they reach maturity. Additionally, harvesting is rarely done with consideration for the future forest.

A silvicultural approach commonly used is diameter limit cutting, which selects trees only on the basis of tree diameter (Kelty and D'Amato 2005), with no consideration given to forest regeneration, or to selections that will promote long-term forest health and resilience. Pennsylvania has virtually no rules governing forest harvest practices or techniques, and as a result, many of the forest harvest operations are unsustainable (Fajvan et al. 1998). Ironically, but not surprisingly, even when landowners think that they are employing sound forest harvest techniques, the actual outcomes do not match their sustainability goals (Egan 1993). Economically, high intensity harvesting can result in greater short-term net economic returns than low intensity harvesting (Moss and Heitzman 2013), however long-term income from timber, as well as the condition of the forest, are reduced (Nyland 2005).

Private ownership poses opportunities for citizens, however few landowners have professional knowledge of forestry, and most are unaware of sources of sound advice. In some cases, loggers advise landowners to avoid using professional foresters on the notion that in doing so, landowners will avoid an additional expense and thus realize a higher income. Further exacerbating the situation, poverty rates are high, thus when under duress, landowners turn to the wood resources in their backyards as income sources (Bensel 2001). This is not necessarily a bad thing, however improper harvests, notably diameter limit cuts, degrade the long-term economic and ecologic viability of the forest. Additional threats to area forests include invasive species (Holmes et al. 2009), high deer populations (Rawinski 2008), and forest parcelization (Sampson and DeCoster 2000).

Against this backdrop of forest opportunities and challenges, there has been considerable interest among faculty and students at Allegheny in learning about forests, forestry, and the state of forest operations in the region. To foster student learning about forest issues, to give hands-on learning experiences, and to provide meaningful opportunities with "real-world" partners, Allegheny has partnered closely with the Foundation for Sustainable Forests (FSF), a nonprofit land trust that protects working woodlands using sustainable forest management. Here, we describe our experiences in this partnership from several perspectives—that of a faculty professor, the executive director of FSF, a student who has interned with and assisted the organization, and an Allegheny alumnus who is a professional forester and member of the board of directors for FSF. We point out the benefits and challenges of this relationship from various viewpoints so that others involved in developing and maintaining these academic-community partnerships can learn from our experiences.

2.3 The Foundation for Sustainable Forests

The Foundation for Sustainable Forests is a land trust that stewards approximately 900 ha of working woodlands through direct ownership or conservation easements that include sustainable forest management. By keeping these woodlands as working forests, FSF-conserved lands support the rural economy through sustainable forestry and provide critical ecosystem services such as clean air and water, biodiversity, and habitat protection. They also provide recreational opportunities for the public. Affirming the need to be a responsible community citizen, FSF properties remain on the tax rolls and support rural jobs in the sustainable timber and land stewardship industry. Through donations, grants, and proceeds, FSF maintains a program of land conservation, outreach, and education.

FSF seeks to raise awareness of the importance of conserving intact forested ecosystems, and highlight sustainable forestry practices for the benefit of the land. Its underpinnings began in 2004 when Troy and Lynn Firth, owners of Firth Maple Products, a sustainable timber and maple syrup business based in Spartansburg, Pennsylvania, started the Firth Family Foundation to manage and protect their woodlands in perpetuity. In 2009, after realizing the need for a broader conservation entity active in forest management, the Firth Family Foundation became the Foundation for Sustainable Forests and began work regionally with landowners to assist them in their desire to continue their legacy of forest stewardship beyond their tenure.

As northwestern Pennsylvania is a timber-dependent region, it is crucial that land protection efforts do not stifle the local economy. Thus, rather than placing woodlands into preserves that cannot be touched, FSF actively manages its timber resources using sustainable approaches. As a member of the local community, FSF positions itself to educate the public about conservation-based, restorative forestry across the region.

2.4 AC-FSF Projects

Collaborations between Allegheny and FSF have included field trips to FSF properties, class visits by FSF representatives, student internships, and partnered projects. Field trips and classroom visits have been for entry- through upper-level courses that are exploring elements of forest conservation. Additionally, students have volunteered to assist at FSF's annual Loving the Land Conference and annual member pot-luck dinner. The collaborative projects between Allegheny and FSF have been initiated primarily by the college, where an individual faculty member contacted the organization to seek out opportunities that would be beneficial to both. However, the organization has also come to Allegheny seeking partnerships on projects. FSF typically provides guidance to projects through the course instructor, and final results are presented by students to FSF in the form of written reports and oral presentations. Projects to date have included an analysis of invasive plants, a survey of desires

and expectations of FSF members, development of information and video marketing material, evaluation of horse logging effects on soil, estimation of tree canopy openings, land use history analysis, and a geographic information systems story map of FSF properties that remains active on its website.

3 Results and Discussion

3.1 Faculty Perspective

All forms of collaboration have been highly beneficial from a faculty member perspective. Field trips, for example, have enabled us to show students what the forest actually looks like during sustainable harvest operations, from tree selection to cutting, and then removal with horses. Classroom descriptions cannot substitute for the visceral experience of the sounds of a chainsaw, the aroma of fresh sawdust, or seeing the breath of draft horses on a cold winter's day. Principles taught in the classroom are much more real when students can actually see them. Talking about the importance of sugar maple trees and maple syrup is much more engaging when walking through the forest to see tapped trees and miles of tubing, and then students taste hot syrup that has just come out of the commercial boiling pan. The instructional material of maple tree biology and the syrup industry comes alive with real sounds, smells, and tastes. Students who assisted with the annual conference gained insights into conference management and logistics and insights into means by which technical information is translated into formats accessible by a public audience.

The field trips, or classroom visits by FSF personnel who discuss the philosophy of the organization are extremely valuable, and usually fun for students (even if students are traipsing through knee-deep snow). Field trips provide important opportunities to engage students actively in their education (Munge et al. 2018) and have been shown to link concepts and theories discussed in class to actual experiences in the field (Lei 2010); and this is clearly our experience. Yet even more is added to the learning experience when actual projects are conducted. For example, when students conducted a member survey, they had been informed by the FSF Executive Director that the organization needed better information on member needs and desires, but that FSF itself did not have the capacity to conduct the survey. After being given the charge, students first had to learn more about the topics—forests, forest harvesting techniques and impacts, and sustainable alternatives. Instead of lecturing, my task was to guide students to learn what they needed to learn about background material that would guide them toward developing meaningful surveys. Students were treated as research professionals who needed to learn a lot to become proficient in the topic and then in constructing a suitable survey. None of the students came in with experience or coursework in forests, but they learned how to gather information on basic forest and forestry processes, as well as the social science components of forest management.

Now, prepared with the intellectual background, they delved into the challenging task of preparing meaningful and rigorous surveys. Students were not presented with typical sets of how-to instructions found often in a class lab; rather they had to search through the literature to find suitable approaches, and struggle through the tedium of designing a rigorous survey. Telling students to ask questions is one thing. Giving them examples is another. But, now needing to produce an actual survey takes on real meaning and importance for them, with the process and reality of real research becoming apparent.

The invasive plant analysis was a field-based project, and like the survey project, required students to become knowledgeable on critical background information. Based on reading peer-reviewed papers, students worked collaboratively to develop a unified experimental design that would provide data useful to FSF. This was often challenging, as students argued over numbers of samples and transects, how to determine plant density, and the most efficient sampling schedule. Because the information was to be used by FSF to develop invasive plant treatment strategies, data collected in this project needed to be accurate and complete. The work also required several trips afield, often on hot days, traipsing through thorn-covered thickets of multi-flora rose. Experiences such as these help students to get a better view of what real research entails, and helps to unveil the myth that research can be completed in an afternoon (a typical academic lab period).

The other projects provided similar opportunities and experiences. The GIS story map was conducted by a student intern who translated her skills learned in GIS courses into an outcome that enabled FSF to better display their land holdings to the public. The student gained exposure and experience in a forest organization, and also saw how classroom skills could be applied meaningfully. The marketing project found students preparing background information handouts and plans for informative videos. Notably, students in this course learned the harsh reality of presenting to other professionals, when their outputs, which were academically sound and the result of a great deal of work and editing, still met with constructive but blunt criticism from a professional videographer. Students expect this criticism from their professors; experiencing critique from professionals prepares them for the kinds of unshielded critique that they may well face in the real world.

3.1.1 Benefits

Undergraduate research experiences are popular with students, but the evidence for their success as educational tools are still incompletely understood and quantified (Linn et al. 2015). As professors trained in forest studies, we have seen that the partnership with FSF makes real principles that are taught in the classroom. Students become accustomed to hearing information from professors, but when that same information is also presented by outside professionals, we find that students gain further appreciation for that material. Perhaps the biggest advantage is that students view their efforts as having meaning. Not only are they learning for themselves, but the product of their learning benefits someone else. They take ownership of the

project, and are motivated to do the hard work and go the distance needed to produce quality work. Students have been proud to have their work used or adopted by FSF. They can also include these efforts on their resumes, showing their experience in conducting a project and in professionally presenting their work. The report-writing and presentation aspects of the projects are perhaps the hardest for students, but most valuable pedagogically. Here, they pull it all together to demonstrate their working knowledge of the big picture, their understanding of their data, and the implications of their work. Presenting their results gives them experience in communications, and gaining affirmation and feedback from outside professionals validates the value of their learning and project efforts. Establishing a close connection with FSF also models for students the collaborative nature of much sustainability work, and shows students how professional relationships are based on mutual respect and understanding.

3.1.2 Costs and Challenges

Collaborative projects are not without challenges. As students learn what has been done in other courses, or in their own previous courses, they can have expectations for projects that are beyond the scope of the course. Allegheny has been fortunate that FSF understands well what can be conducted at the undergraduate level, and has not proposed efforts that are beyond the capabilities of any given course or level of experience. The college may be positioned well in this regard because the FSF Director also occasionally teaches courses, and the Allegheny alumnus who works with FSF is familiar with the college. All laboratory or field exercises require preparation, but often once the supplies and methods are set, the exercise is usually ready to proceed. In collaborative projects, however, there is substantial planning to assure that a given project is likely to succeed, taking into consideration class size, logistics and travel, and student expertise. Additionally all such projects carry with them levels of uncertainty, requiring the ability to adapt and think on one's feet. For example, in a course that has a once-per-week lab, a rainy day might preclude field work. Hence, one needs to have contingency plans.

We have also found that courses of this nature are messy and can be seen as "chaotic" by students. Students are not wrong. They often expect research and projects to follow carefully scripted methods, like stereotypic laboratory exercises, and are often surprised that the actual research process is much messier (Linn et al. 2015). Interestingly, our approach of incorporating these hands-on experiences as course-based projects closely links classroom lectures and readings to the actual experience, considered to be consistent with well documented instructional strategies in other courses (Linn et al. 2015). While introducing new images of science, research experiences may also reinforce incomplete or inaccurate images. Successful projects are well planned, and have sound logistical plans, and weekly and semester goals. But such plans are still very different from a course where a daily syllabus of detailed activities tells students exactly what they can expect. Students who lean on syllabi find these projects unsettling. In an oft-delivered laboratory, one knows

pretty well what to expect. In a project, plans often adapt on the fly—weather changes, survey recipients don't respond according to student timetables, chalkboard-based experimental designs don't align with field realities. Most professionals have experienced this before in research and projects, and know how to adapt. Students, however, need to be guided so that they learn flexibility and resourcefulness, and they need to be reassured that they are still making progress and gaining valuable experience. We have also found that the final product of many projects often comes up somewhat short of desired outcomes. Time is needed to transform undergraduate writing into a professional-level project report; this responsibility can then fall on the professor, or perhaps be assigned to students willing to assume roles as chief editors, and work to produce a professional grade final report (which almost invariably still needs editing by the professor). We have found that FSF has understood this challenge and has been patient and realistic in its expectations.

3.2 Student Perspective

Upon graduating from a high school near Allegheny, Kozalla chose to pursue my college career as an Environmental Science and Sustainability major at Allegheny College. She was already aware of the conservation work of FSF through living in the area and through visiting the campus. Once she became a student, she became intrigued with the FSF's conservation work, and shortly afterwards became involved in projects that she found to be rewarding and memorable projects.

As a college junior, and having recently completed coursework in Geographic Information Systems (GIS), Kozalla was introduced to a project to publish a publicly-accessible map of FSF's conserved lands. This resource would increase the FSF's online presence, serve as a reference for its members, and be a tool for obtaining grant funding. Kozalla then produced an interactive map that displayed the physical, spatial, and qualitative characteristics of each property. She worked closely with the FSF's executive director to ensure that the map (Fig. 2) would be most useful and accessible to FSF members as well as to the public. This experience provided her with personal satisfaction in helping with outreach efforts in her community, and she learned to collaborate with a stakeholder towards a common goal. She knew that there would be a significant need to ask questions and learn independently during this project, as she was still relatively new to GIS and to the Story Map program Kozalla found the FSF director and her professors to be supportive in providing guidance, but also giving her space to make my own decisions and develop ownership of the project, a common them in undergraduate research (Hanauer et al. 2012). She found that her experience bridged her coursework knowledge with a real-world environmental project, as has been highlighted in previous studies (Lei 2010).

Kozalla found that her GIS project with FSF facilitated planning for her year-long senior thesis when she learned that FSF was evaluating the impact of its forest management approach on forest birds in a cooperative project with the director of conservation and field research for the National Aviary. As a volunteer at the FSF

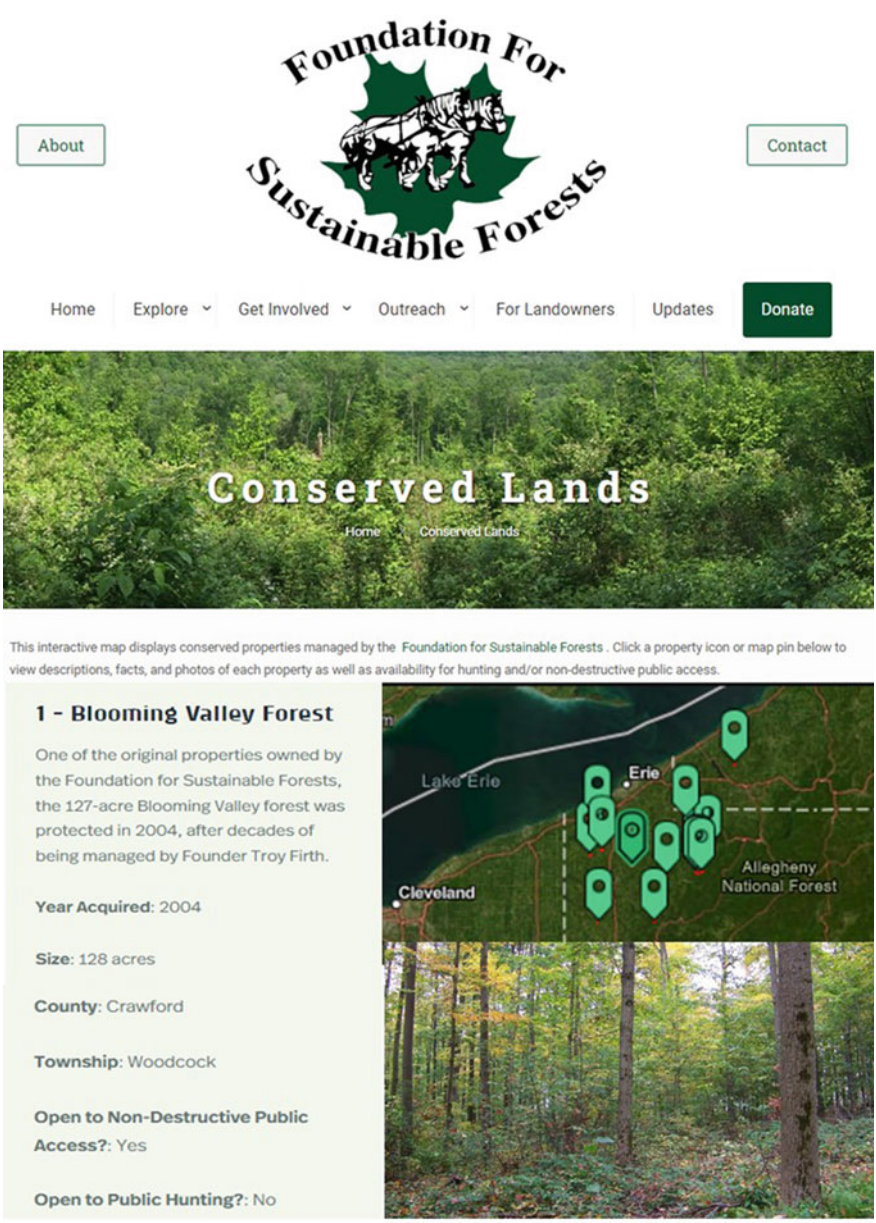

Fig. 2 Story map developed for the Foundation for Sustainable Forests

Loving the Land Conference, she met with the aviary director who was studying the role of forest openings as bird habitat, and needed to know landscape-level of their importance.

Having gained confidence through coursework and her previous work with FSF, Kozalla was confident in her ability to pursue a senior project that would be beneficial both to her goals as a student, and to FSF's goal to obtain an understanding of the role that canopy openings play in forests. She gained further confidence GIS knowledge and research skills, while also improving upon my interpersonal communication when asking questions and explaining her project to others.

As an undergraduate student pursuing career goals in conservation, Kozalla found that her involvement with conservation organizations equipped her with skills that would be valuable to an employer. As an information and education summer intern with the Pennsylvania Game Commission, her GIS knowledge, her knowledge of conservation, and her ability to communicate with the public and other conservation organizations, she had been saw a direct connection between her educational experiences and desired qualifications employment upon her college graduation.

In reflecting on her partnership with the FSF, she remarked on the benefits of having a professor who has introduced her to cooperate with a community organization, as well as the organization's willingness to allow her to participate in their work. She learned the need to be patient and mindful of both the mission of the FSF as well as her personal goals as a student. She was able to trust in her ability to think independently, while communicating the questions she had with my stakeholders and professors.

3.2.1 Community Partner Perspective

As a small nonprofit organization with no more than one full-time employee at any time during its 18-year tenure, community partnerships are invaluable to FSF for a number of reasons—ranging from broadening awareness of the FSF and its mission, to furthering mission impact directly through specific outputs. The right project, with the right person(s), can prove invaluable and add novel dimensions to FSF's work. While there are risks inherent to the partnerships, such as investment costs that may not be returned, the honing of the partnership process over time has yielded measurable and valuable outcomes towards FSF's mission to conserve forested land and highlight sustainable forestry practices that benefit the land.

3.2.2 Benefits

Capacity is naturally one of the biggest barriers to mission success and organizational growth. Student partnerships with Allegheny College have provided meaningful opportunities to overcome this barrier for specific undertakings throughout FSF's history, particularly when the skills of the student(s) and the needs of the project are well matched. Furthermore conservation efforts increasingly require effective

partnerships across wide ranges of groups and organizations (Guerrero et al. 2014; Gavin et al. 2018).

Specific examples of the most successful partnerships to date highlight the benefits and keys to success. A class that was learning Geographic Information Systems (GIS) mapping software completed a thorough analysis of privately-owned wooded parcels in five counties in northwestern Pennsylvania. Their undertaking yielded a database of thousands of woodland owners that FSF was able to reach strategically regarding the importance of caring for and conserving their woodlands. New lands were conserved, new partnerships formed, and new supporters recruited. The class had a skill set that FSF did not have at the time, and the benefits to the organization were clear. For their part, the students had a positive, applied learning experience, and the knowledge that their good work helped to conserve forested lands in perpetuity.

A successful example of an individual student partnership was an independent study with a student specialized in journalism and environmental studies in 2018. The student is a talented writer who applied her skills to curate a quality, well-received collection of landowner stories that was featured in print and social media. These stories provided critical connections between the community and FSF, and one semester of partnership yielded two years of newsletter content. Volunteers and staff have since contributed additional stories, but capacity remains a challenge. Having a student dedicate a semester project to compiling stories in quantity carried this initiative forward by leaps and bounds. For her part, she learned a great deal about environmental writing and journalism, which she is pursuing in her career.

Alleviating workload can be an important benefit to collaborators. The student (Kozalla) who created a story map that highlighted FSF's conserved lands reduced some workload for the foundation, as the number of phone calls to FSF's office regarding property access and locations has declined significantly, and FSF has received positive feedback from grantors and supporters about the map's appearance and efficacy.

3.2.3 Costs and Challenges

One of the most measurable costs of collaboration is the investment of time by limited FSF personnel in training, mentorship, and monitoring of community partners at each phase. This is in an investment in the partnership, with the hope that the returns will equal or surpass the costs. In over a decade of partnerships, FSF has found that this has largely been the case. Still, there have been occasions where specific projects yielded little or no benefits to the FSF, despite the time and resources devoted to them.

In parsing out class projects, it can be challenging to adequately convey effective knowledge of the organization, sustainable forestry, and the culture of private forest landowners in the region to a classroom that may not yet have the necessary foundations to embrace and apply it. There are costs to both parties involved; through my observations the students can feel the stress of wanting to succeed while not feeling comfortable with the material, and FSF is less likely to receive a useful product.

Although the challenges described above are not entirely avoidable, if the community partner is intentional in its approach the associated costs can be significantly diminished and positive impacts thus enhanced. When it comes to individual projects, thoughtful communication of specific goals and expectations (i.e. SMART—Specific, Measurable, Achievable, Realistic, and Time-bound) very early in the partnership is crucial. In these cases, should the partnership ultimately prove unsuccessful, there is generally less of an investment in time and resources, since bench-marking along the way helps to identify potential problems early.

For classroom-based projects, the intentional relaying of relevant information alongside the thoughtful omission of tangential material can build confidence in the students and maintain their focus on the specific project at hand. An introductory visit with FSF early on, and a mid-semester check-in, can effectively redirect or reassure the students and increase the efficacy of the final product.

3.3 Alumni Perspective

FSF has collaborated with a number of local colleges and universities over the last eighteen years. Despite wide variety in the academic focus of these classes, projects have always centered on themes of forest stewardship and conservation. These collaborative projects allow unique opportunities to amplify our impact. From the viewpoint of FSF, working with a classroom of students allows us to train a small group of focused partners and then utilize their perspectives and skills to accomplish both more, and better, work than could be done otherwise. Often these students are eager for an experiential learning opportunity, and pleased to put into practice their academic understanding of forest conservation.

As an alumnus, Dunkley's progression to a professional forester proceeded from a youth playing in the forests of Crawford County, to a college student conducting research in those forests, and then to a professional working in and managing them, giving him perspective about interactions between the human community and rural land.

As a student at Allegheny College, twenty years ago, Dunkle recalled a tour where an academic course class met with the founder of FSF. As a student, he was fascinated by the specific techniques of managing forests with varied and diverse conditions, asking how one can you tell which trees, and how many, to cut. His professional years of experience since then, now helps him when he answers that same question posed by students. Importantly, Dunkle can also relate to their inquisitiveness as well as their attempts to learn how forest harvesting can be a conservation technique. These forest tours are typically the first interaction that FSF has with student groups. This provides an opportunity to introduce important concepts in forest conservation, and to discuss projects where in need of assistance. Often, students who are inspired or intrigued by these tours approach FSF in later semesters to offer help via volunteer work, or through academic projects through course projects, internships and senior projects. These intensive experiences can yield excellent results for FSF; students are

available for large chunks of time, and there is accountability to both the academic institution, and to FSF, for the quality and quantity of work. Such connections are also important in bringing into the classroom the kinds of knowledge and experience that are relevant to student employment after graduation, and showing students that in the real-world, this learning and experiential education is valuable, particularly as many students view classroom learning and the work world as different life-spaces (Dahlgren et al. 2008). To meet this challenge, faculty members are encouraged to connect with professional bodies to link academic activities with requirements for successful employment (Munge et al. 2017).

4 Conclusions and Lessons Learned

We acknowledge that our experience at a small school is not likely to be applicable at all institutions. Specific to forest conservation, urban universities may have logistical hurdles in getting to natural regions, and natural resource agencies and organizations may not be found locally. Time and resources are also important limitations. For example, the ability to get students afield, funds for transportation, the ability to find willing partners will all contribute to the ability to develop successful partnerships.

We conclude that although this is a single example of a partnership between a university and a community organization, there are numerous benefits to the partnering organizations and to students and faculty members. There are indeed challenges that must be considered, but with careful planning and thoughtful attention, the benefits exceed the challenges for all involved.

Based on our experience, we provide lessons that we have learned in our collaboration between Allegheny and FSF. These guidelines will be relevant not only in college-forest conservation partnerships, but likely to be useful in many such efforts. Our suggestions are similar to those offered for successful mentoring of undergraduate research (Shanahan et al. 2015), but are geared more toward development of successful collaborations with community partners.

Clear communication between the college and partner

We have found it valuable to have frank conversations between Allegheny and FSF at the outset of projects and periodically during the project. Academically, it is natural for faculty members to be constantly thinking about the project as the course proceeds. However, FSF is a small organization with limited personnel, and many issues demand time. Faculty need to know that their project is not the only thing going on in the partner organization. Likewise, community partners need to know that the collaborative project is not the only thing that the faculty member is doing. Communicating as often as is needed, but not more so, is critical.

Select the right project

Our projects have not been easy, but all have been selected as being appropriate to the course level and of having a high likelihood of being successful. Risky projects

that don't work can sour students to a course, then making overall course objectives hard to accomplish. Students can also become frustrated and disenchanted, losing interest in the course and the project. Partners also do not have time for projects that are unlikely to succeed.

Have realistic expectations

Students have come into most of our projects with no experience or background in forests or forest management. Hence, getting up to speed is part of the process if the project is to be done correctly. Of course, this expectedly takes time away from the project itself.

Treat students as professionals

Students will absolutely rise to the challenges of these projects, especially when they are treated as valuable, contributing members of the project. They will need leeway to explore, sometimes be wrong, and allowed to follow the wrong paths at times. Guiding them, rather than telling them what to do, enhances confidence and furthers learning.

Treat all sets of partners as professionals

Avoid the common ivory tower mistake of treating community partners as lesser equals. They have invaluable skills and insights in the real world that are highly beneficial to students, and have usually been achieved due to a great deal of training and worldly experience. Likewise, community partners should not assume that college personnel lack experience or the ability to understand the real world.

Reassuring students

Students generally have little experience with course-based projects. They need to be guided in the process, alternative plans need to be explained clearly, and students need to be shown that setbacks are expected but can be overcome.

Remember that this is a course

Ultimately, students are in the course to learn both material and the process of conducting a project. Whereas the success of the project is highly desirable, students are not employees of the course or the partnering institution.

References

AACU (2022) High-impact practices. Association of American Colleges and Universities. https://www.aacu.org/trending-topics/high-impact. Last Accessed 26 January 2022

AASCU (2002) Stewards of place: stepping forward as a guide for leading public engagement at state colleges and universities. American Association of State Colleges and Universities. www.aascu.org. Last Accessed 18 Mar 2022

Albright TA (2018) Forests of Pennsylvania, 2017. Resource Update FS-175. U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA, 4 pp. org/https://doi.org/10.2737/FS-RU-175

Bensel T (2001) Promoting certified sustainable forestry on private woodlots in northwestern Pennsylvania: challenges and opportunities. Local Environ 6:257–278

Black BA, Ruffner CM, Abrams MD (2006) Native American influences on the forest composition of the Allegheny Plateau, northwest Pennsylvania. Can J for Res 36:1266–1275. https://doi.org/10.1139/x06-027

Bowden RD, Ams K, Bensel T, Bethurem M, Boulton K, Branby L, Bradshaw-Wilson C, Byrnes Carbone I, Choate B, Demi L, Kedzierski W, Pallant E, Pearce K, Shaffer C, Swann-Quinn J (2022) Teaching beyond campus borders: engaging students in community-based projects and research. In: Submitted to 5th world symposium on sustainable development at universities (WSSD-U-2022) June 2022 Allegheny College, Meadville, PA

Bowden RD, Deem L, Plante AF, Peltre C, Nadelhoffer N, Lajtha K (2014) Litter input controls on soil carbon in a temperate deciduous forest. Soil Soc Am J 78:S66–S75

Brame C. (2016) Active learning. Vanderbilt University Center for Teaching https://cft.vanderbilt.edu/active-learning/. Last Accessed 18 January 2022

Butler BJ, Butler SM (2016) Family forest ownerships with 10+ acres in Pennsylvania, 2011–2013 Res. Note NRS-234. U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA, 2 pp. https://doi.org/10.2737/NRS-RN-234

Dahlgren MA, Reid A, Dahlgren LW, Petocz P (2008) Learning for the professions: lessons from linking international research projects. High Educ 56:129–148. https://doi.org/10.1007/s10734-007-9094-0

Fajvan M, Grushecky ST, Hassler CH (1998) The effects of harvesting practices on West Virginia's wood supply. J For 96:33–39. https://doi.org/10.1093/jof/96.5.33

Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, Wenderoth MP (2014) Active learning increases student performance in science, engineering, and mathematics. Proc Nat Acad Sci 111:8410–8415

Gavin C, McCarter J, Berkes F, Mead ATP, Sterling EJ, Tang R, Turner NJ (2018) Effective biodiversity conservation requires dynamic, pluralistic, partnership-based approaches. Sustainability 10:1846. https://doi.org/10.3390/su10061846

Guerrero AM, Mcallister RRJ, Wilson KA (2014) Achieving cross-scale collaboration for large scale conservation initiatives. Conserv Lett 8:107–117. https://doi.org/10.1111/conl.12112

Holmes TP, Aukema JE, Von Holle B, Liebhold A, Sills E (2009) Economic impacts of invasive species in forest past, present, and future. In: The year in ecology and conservation biology, 2009 Ann NY Acad Sci 1162:18–38

Hanauer DI, Frederick J, Fotinakes B, Strobel SA (2012) Linguistic analysis of project ownership for undergraduate research experiences. CBE-Life Sci Educ 11:378–385. https://doi.org/10.1187/cbe.12-04-0043

Jones JC, Washko S (2021) More than fun in the sun: the pedagogy of field trips improves student learning in higher education. J Geosci Ed. https://doi.org/10.1080/10899995.2021.1984176

Kelty MJ, D'Amato AW (2005) Historical perspective on diameter-limit cutting in northeastern forests. In: Kenefic, Laura S, Nyland RD (eds) Proceedings of conference on diameter-limit cutting in northeastern forests 2005 May 23–24, Amherst, MA. Gen Tech Rep NE-341. U.S. Forest Service, Northeastern Research Station, Newtown Square, PA

Lei SA (2010) Field trips in college biology and ecology courses: revisiting benefits and drawbacks. J Instr Psych 37:42–48

Linn MC, Palmer E, Baranger A, Gerard E, Stone E (2015) Undergraduate research experiences: impacts and opportunities. Science 347(6222). https://doi.org/10.1126/science.1261757

Moss SA, Heitzman E (2013) The economic impact of timber harvesting practices on NIPF properties in West Virginia. In: Miller GW, Schuler TM, Gottschalk KM, Brooks, JR, Grushecky ST, Spong BD, Rentch JS (eds) Proceedings of 18th central hardwood for conference 2012 March

26–28; Morgantown, WV; Gen Tech Rep NRS-P-117. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station, pp 129–141
Munge B, Thomas G, Heck D (2018) Outdoor fieldwork in higher education: learning from multidisciplinary experience. J Experien Educ 41:39–53. https://doi.org/10.1177/1053825917742165
Nowacki GJ, Abrams MD (2008) The demise of fire and "mesophication" of forests in the eastern United States. Bioscience 58:123–138. https://doi.org/10.1641/B580207
Nyland RD (2005) Diameter-limit cutting and silviculture: a comparison of long-term yields and values for uneven-aged sugar maple stands. North J Appl for 22:111–116. https://doi.org/10.1093/njaf/22.2.111
PA Dept of Agriculture (2022) Forest products industry in Pennsylvania. Hardwoods Development Council. https://www.agriculture.pa.gov/Business_Industry/HardwoodDevelopmentCouncil/pages/default.aspx. Last Accessed 31 January 2022
Pennsylvania State University (PSU) (2022) Pennsylvania forest stewardship talking points. Penn State College of Agricultural Sciences. https://ecosystems.psu.edu/research/centers/private-forests/outreach/legacy-planning/talking-points/pennsylvania-forest-stewardship-talking-points. Last accessed 26 January 2022
Rawinski TJ (2008) Impacts of white-tailed deer overabundance in forest ecosystems: an overview. Northeastern Area State and Private Forestry, Forest Service, U.S. Department of Agriculture, Newtown Square, PA. www.na.fs.fed.us. Last Accessed 31 January 2022
Shanahan JO, Ackley-Holbrook E, Hall E, Stewart K, Walkington H (2015) Ten salient practices of undergraduate research mentors: a review of the literature. Mentoring Tutoring: Partnership Learn 23:359–376. https://doi.org/10.1080/13611267.2015.1126162
Sampson N, DeCoster L (2000) Forest fragmentation: implications for sustainable private forests. J Forestry 98:4–8. https://doi.org/10.1093/jof/98.3.4
US Forest Service (USFS) (2021) State and private forestry fact sheet, Pennsylvania 2021
US Forest Service (2020) Forests of Pennsylvania, 2019. Resource Update FS-251. U.S. Department of Agriculture, Forest Service, Madison, WI, 2 pp. https://doi.org/10.2737/FS-RU-251
Whitney GG (1996) From coastal wilderness to fruited plain: a history of environmental change in temperate North America from 1500 to the present. Cambridge University Press, Cambridge, 488 pp. ISBN-10: 052139452X
Whitney GG, DeCant JP (2003) Physical and historical determinants of the pre-and post-settlement forests of northwestern Pennsylvania. Can J for Res 33:1683–1697

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Sustainability in Higher Education Procurement: The Role of Employee Paper Purchasing Decisions

Nathaniel Elser and Judd Michael

1 Introduction

Sustainability has become a paramount issue for many organizations as stakeholders become increasingly ardent in the expectation they take genuine steps to minimize the environmental and social impacts of their operations. Organizations of all types now consider sustainability to be strategically, if not inherently, important to their long-term success. This is especially true in higher education, where institutions face pressure from myriad stakeholders both internal and external to the organization.

Institutions of higher education (HEIs) today often pursue sustainability in a holistic manner, integrating sustainability into their day-to-day operations as well as their long-term strategic plans. Institutional purchasing has become a crucial component to the overall sustainability performance of HEIs. Purchasing decisions can broadly impact university operations and are also within the scope of institutional control.

One area of university procurement that is commonly a focus of sustainability efforts is paper products. Much of the attention that paper products receive is due to the environmental burdens people often associate with their production, namely deforestation. For instance, the Union of Concerned Scientists has identified wood products, including wood pulp, as one of the "big four" agricultural commodities driving global deforestation. Paper products are also so ubiquitous in university settings that nearly all campus users will be directly exposed to them on a daily basis, making them a very visible issue for stakeholders. Another contributing factor to the

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attention given to paper products is likely that, in terms of ways to improve sustainability performance, changing how paper products are purchased and consumed is a "low-hanging fruit" relative to other major initiatives like banning plastics on campus or becoming carbon neutral.

Reducing paper consumption has long been a focus of organizational sustainability efforts. Despite this, many organizations struggle to decrease overall paper consumption. Organizations that have employed common paper reduction strategies, such as removing personal printers, setting duplex printing as default, digitizing records, and utilizing print management services have experienced varying levels of success. A recent publication, in which the paper reduction efforts of five institutions were highlighted, reported reductions in paper use ranging from 18 to 32% (Van Leuvan et al. 2019). Although these are positive outcomes, they suggest that limits exist in the effectiveness of sustainability efforts that focus solely on reducing paper use. The implication then is that beyond paper reduction practices, HEIs and other organizations must also manage the impact of their unavoidable paper consumption.

As a result of these motivations and others, many HEIs have adopted paper purchasing policies or guidelines that prioritize products with sustainability certifications (i.e., FSC, SFI, PEFC) or that contain recycled fiber. Many universities, however, may find it challenging to achieve substantial improvements in purchasing outcomes following implementation of green purchasing policies. This is particularly true for large HEIs with decentralized purchasing systems in which authority for minor procurement (ex., purchasing office supplies) is widely distributed among many employees. Achieving sustainability goals in these contexts may require compliance of hundreds or even thousands of employees across many locations.

Understanding how individual differences and contextual factors influence employee purchasing decisions is important for improving the sustainability of organizations and their supply chains. A goal of this study is to add to the limited body of literature addressing sustainable purchasing behaviors of administrative staff members in organizational contexts. Through application of an extended theory of planned behavior (TPB) framework, this study investigates antecedents to employee intentions to purchase recycled copy paper in the context of a large research university as a means to understand how purchases of sustainable materials can be managed and encouraged within a higher education setting. This project has implications for how university staff should be educated regarding the availability and benefits of more sustainable products that can be purchased for their organization.

2 Background

2.1 Sustainable Supply Chain Management

Within the Supply Chain Management (SCM) field, Sustainable Supply Chain Management (SSCM) has become a dominant domain over the past decade (Rajeev

et al. 2017) and is now one of the most dynamic research areas in the broader SCM field (Martins and Pato 2019). Organizational motivations for pursuing sustainability within supply chains can be similar to those for traditional supply chain management, namely reducing risk and creating competitive advantage. Attention from NGO's can also influence public sentiment, potentially weakening or strengthen a company's brand. For instance, the National Resource Defense Council recently published a sustainability "report card" for products of major tissue brands, focused largely on how the raw materials of each brand are sourced (Skene and Vinyard 2019).

2.2 Minor Procurement

Over the past two decades, SSCM and green procurement research has largely focused on areas of procurement that are vital and strategically important to companies, particularly those in manufacturing and production contexts (Haake and Seuring 2009; Boström 2015; Mosgaard 2015). In some cases, managing these supplier relationships can also be a key source of competitive advantage.

The current study, however, is primarily concerned with office supplies, which are classified as noncritical items in Kraljic's (1983) model. Referred to here as minor procurement, this generally includes all those areas of procurement that present little risk to an organization. That is, goods and services that are not part of core operations, are readily and widely available from multiple sources, have little impact on profits, are not strongly associated with the organization's brand or image, etc. Although minor procurement is rarely prioritized in the SSCM practices of most organizations and has received only limited attention in the SSCM literature, it can nonetheless pose a significant risk to environmental sustainability.

2.3 Sustainable Procurement in the Higher Education Context

Formal policies that are developed to guide purchasing decisions by taking into account environmental sustainability are often referred to as Environmentally Preferable Purchasing (EPP) programs or simply "Green Procurement" (Li and Geiser 2005). In the context of higher education, universities are increasingly placing greater emphasis on sustainability in procurement functions. According to the National Association of Educational Procurement (NAEP), results from their annual Green Procurement Survey indicated that 40% of responding institutions had a formal green procurement policy in 2016, up from 24% in 2009 (NAEP 2016) with other research suggesting even more HEI's have such policies now (AASHE 2021).

Sustainable procurement programs in university contexts can be broad, addressing a variety of expenditure areas from energy to food service packaging. Environmentally preferable purchasing policies though are often more narrowly focused on commodity products that support the day to day operations of universities, such as cleaning products, office supplies, furniture, etc. Due to the vast selection of these kinds of products, it is not feasible for procurement managers to assess the relative environmental attributes of all competing products. Instead, EPP policies typically rely on third party certification systems to identify and assign purchasing preference to different products (e.g., BIFMA, ENERGY STAR, BPI). Seemingly all EPP guidelines for paper products focus on recycled content and/or certification programs that ensure responsible sourcing.

2.4 Paper Purchasing in Higher Education: Policies and Trends

As noted in the previous section, most EPP guidelines rely on third-party certification systems to assign purchasing preferences based on sustainability attributes. For paper products, the most commonly cited certifications in the United States are those of the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI). Though the policy details, requirements, and administration methods of these certification schemes can differ substantially, the general focus of these programs is how and where wood materials are being sourced (World Wide Fund For Nature 2015; Skene and Vinyard 2019; Environmental Paper Network 2018).

With regard to recycled content, many universities have established or proposed procurement policies that prioritize high levels of recycled content as a key consideration in purchases of paper products. For example, Princeton University implemented a university-wide policy in 2004 requiring all printing, copying, and writing grade papers to be certified 100% post-consumer recycled content (Princeton University 2004).

2.5 Research Framework

The theory of reasoned action (TRA) (Fishbein 1967) and, by extension, the theory of planned behavior (TPB) (Ajzen 1985), were developed to better explain the role of attitudes in the formation of intentions and, ultimately, in determining actual behaviors. A simplistic explanation of TPB is that, according to the model, behavior is a function of salient beliefs applicable to the behavior (Ajzen 1991). As was noted earlier, TPB is an extension of TRA, with the fundamental difference being the addition of perceived control. Including a measure of control as a predictor to behavioral intention is an acknowledgement that few behaviors are entirely volitional,

as most require at least some kind of resource (ex., ability, opportunity, knowledge, skill, etc.) that is not universally held by all people. Central to both theories though is the direct relationship between behavioral intention and behavior. According to Ajzen (1991), "intentions are assumed to capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (p. 181). The general expectation, then, is that the likelihood of performing a behavior increases as the strength of the behavioral intention increases.

The theory of planned behavior has become one of the most prominent frameworks for explaining sustainability related behaviors of individuals (Norton et al. 2015). For example, TBP has been used to explain decisions to engage in sustainable agricultural practices, environmental activism, household waste reduction, recycling, energy conservation, carpooling, and use of public transportation (Fielding et al. 2008a, b; Graham-Rowe et al. 2015; Tonglet et al. 2004; Abrahamse and Steg 2009; Bachmann et al. 2018; Heath and Gifford 2002).

Similarly, TPB is also commonly used to explain consumer behaviors involving green purchasing decisions. Some examples of green purchasing behaviors the TPB framework has been applied to include decisions related to consumer electronics, organic personal care products, eco-friendly restaurants, product packaging, organic food, local food, and green hotels (Young et al. 2010; Yeon et al. 2011; Kim et al. 2013; Martinho et al. 2015; Yazdanpanah and Forouzani 2015; Kumar and Smith 2018; Han et al. 2010).

Of particular interest to researchers investigating these types of purchasing decisions is what is known as the "attitude-behavior gap," which describes the difference between a person's general attitude about an issue and their actual behavioral decisions related to that issue. For example, a large proportion of consumers may report being concerned about climate change yet only a small minority of those same consumers choose to purchase electricity exclusively from renewable sources. The attitude-behavior gap here is represented by those consumers who express concern for the climate but fail to translate those concerns into purchasing behaviors that align with their attitude. Factors that constrain green purchasing decisions may include a lack of knowledge about the product, limited availability, and sacrifices in terms of performance, costs, or convenience (Moser 2015).

3 Methodology

The organizational context for this study was a large research university in the United States. The University has over 35,000 employees and has historically purchased in excess of 150 k reams of copy paper in a typical year. Sustainability is prominent throughout the organizational operations of the university; it currently has a gold rating in the STARS program and leads its relevant peers with the highest overall STARS program score (AASHE 2021).

The research population of the study was employees with purchasing responsibilities for non-critical items (i.e., minor procurement), particularly office supplies. The university has a largely decentralized purchasing system, in which purchasing authority is widely distributed among thousands of employees. Since a large majority of office supplies, and the vast majority of copy paper, are procured through the university's electronic purchasing catalog, the research utilized data from Purchasing Services to determine the size and identify members of the research population.

Although over 3,000 employees typically complete at least one purchase through the university's online purchasing system each year (Sheth 2018), this study focused only on those employees who had purchased copy paper products. More specifically, the research focused only on those employees who had purchased standard copy paper products in FY 2019–2020.

Limiting the study to purchases of a single type of product was advantageous for multiple reasons. First, the product attributes on which purchasing decisions are made were directly comparable across purchasing outcomes. Since all products had the same functional attributes (i.e., size, weight, color, application, etc.), the effect of differences in price, environmental certifications, and fiber content should be more pronounced. Furthermore, studying purchases of a single type of product reduces the variability in how buyers evaluate and compare different sustainability related attributes. For copy paper products, the primary sustainability related attributes are environmental certifications and fiber content (i.e., recycled vs. virgin). Finally, limiting the study to a single type of product allowed for "apple to apple" comparisons between purchasing decisions. That is, since all of the products included in the analysis were direct substitutes of one another, a decision to purchase one was effectively a decision not to purchase another.

3.1 Sampling Design

An initial analysis of purchasing data was conducted to determine the approximate size of the research population. It was found that 24 items accounted for more than 98% of the total spend on standard copy paper products. The 24 standard copy paper product items served as the basis for initially identifying and estimating the size of the research population during the planning phase of the study (n = ~950).

The final research population was based on a slightly modified list of 26 copy paper products purchased in FY 2019–2020. Purchasing history for these products was obtained from Purchasing Services, covering an approximately 12 month period prior to the survey's administration in June 2020, roughly representing the 2019–2020 FY. The data represented approximately 3,000 unique purchase orders, each including at least one of the 26 copy paper products. Only university employees who submitted purchase orders totaling at least ten reams (or one case) of copy paper during the research period were selected to participate in the study, resulting in a final research population of 873 cases.

3.2 Administration of the Survey Instrument

The questionnaire was administered online using Qualtrics. An invitation to participate in the study was emailed in July, 2020 to the work email address of research population members ($N = 873$). The survey remained active for a period of two weeks, during which two additional reminder emails were sent to nonrespondents. In total, 263 participants provided useable data, representing an effective response rate of 30.8%. Notably, it is estimated that over 90% of participants were female. Although this proportion is quite high, it was not unexpected given the known percentage of female staff employees in this university.

3.3 Measures and Questionnaire Design

Behavioral beliefs and sources of normative pressure were identified through literature review and consideration of contextual factors. All items were measured using the same 7-point Likert-type scale with anchors of Strongly Agree to Strongly Disagree. Descriptions of the items and scaling procedures are provided below.

Subjective norm was calculated as a latent variable reflecting both normative beliefs and motivations to comply with the associated referent groups. Since the research is focused on purchasing behavior in a professional capacity (as opposed to purchasing for personal use), referent groups specific to the organizational context were selected as these are of most interest to the research and likely to be among the most salient for employees. Specifically, normative belief strengths were measured by asking participants if they agreed/disagreed that each of the following groups would approve of their purchasing recycled copy paper: my supervisor (IN1), my coworkers (IN2), students (IN3), faculty (IN4), and university leadership (IN5). Similarly, participants were also asked about their motivation to comply (MC) with each of these groups (ex. "when it comes to purchasing copy paper, I want to do what _____ thinks I should do") (MC1-MC5). Taking motivation to comply into account effectively weights the behavioral beliefs of important referents while discounting those of unimportant referents. Finally, a direct measure item for normative pressure was also included ("most people who are important to me think I should purchase recycled copy paper") (SND) as a means of confirming the saliency of the identified referent groups and the validity of the latent subjective norm variable.

Following the recommendations of Fishbein and Ajzen (2009), normative belief strength items were scored on a bipolar scale (−3 to 3) while motivation to comply items were scored on a unipolar scale (1–7). The reason for doing this is that the scores for each pair of items were then multiplied to produce an overall score (ex., IN1xMC1 = SN1) reflecting the strength and direction of perceived pressure from each referent group (SN1-SN5), potentially ranging from −21 to + 21.

Like the measures of subjective norm, attitude items (IA1-IA7) were also composite measures, in this case composed of item pairs measuring behavioral

beliefs and evaluations. The beliefs and evaluations addressed issues commonly associated with recycled copy paper. Specifically, behavioral beliefs were measured by asking participants if they agreed/disagreed that purchasing recycled copy paper: helps my unit/department be more sustainable (BB1), leads to paper jams and other printer malfunctions (BB2), helps prevent deforestation (BB3), increases the operating expenses of my unit/department (BB4), helps to conserve our natural resources, (BB5), hurts communities that rely on the forest products industry for jobs and economic growth (BB6), and can support local business (BB7). Items BB2, BB4, and BB6 were reverse coded. The final item (BB7) was contextually specific as a key supplier of recycled copy paper is located in the same region as the university. Behavioral belief items were scored on a bipolar scale ranging from −3 to + 3.

Whereas behavioral beliefs items are intended to measure the subjective probability that a behavior leads to a particular outcome (ex., purchasing recycled copy paper leads to paper jams), behavioral evaluation items are intended to measure positive or negative perceptions of the outcome. This approach of measuring outcome beliefs paired with outcome evaluations is based in the expectancy-value model of attitude formation (Fishbein 1963). Behavioral evaluation (BE1-BE7) items asked respondents if they agreed/disagreed with statements assessing the value of each outcome (ex., "deforestation is a serious problem"; "it is important to help my unit/department be more sustainable") and were scored on a unipolar scale ranging from 1 to 7. Product scores of behavioral belief and evaluation items were calculated for each outcome (ex., BB1xBE1 = ATT1) as indicators of the instrumental attitude latent variable (ATT1-ATT7).

In line with recognized best practices for TPB studies, direct measures of attitude were also included (Fishbein and Ajzen 2009; Oluka et al. 2014). These measures (AD1-AD4) focused on instrumental aspects of the behavior (i.e., good, important, useful, etc.) rather than experiential aspects (i.e., pleasant, exciting, fun, etc.). Since the actual process of purchasing recycled copy paper is effectively the same for all members of the research population, items measuring experiential aspects would likely not have produced sufficient variation in responses. Direct measures of attitude asked participants if they agreed/disagreed with the following statements: purchasing recycled copy paper is a good idea (AD1), it is important to purchase recycled copy paper (AD2), purchasing recycled copy paper does more harm than good (reverse-coded; AD3), and purchasing recycled copy paper is worthwhile (AD4). The four direct measure items were scored on a unipolar scale ranging from 1 to 7 and averaged to create a composite score of attitude ($\alpha = 0.73$) to measure correlations with the identified behavioral outcomes.

The final core predictor in traditional TPB models is, of course, behavioral control. Measures of perceived control often address separately the capacity to perform a behavior (ex., "If I wanted to, I could easily _____" or "I have the ability to _____") and the autonomy to perform a behavior (ex., "Whether or not I _____ is completely up to me" or "I have control over whether or not I _____").

In the case of the current study, it was not expected that members of the research population would face substantial challenges or obstacles to purchasing recycled paper. In the organizational context of the study, the process for purchasing recycled

copy paper is nearly identical to that of virgin fiber copy paper. Access, availability, cost, and time to delivery are also effectively the same for both types of paper, with little differentiation among buyers. In general, the resources needed to purchase standard copy paper products are the same, regardless of fiber type.

Since the study is concerned with purchasing decisions related to minor procurement, measures of perceived control addressed autonomy within the purchasing function. Specifically, a single-item measure of task discretion from the European Quality of Life Survey (OECD 2017) was slightly modified to create a measure of purchasing task discretion. The item, which asked respondents if they agreed/disagreed with the statement, "with regard to making purchasing decisions, I have a great deal of influence in deciding how to do my work" (PTD), was scored on a scale ranging from 1 to 7. Although the generalized wording of the item does not follow the principle of compatibility with regard to the behavioral criterion (i.e., purchasing recycled copy paper), it is intended to reflect the decentralized nature of purchasing authority for minor procurement activities (see Kraljic 1983).

Environmental involvement was measured with four items, scored on a unipolar scale from 1 to 7: "I am concerned about the environment" (EI1), "the condition of the environment affects the quality of my life" (EI2), "I am willing to make sacrifices to protect the environment" (EI3), and "my actions impact the environment" (EI4) (Schuhwerk and Lefkoff-Hagius 1995; Wei et al. 2017). Finally, behavioral intention was measured with three items based on standard TPB measures and scored on a unipolar scale from 1 to 7: "when purchasing copy paper, I intend to select products made with recycled content" (BI1), "I am willing to purchase copy paper that contains recycled material" (BI2), and "I plan to choose products that are made from recycled material when purchasing copy paper" (BI3).

4 Data Analysis and Results

4.1 Descriptive Statistics for Calculated Measures

Table 1 presents descriptive statistics for the normative belief (IN), motivation to comply (MC), and INxMC product measures for each of the referent groups, as well as correlations of the INxMC product measures with the direct measure of subjective norm.

As can be seen in Table 1, respondents on average identified their supervisors ($x = 1.92$) as being most supportive of purchasing recycled paper, followed by university leadership ($x = 1.79$) and coworkers ($x = 1.62$). Their motivation to comply with university leadership ($x = 5.51$) was substantially stronger than with coworkers ($x = 3.79$). Considering both measures in conjunction with one another, the INxMC product represents a measure of belief strength weighted by the motivation to comply with those beliefs. From this, it can be inferred that university leadership is the primary source of normative pressure to purchase recycled copy paper, followed

Table 1 Descriptive statistics for subjective norm measures

Referent Group	Normative belief (IN)[a]		Motivation to comply (MC)[b]		INxMC (SN)[c]		Correlation
	x	(SD)	*x*	(SD)	*x*	(SD)	INxMC with SND
My supervisor	1.92	1.04	5.00	1.30	9.74	6.20	0.36***
My coworkers	1.62	1.12	3.79	1.41	6.38	5.48	0.47***
Students	0.95	1.12	3.16	1.42	3.35	4.95	0.23**
Faculty	1.13	1.21	3.72	1.37	4.60	5.52	0.32***
University leadership	1.79	1.04	5.51	1.24	10.15	6.63	0.34***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Scored on a bipolar scale of −3 to +3; [b]Scored on a unipolar scale of 1–7; [c]Possible range of −21 to +21, actual range was −12 to +21

by supervisors ($x = 10.15$ and 9.74, respectively). Interestingly though, it was the weighted belief measure for coworkers that correlated (0.48) most strongly with the direct measure of subjective norm (SND), suggesting coworkers may be the most salient among the identified referent groups for university employees.

Table 2 presents descriptive statistics for the behavioral belief (BB), behavioral evaluation (BE), and BBxBE product measures for each of the identified outcomes, as well as correlations of the BBxBE product measures with the composite attitude score composed of the direct measures (AD).

As can be seen in Table 2, respondents on average agreed most that helping to conserve natural resources ($x = 2.42$) and helping their department be more sustainable ($x = 2.12$) were outcomes of purchasing recycled paper. It is worth noting again that items BB2 (leads to paper jams; $x = 0.82$), BB4 (increases expenses; $x = 0.11$), and BB6 (hurts communities; $x = 0.61$) were reverse coded. As such, results for these items in Table 2 indicate that respondents, on average, neither agreed/disagreed or slightly disagreed that these are outcomes of purchasing recycled paper. Similarly, there was only slight agreement on average that purchasing recycled paper can support local business ($x = 0.90$).

The behavioral strength measures (ATT1-ATT7) represented both the subjective probability that the outcome would occur as well as the overall evaluation of that outcome, measured as the product of the paired responses. These results suggest that the strongest behavioral beliefs, and so those theorized to most influence attitudes, were on average associated with the outcomes of conserving natural resources (ATT5; x = 16.56), helping my department be more sustainable (ATT1; x = 13.77), and helping prevent deforestation (ATT3; x = 9.14). The other identified outcomes of purchasing recycled paper are less likely to influence attitudes about the behavior, either positively or negatively.

Table 2 Descriptive statistics for attitude measures

Purchasing recycled copy paper outcome	Behavioral belief (BB)[a]		Behavioral evaluation (BE)[b]		BBxBE (ATT)[c]		Correlation
	x	(SD)	*x*	(SD)	*x*	(SD)	BBxBE with AD
Helps my unit/department be more sustainable	2.12	0.88	6.31	0.75	13.77	6.41	0.67***
Leads to paper jams or other malfunctions in our printer(s)	0.82	1.47	6.18	1.08	4.92	9.34	0.51***
Helps prevent deforestation	1.43	1.16	5.88	1.13	9.14	7.67	0.46***
Increases the operating expenses of my unit/department	0.11	1.33	6.46	0.75	0.77	8.83	0.20**
Helps to conserve our natural resources	2.42	0.69	6.74	0.52	16.56	5.16	0.64***
Hurts communities that rely on the forest products industry for jobs and economic growth	0.61	1.20	4.45	1.22	2.55	5.46	0.19**
Can support local business	0.90	1.19	6.18	0.92	5.81	7.78	0.34***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Scored on a bipolar scale of −3 to +3; [b]Scored on a unipolar scale of 1–7; [c]Possible range of −21 to +21, actual range was −21 to +21

4.2 Testing the Measurement Model

Confirmatory factor analysis (CFA) was then conducted to verify the measurement quality of the latent constructs used in the structural equation model and determine whether the item-factor structure of the proposed model supports the theorized constructs. A measurement model containing the four latent constructs of the research model and the 18 remaining indicator variables was created to calculate the factor loadings of the indicators on the associated latent constructs.

4.3 Testing the Structural Model

After establishing adequate fit of the measurement model, a structural model was specified representing the hypothesized dependence relationships among the variables. Path analysis was conducted using AMOS 27 to estimate the hypothesized relationships between environmental involvement, the TPB constructs, and intention to purchase recycled paper. The estimated structural equation model with standardized coefficients is presented in Fig. 1. The goodness-of-fit indices indicate an adequate fit of the model to the underlying data (CFI = 0.94, RMSEA = 0.08, SRMR = 0.06). Using the combinational rules proposed by Hu and Bentler (1999) for a model of this type, the RMSEA and SRMR indices both met the recommended cutoffs while the CFI parameter was just below the recommended level of 0.95. The chi-square statistic for the model was x^2 (68) = 155.65, $p < 0.000$. Again, significance of the chi-square statistic is expected for complex models (i.e., models having greater than 12 observed variables) with less than 250 observations (Hair et al. 2009). The structural model explained 81% of the variance ($R^2 = 0.81$) in employee intentions to purchase recycled copy paper.

The path coefficients between environmental involvement (EI), instrumental attitude (IA), purchasing task discretion (PTD), subjective norm (SN), and behavioral intention (BI) can be used to evaluate support for the hypothesized relationships by assessing their size, statistical significance, and direction. Each path coefficient was statistically significant; that is to say, an employee's instrumental attitude (a product of behavioral beliefs and behavioral evaluations), perceived task discretion, and

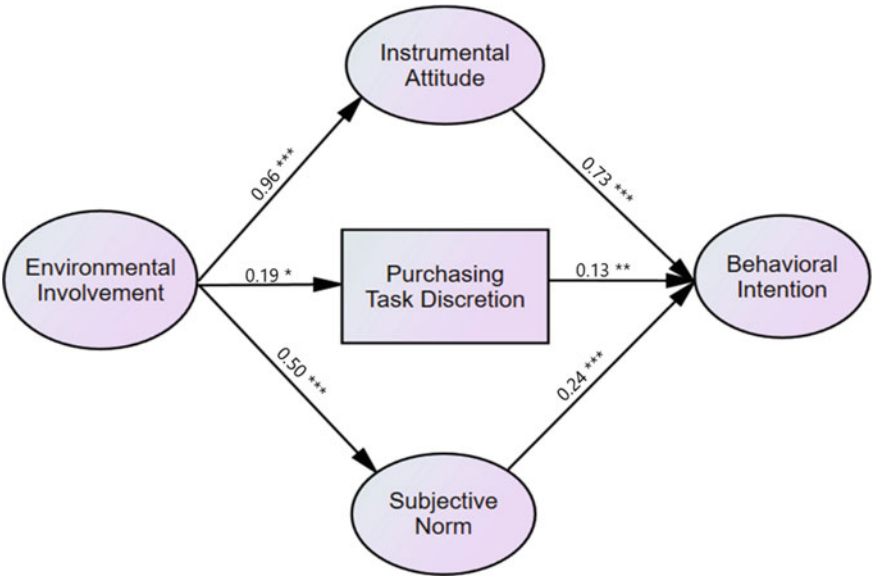

Fig. 1 Estimated structural equation model of employee intention to purchased recycled copy paper

subjective norm (a product of injunctive norms and motivations to comply with them) are all positively influenced by his/her environmental involvement. Furthermore, an employee's intention to purchase recycled copy paper is positively influenced by his/her instrumental attitude, perceived task discretion, and subjective norm.

We tested the multiple mediation between environmental involvement and behavioral intentions with path analyses comparing both indirect and direct effects. A partially mediated model that measured the direct effect of environmental involvement on behavioral intentions in addition to the indirect effects through the TPB measures was tested and compared to the fully mediated model of Fig. 1. To calculate the indirect effect of EI on BI via the collective TPB constructs, the indirect effects for each path from EI to BI were first calculated. Indirect effects are calculated as the product of all path coefficients (i.e., direct effects) between two related variables. The total indirect effect of EI on BI then is the sum of these compound paths. Table 3 presents the unstandardized path coefficients and associated confidence intervals. Direct and indirect effects were calculated using a bootstrapping method with bias-corrected confidence intervals at 95% (Crowson 2021).

Our expectation was that the positive impact of employee environmental involvement on intentions to purchase recycled paper would be mediated collectively by the core TPB measures (IA, PTD, SN). The total indirect effect of EI on BI accounts for the compound paths through IA, PTD, and SN. As shown in Table 3, the indirect effect of 1.465 ($\beta = 0.843$) is significant ($p < 0.05$) with CI range above zero, supporting the TPB measures (IA, PTD, SN) as collectively mediating the EI → BI relationship. Furthermore, under the partial mediation model in which the effect of EI on BI is measured directly as well as indirectly through the TPD measures, the coefficient ($\beta = -0.254$) representing the direct effect of EI on BI is nonsignificant ($p = 0.849$).

Table 3 Unstandardized path coefficients for direct and indirect effects

Path	Effect (*B*)	95% CI
EI → IA	9.486*	(7.03, 14.71)
IA → BI	0.128**	(0.10, 0.17)
EI → BI (indirect effect via IA)	1.211*	(0.85, 1.89)
EI → PTD	0.503*	(0.01, 1.10)
PTD → BI	0.085**	(0.02, 0.15)
EI → BI (indirect effect via PTD)	0.043*	(0.01, 0.10)
EI → SN	4.667**	(2.35, 7.79)
SN → BI	0.045**	(0.02, 0.08)
EI → BI (indirect effect via SN)	0.211**	(0.10, 0.45)
EI → BI (total indirect effect)	1.465*	(1.10, 2.22)

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

5 Discussion

5.1 Theoretical Contribution

Studies on procurement in organizations and supply chain management tend to focus on procurement professionals at the manager and executive levels (e.g., Swaim et al. 2016; Philippart 2016; Sánchez-Rodríguez and Martínez-Lorente 2004), since these individuals are more likely to be involved in developing purchasing strategies, setting purchasing goals, and managing supplier relationships. Not surprisingly then, the majority of research in sustainable supply chain management, as well as corporate social responsibility, is conducted at either the institutional or organizational levels of analysis.

Thus, one contribution to both the SSCM and CSR literatures of the current research is the individual level of analysis used. The lack of micro level research has been pointed to as a weakness of the SSCM field. Investigations of the human aspects of SSCM, such as the role of decision-making processes, interactions, perceptions, and behaviors in the implementation of SSCM programs, have been identified as a promising area of contribution to the SSCM field (Touboulic and Walker 2015).

This is not unlike the role of individual employees in organizational CSR practices. In one review of CSR literature, the authors called for CSR researchers to place greater emphasis on micro level investigations, noting that "although CSR takes place at the organizational level of analysis, individual actors are those who actually strategize, make decisions, and execute CSR initiatives" (Aguinis and Glavas 2012, p. 953). Likewise, in another review of how organizational behavior is being applied to the study of CSR, the authors noted that "although it is on behalf of corporations that acts of CSR are planned and completed, it is truly individuals who advocate for, comply with, and participate in CSR" (Rupp and Mallory 2015, p. 212).

Finally, this research helps to bridge the gap between the consumer and organizational behavior fields. The opportunity to draw on concepts from both fields (i.e., TPB, consumer involvement, task autonomy) comes from the focus on minor procurement decisions of administrative support staff. For minor procurement in decentralized purchasing contexts, employees typically have greater discretion for making purchasing decisions relative to contexts involving major procurement. Minor items, for example, typically do not need to meet complex specifications to ensure quality or compatibility with current processes. For reasons such as these, minor procurement decisions often don't involve the participation of other organizational members (Mosgaard et al. 2013). The absence of strong internal and external drivers to purchase certain products creates flexibility for employees to make purchasing decisions based on their own attitudes and beliefs, thus to some extent allowing them to behave more like end-consumers than organizational buyers.

5.2 Practical Implications

The information gained from this study can help guide development of HEI purchasing policies and practices. For example, understanding what factors influence employee decisions to purchase non-preferred products over preferred products can help both procurement and sustainability professionals identify solutions to more effectively encourage purchasing of preferred products. Likewise, practitioners in other HEIs with similarly decentralized purchasing systems would benefit from knowing key factors associated with employee purchasing decisions in that context, as this could inform the design of interventions intended to modify behavior.

In the context of large organizations with decentralized purchasing systems, it makes sense that individual employees with administrative purchasing responsibilities be included in the scope of SSCM. Otherwise, efforts made by organizational leaders to implement SSCM practices could fall short, since actual purchasing decisions are still being made by many employees operating beyond the prescribed parameters of those practices. For instance, procurement managers in an HEI may require apparel suppliers to complete an extensive vetting process to determine whether the upstream supply chain meets ethical standards. However, a staff level employee conducting an apparel sale for members of a department within that HEI could select the least expensive supplier without ethical considerations of the supply chain.

Paper products is one such area that should be critically evaluated by most HEIs due to the sheer volume in which they are consumed by universities and the substantial differences in environmental impact that can exist among effectively identical products. Furthermore, in contexts of HEIs with decentralized purchasing systems, it is crucial to understand the antecedents of purchasing decisions involving paper products in order to develop effective green purchasing strategies. For instance, results from this study suggest the behavioral beliefs most influential to purchasing decisions for recycled copy paper are associated with reducing deforestation and other environmental impacts.

5.3 Limitations and Future Research

Survey questionnaires inevitably present the potential for biases that should be considered when designing a study. For instance, this study relied on self-reported data from respondents, which can be prone to bias, for example as a result of memory decay, social desirability, and common-method variance. The research methodology of this study was designed to reduce the likelihood of such bias. For instance, the research population was identified using purchasing history information rather than recruiting from the broader employee population. Communications also emphasized confidentiality to encourage genuine responses. Non-response bias is another common source of error associated with survey questionnaires, due to the generally low response rates that commonly occur with the method. Steps taken to mitigate

the potential for error resulting from low response rates included sending multiple invitations, sharing participation rates with non-respondents as a form of normative messaging, and minimizing the complexity and time-requirements for completing the survey.

A methodological consideration is how the behavioral target (i.e., purchasing recycled copy paper) was conceptualized. Intention to purchase recycled copy paper was effectively treated as a dichotomous outcome (will purchase/will not purchase), preventing the measure to account for variation across the range of recycled content levels. Behavioral antecedents to purchasing 100% RC paper may differ from those to purchasing 30% RC paper, in which case the current study was not able to determine those differences. Related to this, another limitation is that the study measured only behavioral intention but not actual behavior. Although TPB assumes behavior generally follows intention, the relationship is not constant. Analyzing copy paper purchasing data of study participants for a period of time immediately following the survey administration would provide a measure of behavioral outcomes, completing the TPB model. This could also provide the opportunity to test for differences in behavioral antecedents by RC level of paper purchases. Future longitudinal research investigating employee attitudes and behaviors would allow a discussion of cause-and-effect relationships when considering sustainable purchases.

6 Conclusions

Contributions of this research are derived from the context in which the theoretical framework is applied and the particular research population that was studied. Despite its wide use in studies of environmental behaviors, the application of the TPB framework to study those behaviors in organizational contexts is still relatively new. Furthermore, by studying purchasing decisions in an organizational context through the lens of consumer behavior rather than organizational buying behavior, this research helps to bridge the gap between the organizational behavior and supply chain management fields of study. Finally, within the supply chain management field of study, relatively little research has been published on the impact of minor procurement on the sustainability performance of organizations. Likewise, very little research has been dedicated to the purchasing decisions of staff level employees, with the bulk instead focused on senior level organizational buyers and supply managers.

This research highlights the roles of administrative support employees and minor procurement decisions in sustainable supply chain management strategies of large HEIs. Higher education leaders would be wise to consider the impact of employees who are given the autonomy to make purchasing decisions at their own discretion. Limiting the selection of purchasing options, highlighting preferred products, and educating employees on the relative value of different sustainability-related product attributes are potential strategies for improving sustainability performance of university procurement. The potential impact of employee discretion in purchase decisions

may be much greater than previously considered, and is therefore an issue worthy of consideration by HEI leadership at all levels.

Working with suppliers to improve the sustainability of their operations helps firms reduce risk to their brand value by decreasing the likelihood of negative publicity. Sustainable supply chain management can also create competitive advantage by earning customer trust and increasing reliability of supplier networks (Krause et al. 2009). For HEIs pursuing broader sustainability strategies though, improving sustainability within supplier networks may simply be a necessary step in achieving organizational goals. This reflects a growing realization that the sustainability of any given institution cannot exceed that of its suppliers (Krause et al. 2009; Miemczyk et al. 2012). In this context, the role of purchasing becomes central to an organization's sustainability strategy. Future research should focus on the role of HEI procurement as a means for achieving sustainability goals. A related question for future work will be how procurement systems should be designed to ensure that products are, for example, ranked in terms of overall carbon footprint or some other relevant "green" metric so that employees can make informed choices.

References

Abrahamse W, Steg L (2009) How do socio-demographic and psychological factors relate to households' direct and indirect energy use and savings? J Econ Psychol 30(5):711–720

Aguinis H, Glavas A (2012) What we know and don't know about corporate social responsibility: a review and research agenda. J Manag 38(4):932–968. https://doi.org/10.1177/0149206311436079

Ajzen I (1985) From intentions to actions: a theory of planned behavior. In: Action control. Springer, Berlin, Heidelberg, pp 11–39

Ajzen I (1991) The theory of planned behavior. Organ Behav Hum Decis Process 50(2):179–211

Association for the Advancement of Sustainability in Higher Education (2021) STARS report content

Bachmann F, Hanimann A, Artho J, Jonas K (2018) What drives people to carpool? Explaining carpooling intention from the perspectives of carpooling passengers and drivers. Transport Res Part F Traffic Psychol Behav 59:260–268

Boström M (2015) Between monitoring and trust: commitment to extended upstream responsibility. J Bus Ethics 131(1):239–255

Crowson M (2021) Testing specific indirect effects via user defined estimands in AMOS

Environmental Paper Network (2018) The state of the global paper industry

Fielding KS, McDonald R, Louis WR (2008a) Theory of planned behaviour, identity and intentions to engage in environmental activism. J Environ Psychol 28(4):318–326

Fielding KS, Terry DJ, Masser BM, Hogg MA (2008b) Integrating social identity theory and the theory of planned behaviour to explain decisions to engage in sustainable agricultural practices. Br J Soc Psychol 47(1):23–48

Fishbein M (1963) An investigation of the relationships between beliefs about an object and the attitude toward that object. Hum Relat 16:233–240

Fishbein M (1967) Readings in attitude theory and measurement. Wiley, New York

Fishbein M, Ajzen I (2009) Predicting and changing behavior: the reasoned action approach. Taylor & Francis

Graham-Rowe E, Jessop DC, Sparks P (2015) Predicting household food waste reduction using an extended theory of planned behaviour. Resour Conserv Recycl 101:194–202
Haake H, Seuring S (2009) Sustainable procurement of minor items—exploring limits to sustainability. Sustain Dev 17(5):284–294. https://doi.org/10.1002/sd.424
Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL (2009) Multivariate data analysis, 7th edn. Pearson Education Limited, Upper Saddle River, New Jersey
Han H, Hsu LTJ, Sheu C (2010) Application of the theory of planned behavior to green hotel choice: testing the effect of environmental friendly activities. Tour Manage 31(3):325–334
Heath Y, Gifford R (2002) Extending the theory of planned behavior: predicting the use of public transportation 1. J Appl Soc Psychol 32(10):2154–2189
Hu L, Bentler P (1999) Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Modeling 6(1):1–55
Kim YJ, Njite D, Hancer M (2013) Anticipated emotion in consumers' intentions to select eco-friendly restaurants: augmenting the theory of planned behavior. Int J Hosp Manag 34:255–262
Kraljic P (1983) Purchasing must become supply management. Harv Bus Rev 61(5):109–117
Krause DR, Vachon S, Klassen RD (2009) Special topic forum on sustainable supply chain management: introduction and reflections on the role of purchasing management. J Supply Chain Manag Glob Rev Purch Supply 45(4):18–25
Kumar A, Smith S (2018) Understanding local food consumers: theory of planned behavior and segmentation approach. J Food Prod Mark 24(2):196–215
Li L, Geiser K (2005) Environmentally responsible public procurement (ERPP) and its implications for integrated product policy (IPP). J Clean Prod 13(7):705–715
Martinho G, Pires A, Portela G, Fonseca M (2015) Factors affecting consumers' choices concerning sustainable packaging during product purchase and recycling. Resour Conserv Recycl 103:58–68
Martins CL, Pato MV (2019) Supply chain sustainability: a tertiary literature review. J Clean Prod 225:995–1016. https://doi.org/10.1016/j.jclepro.2019.03.250
Miemczyk J, Johnsen T, Macquet M (2012) Sustainable purchasing and supply management: a Structured literature review of definitions and measures at the dyad, chain and network levels. Supply Chain Manag Int J 17(5):478–496
Moser AK (2015) Thinking green, buying green? Drivers of pro-environmental purchasing behavior. J Consum Mark 32(3):167–175
Mosgaard M, Riisgaard H, Huulgaard RD (2013) Greening non-product-related procurement–when policy meets reality. J Clean Prod 39:137–145
Mosgaard MA (2015) Improving the practices of green procurement of minor items. J Clean Prod 90:264–274
National Association of Educational Procurement (2016) Green procurement survey report
Norton TA, Parker SL, Zacher H, Ashkanasy NM (2015) Employee green behavior: a theoretical framework, multilevel review, and future research agenda. Organ Environ 28(1):103–125
OECD (2017) OECD guidelines on measuring the quality of the working environment. OECD Publishing, Paris
Oluka OC, Nie S, Sun Y (2014) Quality assessment of TPB-based questionnaires: a systematic review. PloS One 9(4)
Philippart M (2016) The procurement dilemma: short-term savings or long-term shareholder value? J Bus Strategy 37(6):10–17
Princeton University (2004) University switches to recycled paper. Princeton Weekly Bulletin
Rajeev A, Pati RK, Padhi SS, Govindan K (2017) Evolution of sustainability in supply chain management: a literature review. J Clean Prod 162:299–314. https://doi.org/10.1016/j.jclepro.2017.05.026
Rupp DE, Mallory DB (2015) Corporate social responsibility: psychological, person-centric, and progressing. Annu Rev Organ Psych Organ Behav 2(1):211–236. https://doi.org/10.1146/annurev-orgpsych-032414-111505
Sánchez-Rodríguez C, Martínez-Lorente ÁR (2004) Quality management practices in the purchasing function: an empirical study. Int J Oper Prod Manag 24(7):666–687

Schuhwerk ME, Lefkoff-Hagius R (1995) Green or non-green? Does type of appeal matter when advertising a green product? J Advert 24(2):45–54
Sheth SS (2018) Identifying and mitigating maverick spend at Penn State Purchasing Services. Master's thesis, Pennsylvania State University. Penn State Electronic Theses and Dissertations
Skene J, Vinyard S (2019) The Issue with tissue: how Americans are flushing forests down the toilet. National Resource Defense Council. R: 19-01-A
Swaim JA, Maloni MJ, Henley A, Campbell S (2016) Motivational influences on supply manager environmental sustainability behavior. Supply Chain Manag Int J 21(3):305–320
Tonglet M, Phillips PS, Read AD (2004) Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. Resour Conserv Recycl 41(3):191–214
Touboulic A, Walker H (2015) Theories in sustainable supply chain management: a structured literature review. Int J Phys Distrib Logist Manag 45(1–2):16–42
Van Leuvan N, Highleyman L, Kibe A, Cole E (2019) Turning the page: a behavior change toolkit for reducing paper use. Root Solutions and Association for the Advancement of Sustainability in Higher Education
Wei C-F, Chiang C-T, Kou T-C, Lee BCY (2017) Toward sustainable livelihoods: investigating the drivers of purchase behavior for green products. Bus Strat Env 26:626–639
World Wide Fund For Nature (2015) WWF has developed the Certification Assessment Tool (CAT) to test the strength of certification systems and their standards. World Wide Fund For Nature
Yazdanpanah M, Forouzani M (2015) Application of the theory of planned behaviour to predict Iranian students' intention to purchase organic food. J Clean Prod 107:342–352
Yeon Kim H, Chung JE (2011) Consumer purchase intention for organic personal care products. J Consum Mark 28(1):40–47
Young W, Hwang K, McDonald S, Oates CJ (2010) Sustainable consumption: green consumer behaviour when purchasing products. Sustain Dev 18(1):20–31

Growing A Resilient Campus Forest: Opportunities, Barriers, Solutions

Jesse Swann-Quinn, Eric Pallant, Kelly Boulton, Joe Michael, Sebastian McRae, and Richard D. Bowden

1 Introduction

We often think of forests as those tree-dominated ecosystems that exist "somewhere else"—in national or state forests or parks, in large industrial forest holdings, or simply distant from our neighborhoods. However, although urban areas comprise only three percent of the entire land area of the US, more than 80 percent of the US population live in these communities (Ratcliff et al. 2016), and the forests in these human-dominated landscapes are the ones with which Americans have the most contact or familiarity. Though we may not always recognize it, many of us call urban forests home.

Similarly, whereas we might think distant forests are the ones that provide critical ecosystem services and require preservation or conservation, urban forests also offer a range of valuable ecosystem services (Roeland et al. 2019), including carbon sequestration (Nowak and Crane 2002; Schreyer et al. 2014) and removal of air pollutants (Nowak et al. 2018). The presence of vegetation, soils, and habitat enables these ecosystems to provide water conservation, storage, and mitigation of storm runoff (Kuehler et al. 2017), and despite strong human-forest interactions, these forests are strongholds of biodiversity in urban locations (Korpilo et al. 2018; Kowarik 2011). Shading and transpirational cooling are valuable in energy conservation (Song et al. 2018; Pandit and Laband 2010), thus reducing the urban heat island effect (Tan et al 2016), and increasing human comfort levels in the built environment. Annually, urban forests are estimated to provide $18.3 billion in ecosystem services (Nowak et al. 2018). In short, urban forests hold immense ecological value. Integrating such

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natural functions into urban planning and infrastructure (Pereira and Baró 2022) can enhance urban resilience in the face of climate change and other global environmental threats (Khatri et al. 2022).

We also subject urban forests to a variety of stresses and disturbances that do not exist with such intensity in rural forests. These stresses include soil compaction, tree damage due to human activity, lack of access to water, nutrient-poor soils, elevated air pollution, lack of regeneration, and interference by human infrastructure (e.g. sidewalks, utility lines), among others. Maintaining the ecosystem services urban forests provide requires we quantify, contextualize, and better understand the urban forest in all its complexity (Nowak et al. 2016; Gülçin and van den Bosch 2021). This is equally true of college campuses, an important subset of urban forests.

Yet, as cases from around the world illuminate, forests are as much social and political spaces as they are ecological (Agrawal 2005; Kosek 2006; Peluso 2011; Prudham 2003). Campus forests therefore connect their communities with their broader regional ecosystems. Their curb appeal makes them important in college admissions, valuable in enhancing students' sense of place, and helpful in maintaining students' mental well-being (Krasny and Delia 2015). On-campus forest therapy programs have been shown to reduce stress among students (Kim et al. 2020). However college campuses also exist within broader communities, sometimes serving as potential models and hubs of sustainability (Hussain et al. 2019; Valentin and Nagore 2014), and institutional treatment of their urban forest ecosystems can provide valuable examples to local communities. Efforts to sustainably manage campus forests must therefore account for the many dimensions through which their communities and ecosystems shape one another: economically, culturally, and politically. These dimensions present distinct environmental justice challenges, including unequal access to green space and the uneven accrual of benefits from campus forests' ecosystem services (Holifield 2001; Wolch et al. 2014). However, improving the ecological functions of campus green space also offers opportunities to improve the entire community's environment through improved community access to campus and educational outreach (Agyeman and Crouch 2004).

Despite the recognized importance of college campus forests, campuses struggle to manage them in a coordinated way that either maximizes their ecological integrity and function or considers their broader social contexts. Management plans instead often seem oriented primarily toward arboriculture, or maintenance of individual trees. Campus plantings often include many non-native trees, including those foreign to the ecoregion or the country. Planting decisions can be driven by numerous factors, including aesthetic design wishes, donor instructions, food availability, or maintenance considerations. The voices and values of both students and community members living within the shared urban ecosystem often also remain absent in these decisions. Considering important ecological services and fostering more social inclusion seem to be of lesser importance than other more narrowly defined priorities.

Noting a need to address these issues, members of the Allegheny community have recently embarked on initiatives to develop an ecologically-driven resilient campus forest plan focused on ecological integrity and environmentally just green development. These efforts include both student projects and an initiative driven by the

new Director of Physical Plant, the Campus Sustainability Director, and Environmental Science and Sustainability Professor Eric Pallant. Here we describe progress in preparing groundwork needed to develop a comprehensive plan to foster a resilient campus forest for the future, as well as an initial student project already underway. Through our description and analysis, we aim to offer an actionable framework that members of other higher learning institutions, especially students, might consider, adopt, and further develop, strengthening both the communities and ecosystems to which they belong.

Through these collective efforts we adopt a broader vision of campus forests as important for managing ecologically and socially resilient campus landscapes. We briefly summarize the context of both sustainability efforts and the forest on Allegheny's campus. We then outline efforts undertaken thus far to assess Allegheny's campus forest through various reports and surveys of forest composition, essential steps for any resilient campus forest efforts. We next suggest a series of alternative priorities for managing campus forests for future ecological health. The penultimate section explores the intersections of campus forests and environmental justice through the case of a student-initiated permaculture food forest project. This effort serves as a form of alternative green development and offers opportunities for both community engagement and considering the history of land use on a college campus.

The efforts we outline here remain ongoing, and in some instances remain proposals. We also understand the specific position Allegheny inhabits as a small liberal arts college in the northeast US with specific institutional commitments to sustainability and community. We acknowledge that many higher education institutions might not have the resources and institutional support some of these actions require. The complex relations among a campus, its living landscape, and the communities they exist within make each campus forest unique, and we are therefore limited in providing universal solutions to these questions. We recognize these limitations, and therefore also share our proposed processes and plans for the future, including "lessons learned" that we hope can prove both instructive and adaptable for other colleges trying to build more resilient forested urban campuses.

2 Project Context: Allegheny College and the Campus Forest

Allegheny College is a liberal arts college of approximately 1,500 students, located in Meadville, a small city of approximately 13,000 people in northwestern Pennsylvania. Allegheny has a strong history of sustainability initiatives on campus, including being the eighth college or university in the country to reach carbon neutrality. All electricity used on campus is purchased from wind power electricity producers, and it generates 8500 kWh of solar power annually. It produces nearly a ton of organic produce on campus annually in a student-run garden, and dining hall waste is composted on campus. In the last decade, paper consumption has been reduced 30%

and water consumption has been reduced 40%. Installation of water refill stations on campus has drastically reduced single-use plastic bottle consumption (Bethurem et al. 2021). New buildings and renovations have been LEED certified, including use of geothermal heating and cooling systems.

Ecologically, Allegheny sits within the eastern temperate hardwood forest region dominated by oak-hickory, and maple-beech-birch groups (USFS 2022). Nearly all forested areas within the region are recovering from historic agricultural use. Presently, land use in the county is approximately 52% forest, 28% agriculture, 12% wetlands and open water, and 8% developed areas. The region has seasonally-distributed precipitation (112.5 cm y-1) and mean daily temperatures of −4.1 °C in January and 23.6 °C in July, a four-month growing season, and approximately four months of snow cover (Bowden et al. 2000; 2014). The central campus is 40 ha, approximately 59% of which is in lawn and non-mowed vegetation areas, and much of which has tree cover (Fig. 1). The college also owns two other commonly-used, nearby forested properties, a 83 ha area managed primarily for recreational activities, and a 115 ha forest used for research and teaching.

Allegheny's campus landscape is often considered one of the institution's key assets, featuring prominently in admissions programs and loved by students and alumni. However, the landscape also offers grounds for key sustainability efforts. Management of the heavily forested campus landscape now includes numerous sustainable practices. For example, the college no longer applies fertilizers to lawn areas, instead applying a compost "tea" to grassy areas annually to stimulate a healthy soil microbial community. Pesticides are used rarely, and applied on a "spot" basis rather than broadly across the grounds when they are employed.

At the same time, Allegheny's forest, when viewed ecologically, is at risk. Significant areas of the campus contain large, "monarch" trees, but have little underplanting of saplings that will become the next generation of older trees. The campus has a number of non-native trees, including those not native to the region (e.g. Douglas fir), those not native to the US (e.g. Norway spruce, little leaf linden), and those considered invasive and recently banned from future planting (e.g. Callery pear) (PA Department of Agriculture 2021). Recent plantings have included a large number of red maples, which are native and thrive in soils of this region but are considered to be overly abundant throughout the eastern US due to historic land use (Abrams 1998). Substantial areas of the campus contain mowed lawn areas by default, even in areas not actively used by students. Overall, the college lacks a coordinated, consistent forest management plan.

The Allegheny community clearly demonstrates a commitment to sustainability on campus, and has an exceptional natural resource in its urban campus forest. However, maintaining and improving the ecological and social services the campus provides for generations to come will not be possible without a cohesive and intentional management plan for the campus landscape. Developing such a plan first requires a comprehensive assessment of the current campus forest, and in the following section we outline our efforts toward achieving this necessary step.

Fig. 1 Aerial photograph of Allegheny College main campus. Purple line represents the campus boundary. (Cartography: Chris Shaffer)

3 Methods and Approach

This project emerged over a span of years as multiple parties involved began noticing overlapping interests, potential knowledge gaps, and numerous opportunities related to Allegheny's campus forest. Our approach therefore involves multiple complementary methods. An early step included collecting survey data and reports documenting and quantifying the composition and ecological features of Allegheny's urban forest, as described in further detail below. We also then assessed the institutional structure

and practices supporting Allegheny's forest management through many forms of ongoing dialogue and documentation. Student engagement and organization has also proven key to these ongoing efforts, including both the efforts of individual student researchers and campus clubs.

Our ongoing set of efforts continues to evolve as the project grows, more people become involved, and new challenges arise. However, collaboration rests as a central and necessary tenant of our approach. This has included the involvement of students and class projects alongside institutional and individual support, and suggestions to include community members from beyond campus borders in future processes. We argue this diverse, inclusive, and adaptable approach is key for producing more resilient campus forests and communities into the future.

4 Assessing Allegheny's Forest

4.1 Forest Reports

Any management plan needs an assessment of the current forest to provide a basis for understanding issues to address, and developing a plan to deal with those issues. An initial assessment of the current forest was conducted using several reports (Table 1) housed within the Department of Physical Plant. The first challenge we faced was that the reports lacked any significant organization or centralization. For example, a few of the reports had been "discovered" recently in a file drawer, and contained various data issues that rendered them difficult to use for our purposes. For example, the two most recent reports had some overlapping data, but were not directly complementary and numbered the trees differently. Because the 2000 report contained a more extensive tree list than the more recent 2011 report, we used this survey to determine the relative proportion of native and non-native trees on the campus forest.

4.2 Campus Forest Composition

Of the 1257 trees on campus 74% are broadleaf trees and 26% are conifers. In terms of basal area (based on diameter at breast height [1.4 m], which is a better expression of the biological and ecological importance of each species group), broadleaf trees are 85% of the total, and conifers are 15%. These values are in agreement with the forest composition of this region, which does not have a large conifer component. The campus contains 88 species, 73 of which are broadleaf, and 15 of which are conifers.

Table 1 Tree survey reports at allegheny college

Report	Author	General contents	Date
Trees of allegheny college; senior thesis	Allegheny student	A list of trees across the central campus	2019
Arboricultural assessment	Campus planning consultant	Evaluation and map of core campus trees	2011
Tree inventory management report	A nationally-known tree service	Inventory and maintenance needs of core campus trees	2000
Suggested solutions to improve landscape maintenance	AC physical plant landscaper	Suggestions for planting ground cover and shrubs	2000s (undated)
Tree evaluation	A nationally-known tree service	Maintenance suggestions for several selected trees	1995
Trees of allegheny college	Landscape architect	List of representative tree specimens on campus	1987

4.3 Native v. Non-Native Trees

Environmentally, it was important to know the proportion of trees on campus that are not native. Non-native trees can be invasive, threatening ecosystem biodiversity (Stinson et al. 2007) and potentially reducing native plant species abundance or productivity (Wilcove et al. 1998). The list of tree species on campus reveals that fewer than 40% are native, whereas 65% are either not native to the area, or are not native to the U.S (Fig. 2). Hence, the choice of trees planted on campus is weighted heavily toward non-native species. However, the picture is more optimistic when viewed by either the total number of trees on campus or the basal area of those trees. The total number of native trees approaches 60%, and is more than 70% in terms of basal area. Measures of tree numbers and basal area are important because native trees are much more conducive to healthy populations of insects and thus birds (Helden et al. 2012; Narango et al. 2017). It is estimated that when the number of native trees is less than 70%, the growth of insectivorous birds is reduced (Narango et al. 2017; 2018.)

Allegheny's campus contains more native broadleaf trees than native conifers (Fig. 3). This is not surprising given that Pennsylvania has relatively few native conifers, and that white pine and hemlock have historically been removed during agricultural forest clearance across the area (Whitney and DeCant 2003).

Whereas native and non-native trees in urban areas may contribute equally to major ecosystem services (Schlaepfer et al. 2020), native trees can provide greater food resources to wildlife (Tallamy 2021). The prevalence of non-native trees on campus is especially abundant among the conifers. Of the top six trees in terms of numerical abundance, only two, eastern white pine and hemlock, are native (Fig. 4).

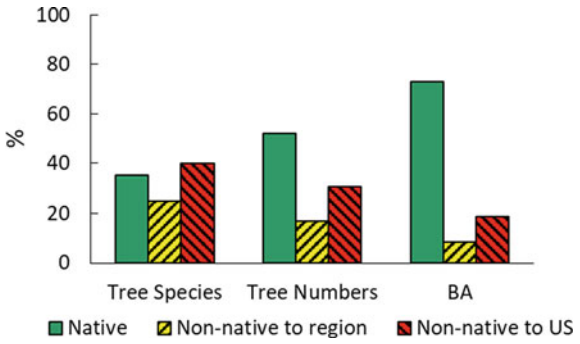

Fig. 2 Proportion of trees on the Allegheny College campus that are native, not native to the area, or not native to the US. BA = Basal Area

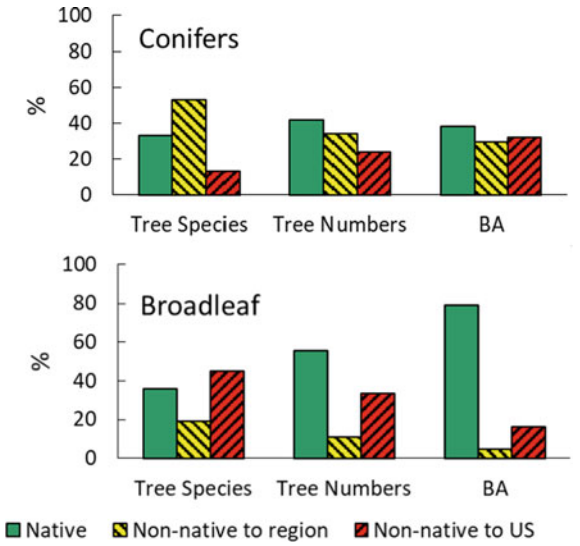

Fig. 3 Proportion of conifers and broadleaf trees on the Allegheny College campus that are native, not native to the area, or not native to the US. BA = Basal Area

For broadleaf trees, flowering crabapple is not native to the U.S, and though a small tree, fruit is consumed by birds and seeds can be broadcast over large regions.

5 The Future Forest: Changing Campus Management Priorities

5.1 Regenerating the Next Forest

A resilient forest is defined not only by the species present, but also by the age distribution of trees on campus. Walking across Allegheny's campus clearly reveals distinct differences in forest age structure across different campus locations. For

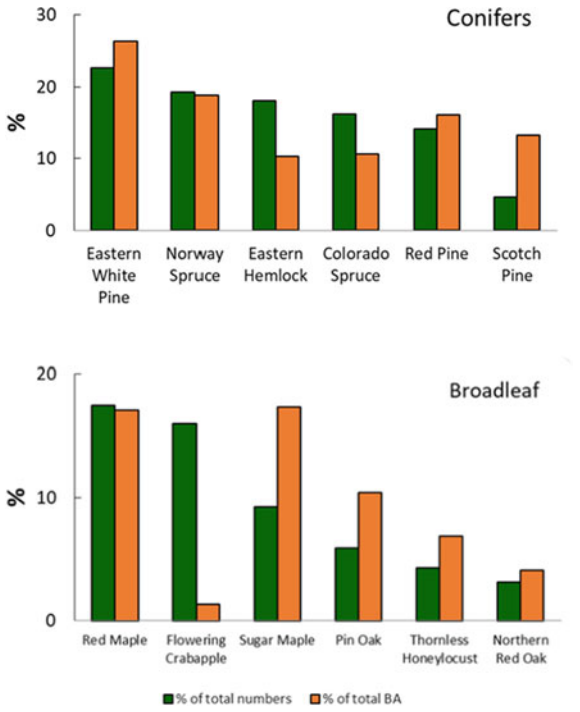

Fig. 4 Most abundant conifer and broadleaf tree species on the campus of Allegheny College. BA = Basal Area

example, the Bentley lawn area (associated with historic Bentley Hall, which was built in the 1820s and is the oldest structure on campus), is filled with many large, mature trees. Meanwhile other areas contain more moderately-aged to young trees. The 2011 Arboricultural assessment corroborates this observation. This report notes that less than five percent of trees are "monarch" trees, or those mature trees more than 0.9 m dbh, and that the proportion of mature trees (36%) is relatively low.

Obviously, current trees cannot be made to grow larger and older faster, and the college has invested in maintaining those larger trees through careful arboricultural treatments. However, windstorms are always a threat to older trees that may have rotten centers or defects. Furthermore, the emerald ash borer, a non-native invasive insect, has decimated the white ash trees across campus, necessitating the removal of nearly all ash trees. Replacing trees is expensive, and prices increase exponentially with size. For example, a 0.25 m seedling may be purchased for less than $10 (USD), and a 3 m sapling may cost $10–50, but a 7 m tree, which is still relatively young, can cost $1500–2000. However, young seedlings that could replace older trees that die or become structurally unsound are notably absent.

The college has recently begun addressing this situation by immediately planting small saplings when large trees are removed. This is an ecologically sound, though only partial solution. A better approach is to plant many saplings more broadly now, when costs are low and the likelihood of planting success is high. Young trees need to be planted across campus so that future natural or human-induced disturbances to

the forest can be buffered, and so that replacement of lost trees remains economically justifiable. Allegheny could also develop a nursery on campus, producing seedlings locally and at low cost that can then grow into saplings and be transplanted throughout the campus landscape after several years. Several locations on campus were identified for possible nursery placement. These simple, low-cost options will allow Allegheny to develop an ecologically healthier and more resilient campus forest in the years ahead.

5.2 Tree Maintenance

As we looked at individual trees, it became obvious that several issues threaten or challenge tree productivity. We did not conduct a systematic survey, but we saw that many trees had evidence of damage at the base caused by stringed weed whackers and lawn mowers. Bark was removed, exposing the cambium layer, which then makes the tree susceptible to insects or microbial damage that can lead to a rotted and weaker tree trunk that predisposes the tree to wind damage or mortality.

We also noted that as is typical of trees in a highly landscaped setting, many of Allegheny's trees have a "lollipop" appearance—a trunk and crown that emerge from a green lawn, resulting in conditions that reduce the ecological value of the tree. Trees, especially native trees, provide important habitats for insects, which in turn offer important food sources for birds. However, as insects complete their larval development and drop to the ground to complete their life cycle within the leaf litter at the base of the tree, they find an environment of a grass lawn, which is far less valuable than leaf litter. A more ecologically sound approach would involve leaving the areas surrounding the trunk and as much of the crown as possible unmowed, and planting native low-growing shrubs or perennials. We do note that in autumn, senescing leaves are mulched into the lawn surface during routine lawn mowing. This is advantageous in allowing organic matter and nutrients to return to the soil.

5.3 Tree Selection and Placement

Finally, we learned that the college does not have a master plan for determining what trees should be planted, and where trees need to be planted. For example, whereas the majority of trees by number or basal area are native, there is no policy that guides this selection. Trees planted as part of construction efforts on campus seem driven more by aesthetic contributions than environmental or ecological consideration. Furthermore, we found that even when native trees are planted, the placement of trees is not ecologically optimal. For example, in one instance a tulip poplar, which grows best in well-drained soil, was planted in a swale that has poorly drained soil. In contrast, a sycamore, which grows well in moist soils, was planted 30 m away on a well-drained slope. Ecologically, these were the right trees, but placed in the wrong locations.

To assist the college with tree selection and ecological requirements, we developed a list of trees that are recommended for planting on campus. This selection (Table 2), based on tree descriptions (USDA 2022) and recommendations for climate resilience (Shortle et al. 2015), is optimized for selecting tree species that are primarily native, able to thrive in this region, devoid of major pest or disease issues, and resilient to expected climate change.

The campus assessments outlined here represent an effort to determine the composition of Allegheny's urban forest ecologies, identify areas in need of improvement, and suggest potential solutions for developing a more comprehensive plan for developing a resilient campus forest for the future. However, we also recognize that campus landscapes involve more than their biophysical and built environments, but are also social spaces filled with people and their many relationships. In the following sections we consider some of the social dimensions and opportunities related to pursuing more resilient campus forests.

6 Campus Forests and Environmental Justice

The complexity of Allegheny's social landscape echoes that of its arboreal ecology. The census block groups surrounding Allegheny's campus are economically and racially diverse, and the people living there often interact with the campus landscape both directly and indirectly. These interactions prove especially significant as the Pennsylvania Department of Environmental Protection has designated many of these communities as Environmental Justice Areas (EJAs), where 20% or more of residents live in poverty and/or 30% identifies as minority (see Fig. 5). While some of Meadville's census block groups have minority populations approaching 20%, those directly adjacent to Allegheny's campus are designated as EJAs due to their poverty rates ranging from 26–52% (Census.gov 2022). Although minority racial identities and poverty overlap and are concentrated downtown, Meadville's socio-economic picture is more nuanced than this with multiple forms of historic marginalization intersecting across the city.

If done incorrectly, urban greening projects have produced unintended negative consequences for such communities, with green spaces historically existing as spaces of elite control, capital development, and in other contexts even displacement (Heynen 2003; Swyngedouw and Heynen 2003; Walker and Bulkeley 2006). Importantly though, these inequalities are neither natural nor inherent, and working to transform them by managing urban campus forests with an eye toward ecological values and community stewardship can offer key avenues toward more sustainable urban forms. Acting socially responsible toward our broader community by removing invasive species, planting more native species, offering increased wildlife habitat, and creating spaces for community members to enjoy will increase ecosystem service provision for our community without risking negative property value effects or community displacement. Doing so also creates opportunities to build stronger relations with surrounding neighborhoods, while also providing enjoyable and productive

Table 2 Trees, with general ecological attributes, recommended for planting on the Allegheny College campus.

	Native Status		Wildlife Value			Moisture Need			Light Need		
Tree	*Native*	*Non*	*High*	*Med*	*Low*	*Wet*	*Med*	*Dry*	*High*	*Med*	*Low*
Coniferous											
Hemlock	X			X		X					X
Norway spruce		X			X		X			X	
Red cedar	X		X				X		X		
White pine	X		X				X			X	
Deciduous											
American plum	X		X				X			X	
Blackgum	X		X			X			X	X	X
Black birch	X			X			X		X		
Black cherry	X		X				X			X	
Black walnut	X		X				X		X		
Sycamore	X		X			X			X		
Gray birch	X		X				X		X		
Florida maple		X		X				X			X
Hackberry	X		X				X		X		
Hophornbeam	X			X		X					X
Sassafras	X			X		X				X	
Shagbark hickory	X		X			X			X	X	
Shumard oak	X		X				X		X		
Slippery elm	X				X		X			X	
Sugar Maple	X		X				X				X
Sweetgum	X			X			X		X		
White oak	X		X				X		X		
Black willow	X		X			X			X		
Tuliptree	X		X			X	X		X		

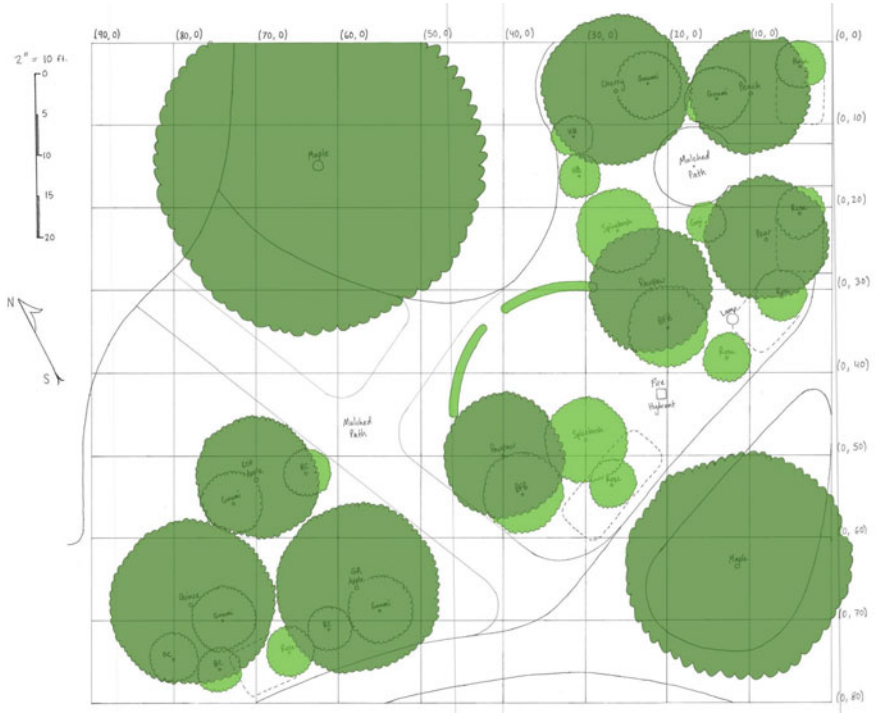

Fig. 5 Proposed Allegheny Food Forest Plan (source: Allegheny Sustainable Design Team, Sebastian McRae)

spaces. In the following section we outline some of Allegheny's plans for building community through conjoined forest management, specifically through the new development of a permaculture food forest, and educational outreach.

6.1 Developing a Food Forest

Our systematic arboreal inventory of campus has revealed important insights for guiding the development of a sustainable campus forest plan. However, although trees are clearly essential to providing ecosystem services, they represent only one value within a forest. Pushing our consideration of the forest beyond trees alone, and recognizing that urban forests are peopled ecosystems filled with a variety of useful and beautiful plants, the campus can also be viewed as a landscape with food-bearing potential. Early efforts to this end included a college course that developed a small campus garden that had several apple trees. Several years later, a larger apple orchard was developed in a college course, endorsed by the college physical plant, and planted in a joint effort by students and physical plant employees.

This effort was further developed by the work of a single college student who began exploring the field of permaculture design in 2018. The student noticed that underused lawns took up vast areas of the campus, presenting little biological utility while requiring significant energy and financial resources to maintain. After presenting this set of observations to a student environmental group, this student formed a new Sustainable Design Team. The group shared its ideas with numerous stakeholders on campus, including the admissions office, the Environmental Science and Sustainability Department, the Inclusion, Diversity, Equity, Access and Social Justice (IDEAS) Center, and the office of Spiritual and Religious Life.

The design team did its homework, learning what fruit trees, shrubs and supporting species could be grown in the area, and gave extensive consideration to site selection. The team followed permaculture design principles, considering social and ecological factors such as proximity to tools and watering equipment, nearness to the centers of activity on campus so that it would be seen and utilized by students, drainage and topography, and light availability. They also considered the potential for use as an informal outdoor classroom space. A key component was to design a food forest that could continue growing and producing with minimal management. The students compiled all the information gathered and developed a plan to convert approximately 5,000 square feet of campus space from unproductive grass lawn to functional food forest as an example of a productive landscaping strategy for the campus (Fig. 5).

Because the students were so thoroughly prepared—having selected a site, investigated planting choices, and garnered widespread support—their efforts were rewarded by approval of the Campus Sustainability Director and the College President. In Fall of 2021, the team broke ground to prepare the site for more extensive planting in Spring 2022.

6.2 Campus Forests as Spaces of Education, Acknowledgement, and Community Building

Such permaculture food forest and campus forest management plan efforts at Allegheny extend the college's long-standing commitment to pursuing sustainable campus life. Likewise, efforts to engage community members in such projects build on Allegheny's long institutional track record of community outreach. Allegheny's greater campus forestry project has begun further exploring these connections by working to also develop our new food forest as a community environmental education space.

To advance these goals, one recent class of third-year students spent Fall 2021 researching food forests and environmental education in coordination with the Sustainable Design Team. Central topics included the historical context of food forests, their roots in Indigenous wisdom, and potential crop species to grow within the Allegheny Food Forest. Students proposed physical signs (Fig. 6) connected to a digital interface to convey information about the food forest to the public, and

Fig. 6 Allegheny Food Forest Educational Interface Design (*Source* Junior Seminar in Sustainable Development class, Fall 2021)

submitted a grant application to fund these signs through the PA Department of Environmental Protection Environmental Education program, which the students then successfully received during Spring 2022.

The students anticipate the food forest will serve primarily as a space where local residents can help themselves to fruits and vegetables. However, the educational aspect of the food forest will further benefit residents and students. Our signs will explain elements of permaculture and the species we grow within Allegheny's food forest. They will also introduce the region's history of Indigenous communities, including the decline of maintained food forests as those communities were driven from the region by European settlers. The food forest will require significant time to reach productive maturity, and the signs will offer key tools to both educate and generate support during both the project's initial years and those to come.

Within the broader campus forest management efforts, these emerging projects illustrate the potential shared goals of pursuing environmental justice, environmental education, and more sustainable urban campus forests when considered from more collaborative, inclusive, and interdisciplinary management perspectives.

7 Conclusion

7.1 Processes, Plans, and Looking to Allegheny's Future Forest

Forest management plans help guide management decisions to reach specific goals while protecting the health and integrity of a forest. Despite their numerous advantages, most forest landowners lack written plans (Chhetri et al. 2018). In this regard, Allegheny falls into the majority. A good tree management plan should have both institutional buy-in and central administration. We learned, however, that this does not currently exist at Allegheny, with management disaggregated across multiple divisions and little coordination among relevant parties.

Instead, decisions regarding individual tree care are made largely by Allegheny's Physical Plant, which makes sense given that this department needs to either do the work itself or hire arboricultural experts who perform specialized tree removal or maintenance. Physical Plant makes decisions on tree replacement, and donors to the college also have input on tree selection in that, as part of the donation process, they can select trees for planting and request planting locations. The Athletics Department has input on tree selection and removal in the vicinity of playing fields at the sports complex located two km from the campus. Furthermore, new construction or building renovation typically involves post-construction planting efforts, and those decisions are usually made by the hired project architects. Given that none of these entities or parties are likely to have expertise in tree autoecology, or in the environmental needs that can be satisfied on campus by tree plantings, the current dispersed decision-making system results in an uncoordinated effort to maintain the campus forest. We recommend that a more forward-thinking approach would develop a single committee, headed by the Campus Sustainability Office. This committee would develop and maintain a comprehensive campus forest management plan informed by relevant constituencies across the college.

7.2 Lessons Learned

Forest Management and Decision-Making

Numerous entities or persons on campus had excellent intentions when it came to the integrity and beauty of the campus forest, yet the lack of shared goals and a central plan led to little planning on the forest. We propose formation of an institutional committee, with wide and inclusive representation, including the local community, that develops a shared vision for a resilient forest and that produces an actionable management plan.

Plans and Assessment of the Forest

We learned that the college had indeed received several good assessments of the forest, including plans for developing and maintaining a vigorous forest. However, these plans were benignly but largely ignored. We urge a more organized system that allows continuity of plans and information as college personnel come and go from the institution. We also urge that forest assessment be conducted routinely to maintain a healthy forest and reduce excessive long-term maintenance costs.

Tree Selection

Despite good actions and plans regarding maintenance of current trees, there is minimal vision toward the future of the forest. We propose developing an ecologically grounded and environmentally advantageous plan for tree selection, placement, planting, and replacement. This plan should remain responsive to different campus

constituencies through the newly formed institutional committee. We also recommend that the forest not be viewed as a static collection of trees, but viewed as the dynamic biological and social entity that it is. This requires considering development of the forest that will exist in future decades.

Community Context

The college campus sits within the community of Meadville, yet despite the fact that neighbors are allowed to walk the campus, the forest ecosystem has not been viewed as an educational asset to local citizens. We suggest that development of a resilient forest can serve as a local and regional example of urban forest sustainability, offering a productive and educational asset that extends beyond student clientele to both meet broader community needs and respond to global challenges.

Expertise

We found an abundance of tree-related expertise within the immediate and extended college community. Within the college, faculty members in natural resource-related departments had expertise in forests and forestry, but were rarely consulted. Within the community, local and state-level forest expertise was available, but not used. Broader solicitation of expertise will provide a more robust management scenario.

Making Progress

Development of a resilient forest will be strongest if developed through both bottom-up and top-down coordination. A resiliency-minded approach needs to be accepted at the administrative level. Faculty expertise, student energy, student initiatives, and faculty-student collaboration can provide the resources to enact actual projects that simultaneously further institutional objectives and student learning.

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References

Abrams MD (1998) The red maple paradox. Bioscience 48:355–364. https://doi.org/10.2307/1313374

Agrawal A (2005) Environmentality: Community, intimate government, and the making of environmental subjects in kumaon, India. Curr Anthropol 46:161–190

Agyeman J, Crouch C (2004) The contribution of environmental justice to sustainability in higher education. In Corcoran PB, Wals AEJ (Eds), Higher Education and the Challenge of Sustainability: Problematics, Promise, and Practice (pp 113–130). Springer Netherlands. https://doi.org/10.1007/0-306-48515-X_10

Bethurem M, Choate B, Bramwell S (2021) Stop piling on: Assessing efforts to reduce single-use water bottles at Allegheny College. Sustainability 13:8864. https://doi.org/10.3390/su13168864

Bowden RD, Rullo G, Stevens GR, Steudler PA (2000) Soil fluxes of carbon dioxide, nitrous oxide, and methane at a productive temperate deciduous forest. J Environ Qual 29:268–276. https://doi.org/10.2134/jeq2000.00472425002900010034x

Bowden RD, Deem L, Plante AF, Peltre C, Nadelhoffer K, Lajtha K (2014) Litter input controls on soil carbon in a temperate deciduous forest. Soil Sci Soc Am J 78:S66–S75. https://doi.org/10.2136/sssaj2013.09.0413nafsc

U.S. Census Bureau (2022) U.S. Census bureau quickFacts: Meadville city, Pennsylvania. Retrieved January 27, 2022, from www.census.gov/quickfacts/meadvillecitypennsylvania

Chhetri SG, Gordon JS, Munn IA, Henderson JE (2018) Factors influencing the use of consulting foresters by non-industrial private forest landowners in Mississippi. For Chron 94:254–259

Allegheny College (2022) Working toward a sustainable campus. Working toward a sustainable world. sites.allegheny.edu/sustainability/. Retrieved 5 January 2022

Gülçin D, van den Bosch CCK (2021) Assessment of above-ground carbon storage by urban trees using LiDAR data: The case of a university campus. Forests 12:62. https://doi.org/10.3390/f12010062

Helden AJ, Stamp GC, Leather LR (2012) Urban biodiversity: Comparison of insect assemblages on native and non-native trees. Urban Ecosyst. 15:611–624. https://doi.org/10.1007/s11252-012-0231-x

Heynen NC (2003) The scalar production of injustice within the urban forest. Antipode 35:980–998. https://doi.org/10.1111/j.1467-8330.2003.00367.x

Holifield R (2001) Defining environmental justice and environmental racism. Urban Geog 22:78–90. https://doi.org/10.2747/0272-3638.22.1.78

Hussain T, Eskildsen J, Edgeman R, Ismail M, Shoukry AM, Gani S (2019) Imperatives of sustainable university excellence: A conceptual framework. Sustainability 11:5242. https://doi.org/10.3390/su11195242

Khatri A, Bustamante D, Ruta M, Gómez Garcia-Reyes C, Thompson F, Kohli S, Pantelidou H, Magnani G, Free M, Schemel S (2022) BiodiverCities by 2030: transforming cities' relationship with nature. Insight Report. World economic forum and alexander von humboldt biological resources research institute

Kim JG, Khil TG, Youngsuwn L, Park K, Shin M, Shin WS (2020) The psychological effects of a campus forest therapy program. Internat J Environ Res and Public Health 17: 3409. doi.org/https://doi.org/10.3390/ijerph17103409

Korpilo S, Jalkanen J, Virtanen T, Lehvävirta S (2018) Where are the hotspots and coldspots of landscape values, visitor use and biodiversity in an urban forest? PLoS ONE 13:e0203611. https://doi.org/10.1371/journal.pone.0203611

Kosek J (2006) Understories: The political life of forests in northern New Mexico. Duke University Press

Kowarik I (2011) Novel urban ecosystems, biodiversity, and conservation. Environ Pollut 159:1974–1983. https://doi.org/10.1016/j.envpol.2011.02.022

Krasny ME, Delia J (2015) Natural area stewardship as part of campus sustainability. J Cleaner Prod 106:87–96. https://doi.org/10.1016/j.jclepro.2014.04.019

Kuehler E, Hathaway J, Tirpak A (2017) Quantifying the benefits of urban forest systems as a component of the green infrastructure stormwater treatment network. Ecohydrology 10(3):e1813. https://doi.org/10.1002/eco.1813

Narango DL, Tallamy D, Marra PW (2017) Native plants improve breeding and foraging habitat for an insectivorous bird. Biolog Cons 213:42–50. https://doi.org/10.1016/j.biocon.2017.06.029

Narango DL, Tallamy DW, Marra PW (2018) Nonnative plants reduce population growth of an insectivorous bird. Proc Nat Acad Sci 115:11549–11554. https://doi.org/10.1073/pnas.1809259115

Nowak DJ, Crane DE (2002) Carbon storage and sequestration by urban trees in the USA. Environ Pollut 116:381–389

Nowak DJ, Greenfield EJ (2018) US urban forest statistics, values, and projections. J for 116:164–177. https://doi.org/10.1093/jofore/fvx004

Nowak DJ, Hoehn RE, Bodine AR (2016) Urban forest structure, ecosystem services and change in Syracuse. NY Urban Ecosyst 19:1455–1477. https://doi.org/10.1007/s11252-013-0326-z

Nowak DJ, Hirabayashi S, Doyle M, McGovern M, Pasher J (2018) Air pollution removal by urban forests in Canada and its effect on air quality and human health. Urban for Urban Greening. 29:40–48. https://doi.org/10.1016/j.ufug.2017.10.019

PA Department of Agriculture (2021) Pennsylvania phasing in ban of invasive callery pear, also called bradford pear. www.media.pa.gov/pages/agriculture_details.aspx?newsid=1171&fbclid=IwAR34tfXjZ3SGr-xz1nLe5LRrR2ryYjTkL9BgnJEimv3RQlnx-v4FZ-CcXGc. Retrieved 3 January 2022

Pandit R, Laband DN (2010) Energy savings from tree shade. Ecol Econ 69:1324–1329. https://doi.org/10.1016/j.ecolecon.2010.01.009

Peluso NL (2011) Emergent forest and private land regimes in Java. J Peasant Stud 38:811–836. https://doi.org/10.1080/03066150.2011.608285

Pereira P, Baró F (2022) Greening the city: Thriving for biodiversity and sustainability

Prudham S (2003) Taming trees: capital, science, and nature in pacific slope tree improvement. Annals Assoc Amer Geog 93:636–656. https://doi.org/10.1111/1467-8306.9303007

Ratcliff M, Burd C, Holder K, Fields A (2016) Defining rural at the U.S. Census Bureau. U.S. Census Bureau. https://www.census.gov/library/publications/2016/acs/acsgeo-1.html

Roeland S, Moretti M, Humberto J, Branquinho F, Fares S, Morelli F, Niinemets Ü, Paoletti E, Pinho P, Sgrigna G, Stojanovski V, Tiwary A, Sicard P, Calfapietra C (2019) Towards an integrative approach to evaluate the environmental ecosystem services provided by urban forest. J for Res 30:1981–1996. https://doi.org/10.1007/s11676-019-00916-x

Schlaepfer MM, Guinaudeau BP, Martin P, Wyler N (2020) Quantifying the contributions of native and non-native trees to a city's biodiversity and ecosystem services. Urban For Urban Greening. 56. doi.org/https://doi.org/10.1016/j.ufug.2020.126861

Schreyer J, Tigges J, Lakes T, Churkina G (2014) Using airborne LiDAR and QuickBird data for modelling urban tree carbon storage and its distribution—a case study of Berlin. Remote Sens 6(11), Article 11. https://doi.org/10.3390/rs61110636

Sci Tot Environ 817: 15 April 2022, 153032. doi.org/https://doi.org/10.1016/j.scitotenv.2022.153032

Shortle J, Abler D, Blumsack S (2015) Pennsylvania climate impacts assessment update. Penn State Univ, University Park

Song XP, Tan PY, Edwards P, Richards D (2018) The economic benefits and costs of trees in urban forest stewardship: A systematic review. Urban For Urban Greening 29: 162-170. doi.org/https://doi.org/10.1016/j.ufug.2017.11.017

Stinson K, Kaufman S, Durbin L, Lowenstein F (2007) Impacts of garlic mustard invasion on a forest understory community. Northeast Nat 14:73–88. https://doi.org/10.1656/1092-6194.2007.14.73.IOGMIO.2.0.CO.2

Swyngedouw E, Heynen NC (2003) Urban political ecology, justice and the politics of scale. Antipode 35:898–918. https://doi.org/10.1111/j.1467-8330.2003.00364.x

Tallamy DW (2021) The nature of oaks: The rich ecology of our most essential native trees. Timber Press, Portland, OR. 200p. ISBN-10:1643260448

Tan Z, Lau KKL, Ng E (2016) Urban tree design approaches for mitigating daytime urban heat island effects in a high-density urban environment. Energy and Build 114:265–274

US Forest Service (2022) National forest type dataset. In united states department of agriculture, forest service, FSGeodata clearinghouse. data.fs.usda.gov/geodata/rastergateway/forest_type/. Accessed 4 January, 2022

USDA (2022) PLANTS Database. plants.usda.gov/home. Accessed 23 September 2021

Valentin G, Nagore I (2014) The sustainable university: A model for the sustainable organization. Manage Sustain Develop J 6:15–24. https://doi.org/10.1515/msd-2015-0002

Walker G, Bulkeley H (2006) Geographies of environmental justice. Geoforum 37:655–659. https://doi.org/10.1016/j.geoforum.2005.12.002

Whitney GG, DeCant JP (2003) Physical and historical determinants of the pre-and post-settlement forests of northwestern Pennsylvania. Can J for Res 33:1683–1697

Wilcove D, Rothstein D, Dubow J, Phillips A, Losos E (1998) Quantifying threats to imperiled species in the United States. Bioscience 48:607–615. https://doi.org/10.2307/1313420

Wolch JR, Byrne J, Newell JP (2014) Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough.' Lands Urb Plan 125:234–244. https://doi.org/10.1016/j.landurbplan.2014.01.017

Impacts of Fourth Industrial Revolution on Education for Sustainable Development in Higher Education Institutions

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1 Introduction

The Fourth Industrial Revolution, commonly known as Industry 4.0, is transforming and shaping the world in which we live through a wide range of cutting-edge technologies such as the Internet of Things (IoT), Big Data and Data Analytics and Artificial Intelligence (AI). Industry 4.0 promises to revolutionize the way we work, live and connect with each other (Kayembe and Nel 2019). Not only do these technologies bring new opportunities and solutions for our everyday lives, but also they bring challenges into many domains, including education (Catal and Tekinerdogan 2019).

Since previous industrial revolutions had an influence on significant changes in education, many changes are occurring and are still expected in this current revolution (Fomunyam 2019). In this way, students in higher education must be exposed to the latest and greatest smart technology so that they are prepared for this Industry 4.0 revolution and its development (Mian et al. 2020).

The use of technological advances in education plays a significant role for higher education institutions (HEIs) (Blaschke 2012) since the incorporation of new technologies can increase the effectiveness and efficiency of teaching and learning processes (Halili 2019). In fact, higher education institutions need to keep up with technological trends and changes in society that directly affect the way we learn and

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teach in the education experience (Brudermann et al. 2019). However, as we strive for an increasingly high-tech future, we must also be able to ensure that the world is a better and more sustainable place for this and future generations.

In this sense, Education for Sustainable Development (ESD) in higher education institutions not only promotes awareness of environmental issues, but also prepares leaders of the future with relevant experiences and good habits that will result in the construction of more sustainable and committed communities that contribute to the overall well-being of the planet (Berchin et al. 2021).

The United Nations 2030 Agenda for Sustainable Development (United Nations 2020) also emphasizes the importance of ESD as a part of the Sustainable Development Goal 4 (quality education); Target 4.7 states that all learners should acquire the knowledge and skills needed to promote sustainable development, including, among others, through ESD and sustainable lifestyles. In view of the importance of ESD for the formation of critical thinking and the empowerment of our young people for climatic and environmental emergencies and the potential of the 4.0 revolution as a tool for education, this article aims to answer the research question, what are the impacts of the Industry 4.0 on education for sustainable development in higher education institutions?

To answer this, we examined the literature looking for evidence that corroborates a proposed causal relationship. Our aim is to fill the gap in this specific topic that has become increasingly relevant to the growth of scientific and academic knowledge on ESD and Industry 4.0 in HEIs. Section 2 of this article presents this literature review on Industry 4.0 and ESD education. Section 3 explains the methodology which was used to determine the decision variables and the steps for the consequent analysis. Finally, the results and findings are discussed in Sect. 4 with the conclusions and suggestions for future studies presented in Sect. 5.

2 Literature Review

2.1 The Fourth Industrial Revolution

Industry 4.0 is unlike anything humanity has ever experienced. Because of its complexity and the scale of its influence, the way we work, live, and engage with one another is fundamentally changing (Schwab 2017a, b). Industry 4.0 has been developed after three transformative historical stages that began when the first power loom was designed and built by Edmund Cartwright in 1786. We can distinguish these stages of the ongoing process of what became known as the Industrial Revolution (Bloem et al. 2014). The first stage, between 1760 and 1830, was initiated by the transformation of production from manual labor-intensive methods to steam-powered mechanized processes (Muhuri et al. 2019). The second phase, occurring in the early twentieth century, made possible mass production through the use of electric-powered production lines (Lu 2017). In the mid-1970s, the third phase (Third

Industrial Revolution) was characterized by the automation of production through the application of information technology (IT) and the development of electronics (Lom et al. 2016; Lukač 2015). In 2011 Industry 4.0 was perceived and described by the then president of the World Economic Forum, Klaus Schwab, as a rapid convergence between cyber-physical systems and the manufacturing process. Today, Industry 4.0 is a global concept that summarizes the new stage of development in management and organization of the entire value chain in the manufacturing industry (Feshina et al. 2018).

However, this new concept in Industry 4.0 is not just about the industry but a widespread transformation of digital integration and smart engineering (Muhuri et al. 2019). The feature of this fourth wave of technological advancement is the very close interaction between the physical, digital and biological worlds based on high-tech strategies (Do Livramento Gonçalves et al. 2021).

Industry 4.0 is driven by nine technological categories of advancement. Many of them are used already in manufacturing, but in newer approaches, the production flow is more fully integrated, automated, and optimized, resulting in greater efficiency; something that is changing traditional relationships in production (Rüßmann et al. 2015). These technological categories (or pillars) are summarised in Table 1 together with their respective concepts.

2.2 Education for Sustainable Development in HEIs

The universal mission of a university is the creation and transmission of information and scientific knowledge (Sachs 2015). With the growing social demand for sustainable practices in HEIs, such institutions have become agents of change by assuming a worldwide role in the development and implementation of sustainable practices and initiatives. HEIs are now embracing their potential to accelerate the progress toward sustainable development (Berchin et al. 2021). This pro-active promotion of sustainability in the higher education sector also has a direct influence on the communities in which they operate. The result is that we see HEIs actively promoting sustainable development and supporting directly such practices for greener cities through their technological resources (Fuchs et al. 2020).

The issue of sustainability in HEIs gained visibility from the United Nations Conference on the Human Environment in Stockholm, 1972, (Alshuwaikhat and Abubakar 2008). A conclusion from this was that society's educators cannot shirk their social responsibility to shape the minds of future society, future teachers, and professionals in all spheres of society (Svanström et al. 2008). Effectively, HEIs are becoming agents of change in promoting a very different mindset about the use of the world's natural resources through their ESD programmes (Silva and Pinheiro 2018).

2.2.1 Education for Sustainable Development

The term education for sustainable development was coined in the mid-1990s and can be defined as "an educational process characterized by approaches and methods that aim to promote awareness of issues related to sustainable development," which differs from previous approaches in which the emphasis was on environmental issues (Leal Filho et al. 2015). ESD aims to promote democratic participation and self-determined engagement of individuals, in a paradigm transformation, so that all citizens can collaborate at some level in moving towards a more sustainable society (Gómez-Zermeño 2020). ESD, as stated by UNESCO, should empower students to new ways of thinking and acting for a more sustainable and just society for all (Piccolo et al. 2021).

To fulfil this ideal, ESD is beginning to be promoted in HEIs both as a concept and as a way of thinking thus providing students with a holistic view of socio-economic structure and environmental issues (Balčiūnaitienė 2016). Encouraging research on the role of HEIs in supporting sustainable development help students expand their concept of the topic especially in the context of competencies for future challenges. In this way HEIs can anticipate and offer more appropriate ways to educate for such competencies (Giesenbauer and Müller-Christ 2020).

2.2.2 The Sustainable Development Goals

In the last few decades, humanity has experienced unprecedented development, driven by the Industrial Revolutions. This enormous development has led to a considerable increase in the availability of goods and services for all, but at the cost of depleting natural resources and causing major changes in the biophysical systems of our planet (Martine and Alves 2019).

This situation has led to the need to balance our ambition for development with our need for environmental preservation. To address these different needs, the United Nations implemented in 2015 the Sustainable Development Goals (SDGs) that comprises a set of goals and targets through which humanity could maintain improvements in quality of life while controlling the environmental impact of its actions (Buhmann et al. 2019; Lago 2013; Sachs 2015; United Nations 2015). Sustainable development is understood to be the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations 1987, p. 37). The adoption of the 17 SDGs was the result of decades of debate on how to balance the need for economic advancement with the environmental concerns (Kanie et al. 2017; Sachs 2015).

The requirement for development is still a major problem around the world, with millions of people lacking access to basic needs. For example, 785 million people live in poverty, 821 million people are undernourished, and 673 million people lack access to basic sanitation (Barbier and Burgess 2020). Although there are concerted efforts to prevent these problems from happening, the world's population continues to increase, making it more difficult to find solutions for everyone (Sachs 2015).

2.2.3 The Current State of Sustainable Development

The SDGs can be seen as the latest instalment in a decades-long journey towards action for sustainability (Kanie et al. 2017). Since the first concerns about environmental sustainability emerged in the 1970s, countries have been asked to find solutions to minimize their own damage to the Earth (France 2010). The first organized commitment to a sustainability agenda came in the Millennium Development Goals (MDGs) that were adopted in the 2000s to focus on and address problems of development and poverty in developing countries with the expectation that they would be met by 2015 (Bebbington and Unerman 2018; Plum and Kaljee 2017). However, in 2015, after the MDGs achieved a mixed success, the SDGs were developed as a much broader and more comprehensive set of goals: they were intended to be universal in nature and address both development and environmental preservation issues simultaneously (Kanie et al. 2017; Plum and Kaljee 2017; Sachs 2015; United Nations 2020).

The current progress on the SDGs has also been mixed and, in 2019, the United Nations believed that a faster response was needed to meet the goals and targets by 2030, stating that efforts to date have been insufficient (Fenner and Cernev 2021; United Nations 2020). This situation has been aggravated by the COVID-19 pandemic and its effects, which represent a major threat to the SDGs and may compromise progress on several goals (Berchin and de Andrade Guerra2020; Leal Filho 2020).

2.2.4 Industry 4.0 and the SDGs

Industry 4.0 is expected to have a major impact on the achievement of the 17 SDGs, but many of its consequences may not be foreseeable right now and may have a varying impact on each of them. For example, Schwab (2017a, b) believes that no variables in the economy are likely to remain unchanged in this revolution. Also, estimates show that poverty reduction (SDG 1) is likely to be unaffected while advancements in gender equality (SDG 5) may be more difficult in the future (Popović 2020; Schwab 2017a, b). Meanwhile, the quality of education (SDG 4) may be one area where Industry 4.0 could have a positive impact, although it is very likely that education will develop new curriculums and education standards to suit the new jobs and areas of concern that this will bring (Popović 2020).

2.3 Education 4.0

Digital transformation has come to revolutionize universities as we know them, and through Industry 4.0, the method of approaching teaching and learning is known as Education 4.0 (Bujang et al. 2019). This new model adapted to evolve in this

newly formed scenario of the fourth industrial revolution is commonly found in the literature under the name University 4.0 (Flores 2018).

Education is no stranger to revolution considering that the first of these was characterized by an informal way of teaching, controlled by the church and accessible to just a privileged few confined within religious institutions. Education 2.0 then emerged to democratize education and gave rise to wider access and mass education. This was followed by Education 3.0 along with the advances in information and communication technologies that revolutionizing the way we learn and teach, making education accessible to the public without restrictions of space, time, and location (Gueye and Exposito 2020).

Education 4.0 now complements the digital inclusion phenomenon as humans and machines work together more closely to create innovation. This paradigm is based on two emerging trends: (i) general innovation and changes to education and pedagogy; and (ii) integration of technologies introduced by Industry 4.0 (Halili 2019).

Gurieva et al. (2019) classified HEIs into four structures, namely, University 1.0 as social institutions that implement the education function and are effective in transmitting knowledge; University 2.0 as those that perform research alongside the educational function; University 3.0, as those institutions that implement, alongside their educational and research functions, the function of technology transfer and delivery to end users, i.e., through the commercialisation of technology); and finally, University 4.0 as those institutions designed by the intellectual elite that perform the function of providing knowledge about the future.

In this new era of learning systems, the characteristics that shape learners are self-directed learning, critical thinking, digital skills, and problem-solving abilities (Bujang et al. 2019). Education 4.0, considers digitisation and globalised learning to happen anywhere and at any time (Konst and Scheinin 2020) and comes to meet the needs of the 'innovation era' in accordance with the changing behaviour of society. Its characteristics of integration and connectivism promote systems of cooperation between humans and machines to solve problems and develop environments conducive to innovation (Halili 2019; Puncreobutr 2016).

This perspective of learning, therefore, encourages students to learn not only the skills and knowledge taught in the classroom, but also to identify sources of learning: students learn together and with each other while the teachers assume more the role as facilitators in this process (Hussin 2018). By offering multivariate knowledge with an emphasis on information and communication technologies, Education 4.0 also results in creativity and prepares individuals with global competencies (Gorina and Polyakova 2021).

3 Methods

Based on a relevant literature, the aim of this study is to identify the impacts of Industry 4.0 on ESD in HEIs. The methodology used to achieve this was a scoping

review analysis of a selected portfolio of literature identified in the relevant scientific publications.

The following scoping review, as proposed by Arksey and O'Malley (2005), was used in this study. This follows five stages.

Stage 1*: Identifying the research question.*

What are the impacts of Industry 4.0 on education for sustainable development in higher education institutions?

Stage 2*: Identifying relevant studies.*

In this step, Scopus, ScienceDirect, and Google Scholar databases were used to identify relevant publications on the topic. A research strategy was developed, including Boolean operators (*Fourth Industrial Revolution* OR *Industry 4.0*) AND (*Education* OR *Education 4.0*) AND (*Sustainable Development* OR *sustainability*) AND (*Higher Education Institutions* OR *HEIs*), which resulted in a wider range of studies to be selected for the purpose of this work.

Stage 3*: Study selection.*

Inclusion and exclusion criteria were adopted to allow articles from the published works identified in Stage 2 to be selected. For studies to be selected, their title or abstract should contain two or more of the themes (Fourth Industrial Revolution; Industry 4.0; Education 4.0; Sustainable Development; sustainability and Higher Education Institutions or HEIs), proposed in this work. Only studies in English were considered for the analysis, and only the most relevant scientific articles and book chapters were selected based on (1) number of citations; (2) relevant recent discoveries, being the period selected for the analysis between 2000–2021.

After a preliminary selection of articles in the databases were selected, 106 were selected for inclusion in this review and after 36 duplicated papers were excluded 70 papers remained for the final analysis (see Table 2).

Stage 4*: Charting the data* The final database of selected articles was organized into an Excel spreadsheet with details regarding year of publication, title, authors, journal and number of citations (Google Scholar).

Stage 5*: Collating, summarizing, and reporting the results (analysis and recommendations).*

Finally, the collected data were used for the construction of the literature review, conceptualising, and defining the terms and ideas raised for the development of the discussion on the impacts of the Industry 4.0 on education for sustainable development in HEIs.

4 Results Discussion

Konst and Scheinin (2020) argue that, while the phenomena of digitalisation and globalisation act as significant drivers for change in education, in the face of the threat of climate catastrophe and other environmental issues, the changes needed are greater than what we currently understand within the concepts of Education 4.0.

Therefore, it is time to incorporate all the important goals of Education 4.0 and link them to the goals of sustainable development.

In today's globalized and interconnected world, education systems need to develop innovative approaches to deal with current and upcoming global issues by enhancing their teaching methods at all levels through technology, making it possible to empower people with the knowledge they need to adapt to their changing environments (Gómez-Zermeño 2020). From our search of the literature, we observe that many researchers have engaged in publications about educational needs in the age of Industry 4.0, and while some of them address new qualification requirements, much of the articles focus on specific areas that should be added to the curricula (Catal and Tekinerdogan 2019).

We identify seven such areas of Industrial 4.0 technologies that can support ESD in HEIs if it is not doing so already. The following section provides an overview and discussion of their significance.

4.1 Big Data

In digitalizing our education, our online activities create an ever-growing collection of digital data that can dramatically improve HEIs (Wang 2016). For example, such data can be used to gain insight into students' performance and analyse the effectiveness of the teaching approaches used for each scholar, rather than relying solely and exclusively on periodic test and exam results (Halili 2019; West 2012). In this way, data regarding students' progress and achievements in class, or derived from questionnaires administered on campus can help HEIs identify and understand students' knowledge, attitudes, and behaviours relating to sustainable development. In turn, this assists the teachers to improve their teaching pedagogy and influences changes according to students' needs, requirements, and expectations (Chaurasia et al. 2018; Drigas and Leliopoulos 2014; Pane et al. 2020).

4.2 Autonomous Robots and Artificial Intelligence

According to Butler-Adam (2018), scientists, educators, political decision-makers, and all those working to achieve the 17 SDGs can benefit from the applications of AI whether it be for climate action, in the fight for decent working conditions, or for promoting quality education. The SDG 4 emphasises equal learning opportunities for all throughout life (United Nations 2020). In this sense, AI can be considered an ally with its technologies seen as a means of ensuring inclusive and equitable access to education for all. This includes providing learning opportunities for people with disabilities, those living in isolation or in marginalised communities, and even refugees (Pedro et al. 2019).

Another point immerging from the literature is the advantage that AI technologies bring in terms of optimizing teachers' time allocation (Ramos 2020). The application of robots working together with educators can reduce irrelevant and exhausting manual work (Chen et al. 2020) that teachers have to do from time to time, meaning they can focus more on meaningful learning experiences for students (Halili 2019).

4.3 Internet of Things (IoT)

The IoT influences education as the popularity of mobile devices increases (Halili 2019). Abdel-Basset et al. (2019) points out that the number of internet-connected devices surpassed the number of people in the world in 2008, and in the coming decades tens of billions of these devices are expected to be connected to the internet. Such technology helps to establish quick communication and interaction between students and teachers inside and outside the classroom (Abdel-Basset et al. 2019). In addition, teaching and learning methods, materials, and equipment are more diverse with the advent of IoT where students can easily find information online through channels such as Google, Youtube, educational apps and collaborative websites such as Wikipedia (Quyet 2020).

Education for a long time was restricted by the need for students to meet in a classroom, but technological innovation is loosening these restrictions and bringing a fundamental change to higher education (Xing 2015). Using the Internet in learning environments, Massive Open Online Courses (MOOCs) have provided the necessary opening for the sharing of resources, ideas, and experiences, providing broad communication and the creation of new networks in an interconnected world (Gómez-Zermeño 2020). The use of online learning and e-Learning allows for student-centred education anywhere and anytime, enabling greater promotion of teaching for sustainable development (Ally and Wark 2019).

4.4 Simulation

Most of the papers found in the literature on the use of simulations for teaching purposes are about gamification. Gamification defines the use of common game techniques in non-game situations, consisting, in the case of education, of the application of game elements in the learning process (Basten 2017). Gamification is an effective and valuable method for teaching skills in universities that follows the idea of combining facts and information into learning aimed at problem solving. In this way, it becomes an important method of knowledge transfer and integrates education in theory and practice, with aspects of social learning and personal development (Holzbaur 2001). Digital simulations create a reflection of reality where students can practice their skills without risk and without interference to or from the environment (Livesay and Lawrence 2018). Learning by playing a simulation game encourages

reasoning, data rationalization, and information synthesisation, enabling problem experience and creative thinking, in a safe manner (Torres and Macedo 2000).

In today's world, an enormous amount of information is available to nearly everyone and yet the ability to synthesise this information is not possessed equally. Gamification and game-based learning have been established as powerful tools in education in general, and particularly in education for sustainable development (Schneider et al. 2017). By providing students with deeper engagement compared to a traditional textbook, they will get visual elements and will enhance connections between learning concepts and information more effectively (Livesay and Lawrence 2018; Halili 2019).

4.5 The Cloud

According to Koutsopoulos and Papoutsis (2016), education has recently experienced a major shift from a student-centred learning approach, which similarly replaced the traditional teacher-centred instructional approach, to an integrative approach, bringing education into the new paradigm of network-centred knowledge transfer based on cloud computing (CC). Any students with an Internet connection can access their books, articles, and content at home or anywhere, anytime (Almotiry et al. 2021; Halili 2019). The same cloud infrastructure can also be many types of users including research as well as teaching and learning (Qasem et al. 2018). The goal of cloud learning services is to provide people with an opportunity for autonomous learning in their daily life, providing greater access to information and reducing inequalities (Chang et al. 2012).

4.6 Augmented Reality

Augmented reality (AR) is a very effective technology for higher education as it enables students to enhance their knowledge and skills in complex theories with contextually enriched vision of the real world provided by a virtual computer (Lee 2012). AR can increase students' motivation and interest and provide them with a better understanding of issues (Elmqaddem 2019). Multiple educational uses have already been documented in the augmented reality literature and AR has been used to develop students' understanding of science-related issues, including environmental science (Bower et al. 2014). Essentially, it helps them engage in authentic real-world explorations (Akçayır and Akçayır 2017). Livramento et al. (2021) point out that AR tools are useful for the inclusion of people with physical disabilities. This exploits further the idea that Industry 4.0 technologies in general may become a tool for inclusion and for reducing inequalities in HEIs by promoting the collaborative experience of multiple users.

4.7 Additive Manufacturing

Additive Manufacturing (AM) is being established as a tool for education and training (Huang and Leu 2014). Students' vision is no longer limited to images in books, because by using a 3D printer, students have access to generating a physical 3D model of their ideas. AM fosters the creativity of learners in terms of the design process and results in the development of problem-solving skills that access a wider range of creative solutions. They will be much more involved with troubleshooting to turn their ideas into reality in the form of a product. The technology allows students communicate more effectively through a combination of this tactical practical experience as well as the traditional image-based tools that combine to help them have a deeper understanding of their subjects (Halili 2019; Srivastava et al. 2019).

In order to provide a better visualization of the main application of the seven Industrial 4.0 technologies in ESD, Table 3 provides a visual summary of the main points raised in this discussion that were identified from our literature survey. Education 4.0 aims to train individuals to be ready to be creative and innovative (Puncreobutr 2016), offering various opportunities, through the best and latest in technology, for students to adapt to the new reality of the changing world where they will eventually work and live (Kayembe and Nel 2019). In this way, learning should not be directed towards completing tests, but towards acquiring real knowledge through deep learning, horizontal learning systems and problem-based learning, i.e., students of the future will be able to solve real problems (Scepanovic 2019).

Industry 4.0 has different implications for many other sectors of life and as such, it presents opportunities and challenges for education (Kayembe and Nel 2019). One of the challenges that can be pointed to is the possibility that implementing Industry 4.0 technologies without careful consideration may actually widen inequalities and social fragmentation through including increased unemployment, e.g., for teachers who cannot keep up with changes in the system (Sanchez et al. 2020). Another challenge for HEIs in the Fourth Industrial Revolution is the fact that innovation usually requires a large investment. Enormous amounts of money, as well as great dedication of time, effort, and training are required to generate industrial and technological breakthroughs (Alam et al. 2020).

In this study, we support the view that incorporating the SDGs into academic curricula, along with the benefit of Industry 4.0 technologies, will contribute not only to enhanced knowledge and production abilities, but can have a significant impact on ensuring the achievement of the UN goals and a better future for everyone (Leal Filho 2020).

5 Conclusions

As the UN 2030 Agenda continues to advance, it is acknowledged that humanity needs to create better connections between its goals and the reality it faces from

Industry 4.0 and its technological advances. In this sense, our society must transform itself so that these new technologies are humanity's allies in building a better future for everyone. Our best opportunity to do this is through education, where the future of society is created.

Through Industry 4.0 technologies, students will enjoy personalized education that meets their individual needs and difficulties. They will be able to study anywhere, at any time, and are no longer restricted by the need for a classroom. They will have the possibility of attending practical classes, through simulations, without the slightest risk to their health or damage to the environment. The use of AR technologies means that students will find it easier to understand complex subjects with a real-time fusion of information from the world that can also provide a virtual computer for augmented reality. In this respect, there are opportunities to increase student motivation and interest through a better understanding of the issues. Likewise, the student's vision is not just limited to pictures in books, or the computer screen. Additive manufacturing now provides students with a way to generate a physical 3D model of their products leading to a deeper tactile experience and understanding of its various elements.

ESD for Industry 4.0 is an exciting opportunity that can transform our society for better. However, we reinforce we recognise that it requires significant investment that can often be a barrier to implementing it into the curricula of HEIs, especially in developing countries. For this reason, a stepwise gradual change in academia is required to integrate its technologies into their students' learning process that, ultimately, will better meet their demands and prepare them with the knowledge and skills needed for a future in Industry 4.0.

It is also necessary to capacitate teachers and employees of the institutions so that technology works as an ally to their teaching methods, and not as a threat. Measures to democratise access to such technologies will also need to be taken in order to avoid exclusion and increasing inequalities. Industry 4.0 technology has the potential to provide quality education for all, keeping in mind SDG 4 and preparing ourselves to achieve all the other 16 goals by 2030.

Given that the topic appears to have received little attention in the literature, the work presented in this article provides a starting point for further studies on the application of Industry 4.0 technologies for ESD.

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Appendix

See Tables 1, 2, 3.

Table 1 The Fourth Industrial Revolution nine pillars of technological advance (*Source* The authors)

Technological category	Principal concepts	References
Big data and analytical intelligence	Characterized by the "5Vs" (volume, velocity, variety, veracity, and value) big data is a term that refers to large and growing data sets that exceed traditional management and processing techniques due to their size, velocity, or complexity	Do Livramento Gonçalves et al. (2021), Furht and Villanustre (2016), Oussous et al. (2018), Surbakti et al. (2020), Ularu et al. (2012)
Autonomous robots	Advanced machines that, autonomously and without human supervision, can perform an increasing number of tasks	Amigoni et al. (2017), Rüßmann et al. (2015)
Simulation	In the context of industry 4.0, simulations are used to mirror the physical world in a virtual model, helping to develop planning models and optimize decision-making	Syam and Sharma (2018), Pawlewski (2018), de Paula et al. (2020)
System integration	It can refer to linking components of a system (vertical integration), two or more systems (horizontal integration), or connecting physical and virtual objects of a system (end-to-end integration)	Mosconi (2015), Sanchez et al. (2020)
Internet of things	The internet of things (IoT) is a global infrastructure that interconnects everyday smart objects (physical and virtual), creating a widely distributed network of advanced services	Wortmann and Flüchter (2015), Kopetz (2011), Xia et al. (2012)
Cyber-physical systems	Cyber-physical systems (CPS) are systems that integrate computing capabilities with the physical environment and humans in a process of interaction Enabled with the internet of things, CPS helps in the process of collecting, storing, and managing data	Baheti and Gill (2011), Do Livramento Gonçalves et al. (2021), Letichevsky et al. (2017)
Cloud	The "cloud" refers to the storage of information and data generated by the huge group of interconnected computers, which can be accessed remotely from anywhere, via the internet	Griffith (2016), Mirashe and Kalyankar (2010)

(continued)

Table 1 (continued)

Technological category	Principal concepts	References
Additive manufacturing	Additive manufacturing is commonly known as "3-D printing. With this technology, you can manufacture objects from three-dimensional modeling data, layer upon layer, using a special printer	Ceruti et al. (2019), Guo and Leu (2013), Wong and Hernandez (2012)
Augmented reality	Technology designed to provide a view of the real world (physical environment) in an "augmented" form, adding relevant information in a virtual form to enhance the experience/view of things	Carmigniani and Furht (2011)

Table 2 Papers remained for the final analysis

Title	Year	Citations	Authors	Journal
Scoping studies: towards a methodological framework	2005	16,092	Arksey, H., & O'Malley, L	International journal of social research methodology
The Fourth industrial revolution	2017	12,964	Schwab, K	Currency
Big data technologies: a survey	2018	3818	Oussous, A.; Benjelloun, F.-Z.; Lahcen, A. A.; Belfkih, S	Journal of King Saud University Science
Industry 4.0: a survey on technologies, applications and open research issues	2017	2359	Lu, Y	Journal of industrial information integration
Industry 4.0: the future of productivity and growth in manufacturing industries	2015	2195	Rüßmann, M.; Gerbert, P.; Waldner, M.; Engel, P.; Harnisch, M.; Justus, J	Boston Consulting Group
A review of additive manufacturing	2012	2189	Wong, K. V., & Hernandez, A	International scholarly research notices
The age of sustainable development	2015	1991	Sachs, J	Columbia University Press
Additive manufacturing: technology, applications and research needs	2013	1767	Guo, N., & Leu, M. C	Frontiers of Mechanical Engineering

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Table 2 (continued)

Title	Year	Citations	Authors	Journal
Internet of things	2012	1350	Xia, F., Yang, L. T., Wang, L., & Vinel, A	International journal of communication systems
Advantages and challenges associated with augmented reality for education: a systematic review of the literature	2017	1305	Akçayır, M., & Akçayır, G	Educational Research Review
An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices	2008	1134	Alshuwaikhat, H. M., & Abubakar, I	Journal of cleaner production
Augmented reality in education and training	2012	1117	Lee, K	TechTrends
Heutagogy and lifelong learning: a review of heutagogical practice and self-determined learning	2012	1016	Blaschke, L. M	The International Review of Research in Open and Distributed Learning
Big data technologies: a survey	2017	819	Oussous, A.; Benjelloun, F.-Z.; Lahcen, A. A.; Belfkih, S	Journal of King Saud University-Science
Augmented reality in education–cases, places and potential	2014	695	Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D	Educational Media International
Education 4.0 made simple: ideas for teaching	2018	683	Hussin, A. A	International Journal of Education and Literacy Studies
Internet of things	2011	510	Kopetz, H	Real-Time Systems
Learning outcomes for sustainable development in higher education	2008	463	Svanström, M., Lozano-García, F. J., & Rowe, D	International Journal of Sustainability in Higher Education
Waiting for a sales renaissance in the fourth industrial revolution: machine learning and artificial intelligence in sales research and practice	2018	411	Syam, N.; Sharma, A	Industrial marketing management
Industry 4.0: a bibliometric analysis and detailed overview	2019	377	Muhuri, P. K., Shukla, A. K., & Abraham, A	Engineering applications of artificial intelligence

(continued)

Table 2 (continued)

Title	Year	Citations	Authors	Journal
Education 4.0: new challenge of learning	2016	270	Puncreobutr, V	St. Theresa Journal of Humanities and Social Sciences
Big data for education: data mining, data analytics, and web dashboards	2012	263	West, D. M	Governance studies at Brookings
Industry 4.0 as a part of smart cities	2016	261	Lom, M.; Pribyl, O.; Svitek, M	Smart Cities Symposium Prague
Implications of the fourth industrial age for higher education	2017	246	Xing, B., & Marwala, T	The Thinker
The future we want: key issues on sustainable development in higher education after Rio and the UN decade of education for sustainable development	2015	234	Leal Filho, W., Manolas, E., & Pace, P	International Journal of Sustainability in Higher Education
Sustainability and development after COVID-19	2020	226	Barbier, E. B., Burgess, J. C	World Development
Global competitiveness and the manufacturing renaissance	2015	195	Mosconi, F	The New European Industrial Policy
Internet of things in smart education environment: supportive framework in the decision-making process	2019	190	Abdel-Basset, M., Manogaran, G., Mohamed, M., & Rushdy, E	Concurrency and Computation: Practice and Experience
Maintenance in aeronautics in an industry 4.0 context: the role of augmented reality and additive manufacturing	2019	167	Ceruti, A.; Marzocca, P.; Liverani, A.; Bil, C	Journal of Computational Design and Engineering,
Augmented reality and virtual reality in education. Myth or reality?	2019	166	Elmqaddem, N	International journal of emerging technologies in learning
Artificial intelligence in education: a review	2020	152	Chen, L., Chen, P., & Lin, Z	Institute of Electrical and Electronics Engineers
The fourth industrial revolution: things to tighten the link between IT and OT	2014	147	Bloem, J., Van Doorn, M., Duivestein, S., Excoffier, D., Maas, R., & Van Ommeren, E	Things Tighten

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Table 2 (continued)

Title	Year	Citations	Authors	Journal
Perspectives on big data and big data analytics	2012	132	Ularu, E. G., Puican, F. C., Apostu, A., & Velicanu, M	Database Systems Journal
The fourth industrial revolution and education	2018	130	Butler-Adam, J	South African Journal of Science
Artificial intelligence in education: challenges and opportunities for sustainable development	2019	129	Pedro, F., Subosa, M., Rivas, A., & Valverde, P	Working Papers on Education Policy
What is cloud computing	2016	105	Griffith, E	Modern Economy
Technological advancements in education 4.0	2019	89	Halili, S. H	The Online Journal of Distance Education and e-Learning
Frontiers of additive manufacturing research and education	2014	87	Huang, Y., & Leu, M. C	Center for Manufacturing Innovation, University of Florida
Factors influencing effective use of big data: a research framework	2020	87	Surbakti, F. P. S.; Wang, W.; Indulska, M.; Sadiq, S	Information & Management
Simulation in industry 4.0: a state-of-the-art review	2020	76	de Paula Ferreira, W., Armellini, F., & De Santa-Eulalia, L. A	Computers & Industrial Engineering
The fourth ICT-based industrial Revolution "Industry 4.0"—HMI and the case of CAE/CAD Iinnovation with EPLAN P8	2015	75	Lukač, D	Telecommunications Forum Telfor
Big opportunities and big concerns of big data in education	2016	69	Wang, Y	TechTrends
Adapting universities for sustainability education in industry 4.0: channel of challenges and opportunities	2020	63	Mian, S. H., Salah, B., Ameen, W., Moiduddin, K., & Alkhalefah, H	Sustainability
Introduction to big data	2016	62	Furht, B., & Villanustre, F	Big data technologies and applications
The use of big data in education	2014	58	Drigas, A. S., & Leliopoulos, P	International Journal of Computer Science Issues

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Table 2 (continued)

Title	Year	Citations	Authors	Journal
Do no harm and do more good too: connecting the SDGs with business and human rights and political CSR theory	2019	54	Buhmann, K., Jonsson, J., Fisker, M	Corporate Governance
Industry 4.0—transition to new economic reality	2018	53	Feshina, S. S., Konovalova, O. V., & Sinyavsky, N. G	Studies in Systems, Decision and Control
Introduction: global governance through goal setting	2017	49	Kanie, N., Bernstein, S., Biermann, F., Haas, P. M	Governing Through Goals: Sustainable Development Goals as Governance Innovation
Challenges and opportunities for education in the fourth industrial revolution	2019	46	Kayembe, C., & Nel, D	African Journal of Public Affairs
A universidade 4.0 com currículo inteligente 1.0 na quarta revolução industrial	2018	44	Flores, R	Revista Iberoamericana para la Investigación y el Desarrollo Educativo
Industry 4.0: survey from a system integration perspective	2020	44	Sanchez, M., Exposito, E., & Aguilar, J	International Journal of Computer Integrated Manufacturing
University 4.0: promoting the transformation of higher education institutions toward sustainable development	2020	38	Giesenbauer, B., & Müller-Christ, G	Sustainability
Cyberphysical systems	2017	36	Letichevsky, A. A., Letychevskyi, O. O., Skobelev, V. G., & Volkov, V. A	Cybernetics and Systems Analysis
Big data academic and learning analytics: connecting the dots for academic excellence in higher education	2018	36	Chaurasia, S. S., Kodwani, D., Lachhwani, H., & Ketkar, M. A	International Journal of Educational Management
Can education as an 'International Commodity' be the backbone or cane of a nation in the era of fourth industrial revolution? A Comparative study	2020	34	Alam, G. M., Forhad, A. R., & Ismail, I. A	Technological Forecasting and Social Change

(continued)

Table 2 (continued)

Title	Year	Citations	Authors	Journal
Aligning education for the life sciences domain to support digitalization and industry 4.0	2019	33	Catal, C., & Tekinerdogan, B	Procedia computer science
Education for sustainable development 4.0: lessons learned from the University of Graz, Austria	2019	29	Brudermann, T., Aschemann, R., Füllsack, M., & Posch, A	Sustainability
Education and the fourth industrial revolution: challenges and possibilities for engineering education	2019	29	Fomunyam, K. G	International Journal of Mechanical Engineering and Technology
GAIA 3.0: effects of the Coronavirus Disease 2019 (COVID-19) outbreak on sustainable development and future perspectives	2020	29	Berchin, I. I., de Andrade Guerra, J. B. S. O	Research in Globalization
The implications of the Covid-19 pandemic for delivering the sustainable development goals	2021	26	Fenner, R., Cernev, T	Futures
Additive manufacturing: Fundamentals and advancements	2019	25	Srivastava, M., Rathee, S., Maheshwari, S., & Kundra, T. K	CRC Press
The implications of learning cloud for education: from the perspectives of learners	2012	19	Chang, C. S., Chen, T. S., & Hsu, H. L	Mobile and Ubiquitous Technology in Education
Toward generalization of experimental results for autonomous robots	2017	18	Amigoni, F.; Luperto, M.; Schiaffonati, V	Robotics and Autonomous Systems
Using PFEP for simulation modeling of production systems	2018	17	Pawlewski, P	Procedia Manufacturing
The fourth industrial revolution and education	2019	17	Scepanovič, S	Institute of Electrical and Electronics Engineers
Massive open online courses as a digital learning strategy of education for sustainable development	2020	17	Gómez-Zermeño, M. G	Journal of Sustainable Development of Energy, Water and Environment Systems

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Table 2 (continued)

Title	Year	Citations	Authors	Journal
Mapping and analyzing process of cloud-based education as a service (CEaaS) model for cloud computing adoption in higher education institutions	2018	16	Qasem, Y. A., Abdullah, R., Atan, R., & Jusoh, Y. Y	Fourth international conference on information retrieval and knowledge managemen
Viewpoint: accelerating the implementation of the SDGs	2020	15	Leal Filho, W	International Journal of Sustainability in Higher Education
School on cloud: transforming education	2016	14	Koutsopoulos, K. C., & Papoutsis, P	Educational Policy Analysis and Strategic Research
Promoting sustainable development in higher education institutions: the use of the balanced scorecard as a strategic management system in support of green marketing	2020	12	Fuchs, P., Raulino, C., Conceição, D., Neiva, S., de Amorim, W. S., Soares, T. C., … & Guerra, A	International Journal of Sustainability in Higher Education

Table 3 Industry 4.0 specific technologies influencing ESD (*Source* The authors)

Technology	Application in education	Authors
Big data	Gathering information about student performance, helping teachers to analyze their teaching pedagogy and influence changes according to student's needs, requirements, and expectations	Chaurasia et al. (2018), Drigas and Leliopoulos (2014), Halili (2019), West (2012)
Autonomous robots and AI	The implementation of robots working together with teachers can reduce the manual labor that teachers have to do from time to time, so that they can focus on other tasks important to the students' learning process	Chen et al. (2020), Ramos (2020)
Internet of things	Teaching is no longer restricted by the need for students to gather in a room: the use of online learning and e-Learning enables learner-centered education anywhere, anytime	Ally and Wark (2019), Xing (2015)
Simulation	Simulation creates a reflection of reality where students can practice their skills without risk and without interference in the environment. Gamification and game-based learning have been established as powerful tools in education in general and ESD in particular	Livesay and Lawrence (2018), Schneider et al. (2017)

(continued)

Table 3 (continued)

Technology	Application in education	Authors
The cloud	With Internet connection, students can access their books, essays, and content at home or anywhere, anytime The same cloud infrastructure can be provided for research, teaching, and learning for many users, giving people an opportunity for autonomous learning in everyday life, and providing greater access to information	Almotiry et al. (2021), Halili (2019)
Augmented reality	Students will be able to enhance their knowledge and skills, especially in complex theories with contextually enriched vision of the real world provided by a virtual computer. Augmented reality can increase student motivation and interest and provide a better understanding of issues	Elmqaddem (2019), Lee (2012)
Additive manufacturing	3D models of different elements will help students to have a deeper understanding of their subjects. The student's vision is not only limited to images in books	Halili (2019), Srivastava et al. (2019)

References

Abdel-Basset M, Manogaran G, Mohamed M, Rushdy E (2019) Internet of things in smart education environment: supportive framework in the decision-making process. Concurr Comput Pract Exp 31(10):e4515

Akçayır M, Akçayır G (2017) Advantages and challenges associated with augmented reality for education: a systematic review of the literature. Educ Res Rev 20:1–11

Alam GM, Forhad AR, Ismail IA (2020) Can education as an 'International Commodity' be the backbone or cane of a nation in the era of fourth industrial revolution?—a comparative study. Technol Forecast Soc Chang 159:120184

Almotiry ON, Sha M, Rahamathulla MP, Omer OSD (2020) Hybrid cloud architecture for higher education system. Comput Syst Sci Eng 36(1):1–12

Ally M, Wark N (2020) Learning for sustainable development in the Fourth Industrial Revolution

Alshuwaikhat HM, Abubakar I (2008) An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices. J Clean Prod 16(16):1777–1785

Amigoni F, Luperto M, Schiaffonati V (2017) Toward generalization of experimental results for autonomous robots. Robot Auton Syst 90:4–14. https://doi.org/10.1016/j.robot.2016.08.016

Arksey H, O'Malley L (2005) Scoping studies: towards a methodological framework. Int J Soc Res Methodol 8(1):19–32

Basten D (2017) Gamification. IEEE Softw 34(5):76–81. https://doi.org/10.1109/MS.2017.3571581

Barbier EB, Burgess JC (2020) Sustainability and development after COVID-19. World Dev 135:105082. https://doi.org/10.1016/j.worlddev.2020.105082

Baheti R, Gill H (2011) Cyber-physical systems. Impact Control Technol 12(1):161–166

Balčiūnaitienė A (2016) Education of sustainable development competence in higher education institution. Doctoral dissertation, VDU, Kaunas

Bebbington J, Unerman J (2018) Achieving the United Nations sustainable development goals. Account Audit Account J 31:2–24. https://doi.org/10.1108/AAAJ-05-2017-2929

Berchin II, de Aguiar Dutra AR, Guerra JBSODA (2021) How do higher education institutions promote sustainable development? A literature review. Sustain Dev 29(6):1204–1222

Berchin II, de Andrade Guerra JBSO (2020) GAIA 3.0: effects of the coronavirus disease 2019 (COVID-19) outbreak on sustainable development and future perspectives. Res Glob 2:100014. https://doi.org/10.1016/j.resglo.2020.100014
Blaschke LM (2012) Heutagogy and lifelong learning: a review of heutagogical practice and self-determined learning. Int Rev Res Open Distrib Learn 13(1):56–71
Bloem J, Van Doorn M, Duivestein S, Excoffier D, Maas R, Van Ommeren E (2014) The fourth industrial revolution: things to tighten the link between IT and OT. Sogeti VINT2014
Bower M, Howe C, McCredie N, Robinson A, Grover D (2014) Augmented reality in education–cases, places and potentials. Educ Media Int 51(1):1–15
Brudermann T, Aschemann R, Füllsack M, Posch A (2019) Education for sustainable development 4.0: lessons learned from the University of Graz, Austria. Sustainability 11(8):2347
Butler-Adam J (2018) The fourth industrial revolution and education. S Afr J Sci 114(5–6):1–1
Buhmann K, Jonsson J, Fisker M (2019) Do no harm and do more good too: connecting the SDGs with business and human rights and political CSR theory. Corp Gov Int J Bus Soc 19:389–403. https://doi.org/10.1108/CG-01-2018-0030
Bujang A, Naho A, Awang N (2019) The application of information and communication technology (ICT) in teaching and learning: the application of information and communication technology (ICT) in teaching and learning. ILKKM J Med Health Sci 1(2):1–5
Carmigniani J, Furht B (2011) Augmented reality: an overview. Handbook of augmented reality, pp 3–46
Catal C, Tekinerdogan B (2019) Aligning education for the life sciences domain to support digitalization and industry 4.0. Procedia Comput Sci 158:99–106
Chang CS, Chen TS, Hsu HL (2012) The implications of learning cloud for education: from the perspectives of learners. In: 2012 IEEE seventh international conference on wireless, mobile and ubiquitous technology in education. IEEE, pp 157–161
Chen L, Chen P, Lin Z (2020) Artificial intelligence in education: a review. IEEE Access 8:75264–75278
Chaurasia SS, Kodwani D, Lachhwani H, Ketkar MA (2018) Big data academic and learning analytics: connecting the dots for academic excellence in higher education. Int J Educ Manag
Ceruti A, Marzocca P, Liverani A, Bil C (2019) Maintenance in aeronautics in an industry 4.0 context: the role of augmented reality and additive manufacturing. J Comput Des Eng 6. https://doi.org/10.1016/j.jcde.2019.02.001
Drigas AS, Leliopoulos P (2014) The use of big data in education. Int J Comput Sci Issues (IJCSI) 11(5):58
Elmqaddem N (2019) Augmented reality and virtual reality in education. Myth or reality? Int J Emerg Technol Learn 14(3)
Fenner R, Cernev T (2021) The implications of the Covid-19 pandemic for delivering the sustainable development goals. Futures 25
Feshina SS, Konovalova OV, Sinyavsky NG (2018) Industry 4.0—transition to new economic reality. Stud Syst Decis Control 111–120. https://doi.org/10.1007/978-3-319-94310-7_11
França JFBF (2010) A política externa brasileira para o meio ambiente: de Estocolmo a Joanesburgo. Cad Relações Interacionais 3:1–31
Fomunyam KG (2019) Education and the fourth industrial revolution: challenges and possibilities for engineering education. Int J Mech Eng Technol (IJMET) 10:23–25
Fuchs P, Raulino C, Conceição D, Neiva S, de Amorim WS, Soares TC, Guerra A (2020) Promoting sustainable development in higher education institutions: the use of the balanced scorecard as a strategic management system in support of green marketing. Int J Sustain High Educ
Flores R (2018) A universidade 4.0 com currículo inteligente 1.0 na quarta revolução industrial. RIDE. Revista Iberoamericana para la Investigación y el Desarrollo Educativo 9(17):168–194
Furht B, Villanustre F (2016) Introduction to big data. Big data technologies and applications. Springer, Cham, pp 3–11
Giesenbauer B, Müller-Christ G (2020) University 4.0: promoting the transformation of higher education institutions toward sustainable development. Sustainability 12(8):3371

Gómez-Zermeño MG (2020) Massive open online courses as a digital learning strategy of education for sustainable development. J Sustain Dev Energy Water Environ Syst 8(3):577–589
Gorina L, Polyakova E (2021) University 4.0 within the context of the sustainable development of higher education. In: E3S web of conferences, vol 250. EDP Sciences, p 04002
Griffith E (2016) What is cloud computing. Retrieved from PC Mag: http://au.pcmag.com/networking-communications-software-products/29902/feature/what-is-cloud-computing
Guo N, Leu MC (2013) Additive manufacturing: technology, applications and research needs. Front Mech Eng 8(3):215–243
Gueye M, Exposito E (2020) University 4.0: the industry 4.0 paradigm applied to education. In: IX Congreso Nacional de Tecnologías en la Educación
Gurieva LK, Btemirova RI, Kovaleva MA (2019) University 4.0: new education technologies in the digital economy. In: International scientific and practical conference on digital economy (ISCDE 2019). Atlantis Press, pp 211–216
Halili SH (2019) Technological advancements in education 4.0. Online J Distance Educ e-Learn 7(1):63–69
Huang Y, Leu MC (2014) Frontiers of additive manufacturing research and education
Holzbaur U (2001) EcoGames–simulation games and sustainable development. Sustainability in the information society. Metropolis, Marburg, pp 971–978
Hussin AA (2018) Education 4.0 made simple: ideas for teaching. Int J Educ Lit Stud 6(3):92–98
Kanie N, Bernstein S, Biermann F, Haas PM (2017) Introduction: global governance through goal setting. In: Kanie N, Biermann F (eds) Governing through goals. MIT Press, Cambridge, Massachusetts, pp 1–29
Kayembe C, Nel D (2019) Challenges and opportunities for education in the Fourth Industrial Revolution. Afr J Public Aff 11(3):79–94
Kopetz H (2011) Internet of things. Real-time systems, pp 307–323. https://doi.org/10.1007/978-1-4419-8237-7_13
Koutsopoulos KC, Papoutsis P (2016) School on cloud: transforming education. Educ Policy Anal Strat Res 11(1):31–46
Konst T, Scheinin M (2020) Why education 4.0 is not enough: education for sustainable future. In: EDULEARN20 proceedings: 12th international conference on education and new learning technologies, 6–7 July, 2020. IATED, International Association of Technology, Education and Development
Lago AAC do (2013) Conferências de Desenvolvimento Sustentável, Em poucas palavras. Fundação Alexandre de Gusmão, Brasília
Leal Filho W (2020) Viewpoint: accelerating the implementation of the SDGs. Int J Sustain High Educ 21:507–511. https://doi.org/10.1108/IJSHE-01-2020-0011
Lee K (2012) Augmented reality in education and training. TechTrends 56(2):13–21
Leal Filho W, Manolas E, Pace P (2015) The future we want: key issues on sustainable development in higher education after Rio and the UN decade of education for sustainable development. Int J Sustain High Educ
Letichevsky AA, Letychevskyi OO, Skobelev VG, Volkov VA (2017) Cyber-physical systems. Cybern Syst Anal 53(6):821–834
Livesay K, Lawrence K (2018) Staff perception of the sustainability of a mature simulation program in nursing and midwifery education: a phenomenological analysis. Nurse Educ Today 71:145–150
do Livramento Gonçalves G, Leal Filho W, da Silva Neiva S, Borchardt Deggau A, de Oliveira Veras M, Ceci F, Baltazar J et al (2021) The impacts of the fourth industrial revolution on smart and sustainable cities. Sustainability 13(13):7165
Lom M, Pribyl O, Svitek M (2016) Industry 4.0 as a part of smart cities. In: Proceedings of the 2016 smart cities symposium Prague (SCSP), Prague, Czech Republic, 26–27 May 2016
Lu Y (2017) Industry 4.0: a survey on technologies, applications and open research issues. J Ind Inf Integr 6:1–10
Lukač D (2015) The fourth ICT-based industrial revolution "Industry 4.0"—HMI and the case of CAE/CAD innovation with EPLAN P8. In: Proceedings of the 2015 23rd telecommunications

forum Telfor (TELFOR), Belgrade, Serbia, 25 Nov 2015, pp 835–838. https://doi.org/10.1109/TELFOR.2015.7377595
Martine G, Alves JE (2019) Disarray in global governance and climate change chaos. Rev Bras Estud Popul 36:1–30. https://doi.org/10.20947/S102-3098a0075
Mirashe SP, Kalyankar NV (2010) Cloud computing. arXiv preprint. arXiv:1003.4074
Mian SH, Salah B, Ameen W, Moiduddin K, Alkhalefah H (2020) Adapting universities for sustainability education in industry 4.0: channel of challenges and opportunities. Sustainability 12(15):6100
Muhuri PK, Shukla AK, Abraham A (2019) Industry 4.0: a bibliometric analysis and detailed overview. Eng Appl Artif Intell 78:218–235
Mosconi F (2015) The new European industrial policy: global competitiveness and the manufacturing renaissance. Routledge, Abingdon, UK
Oussous A, Benjelloun F-Z, Lahcen AA, Belfkih S (2018) Big data technologies: a survey. J King Saud Univ Comput Inf Sci 30:431–448. https://doi.org/10.1016/j.jksuci.2017.06.001
Pane MM, Siregar C, Lake SCJM (2020) The role of big data in enhancing student's sustainable development awareness. In: Proceedings of the 2020 2nd international conference on big data engineering and technology. https://doi.org/10.1145/3378904.3378919
de Paula Ferreira W, Armellini F, De Santa-Eulalia LA (2020) Simulation in industry 4.0: a state-of-the-art review. Comput Ind Eng 106868
Pawlewski P (2018) Using PFEP for simulation modeling of production systems. Procedia Manuf 17:811–818. https://doi.org/10.1016/j.promfg.2018.10.132
Pedro F, Subosa M, Rivas A, Valverde P (2019) Artificial intelligence in education: challenges and opportunities for sustainable development
Piccolo L, Neris V, Menezes L, Neris de Oliveira L (2021) Internet of things in education for sustainable development
Plum A, Kaljee L (2017) Achieving sustainable, community-based health in detroit through adaptation of the UNSDGs. Ann Glob Health 82:981. https://doi.org/10.1016/j.aogh.2016.10.014
Popović A (2020) Implications of the Fourth Industrial Revolution on sustainable development. Econ Sustain Dev 4:45–60. https://doi.org/10.5937/ESD2001045P
Puncreobutr V (2016) Education 4.0: new challenge of learning. St Theresa J HumIties Soc Sci 2(2):92–97
Quyet NT (2020) Higher education in the fourth industrial revolution age. Am J Educ Res 8(6):420–426
Qasem YA, Abdullah R, Atan R, Jusoh YY (2018) Mapping and analyzing process of cloud-based education as a service (CEaaS) model for cloud computing adoption in higher education institutions. In: 2018 fourth international conference on information retrieval and knowledge management (CAMP). IEEE, pp 1–8
Ramos JRM (2020) The use of big data and artificial intelligence: to prevent and detect fraud. Artificial intelligence in the economic sector: prevention and responsibility, pp 85–115
Rüßmann M, Gerbert P, Waldner M, Engel P, Harnisch M, Justus J (2015) Industry 4.0: the future of productivity and growth in manufacturing industries. Boston Consulting Group, Boston, MA, USA
Sachs J (2015) The age of sustainable development. Columbia University Press, New York
Sanchez M, Exposito E, Aguilar J (2020) Industry 4.0: survey from a system integration perspective. Int J Comput Integr Manuf 1–25. https://doi.org/10.1080/0951192x.2020.1775295
Schneider J, Schaal S, Schlieder C (2017) Geogames in education for sustainable development: transferring a simulation game in outdoor settings. In: 2017 9th international conference on virtual worlds and games for serious applications (vs-games). IEEE, pp 79–86
Silva JIAO, Pinheiro ALS (2018) Avaliação da Sustentabilidade do Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Norte. Desenvolvimento Em Questão 16(45):249–272
Srivastava M, Rathee S, Maheshwari S, Kundra TK (2019) Additive manufacturing: fundamentals and advancements. CRC Press

Surbakti FPS, Wang W, Indulska M, Sadiq S (2020) Factors influencing effective use of big data: a research framework. Inf Manag 57:103146. https://doi.org/10.1016/j.im.2019.02.001
Schwab K (2017a) The fourth industrial revolution. Currency, Genebra
Scepanovič S (2019) The fourth industrial revolution and education. In: 2019 8th Mediterranean conference on embedded computing (MECO). IEEE, pp 1–4
Schwab K (2017b) The fourth industrial revolution. Currency
Syam N, Sharma A (2018) Waiting for a sales renaissance in the fourth industrial revolution: machine learning and artificial intelligence in sales research and practice. Ind Mark Manag 69:135–146. https://doi.org/10.1016/j.indmarman.2017.12.019
Svanström M, Lozano-García FJ, Rowe D (2008) Learning outcomes for sustainable development in higher education. Int J Sustain High Educ
Torres M, Macedo J (2000) Learning sustainable development with a new simulation game. Simul Gaming 31(1):119–126
Ularu EG, Puican FC, Apostu A, Velicanu M (2012) Perspectives on big data and big data analytics. Database Syst J 3(4):3–14
United Nations (2020) The sustainable development goals report 2020. United Nations
United Nations (2015) United Nations sustainable development goals
United Nations (1987) Our common future: report of the World Commission on Environment and Development
Wang Y (2016) Big opportunities and big concerns of big data in education. TechTrends 60(4):381–384
West DM (2012) Big data for education: data mining, data analytics, and web dashboards. Gov Stud Brook 4(1):1–10
Wortmann F, Flüchter K (2015) Internet of things. Bus Inf Syst Eng 57(3):221–224
Wong KV, Hernandez A (2012) A review of additive manufacturing. International scholarly research notices
Xia F, Yang LT, Wang L, Vinel A (2012) Internet of things. Int J Commun Syst 25(9):1101
Xing J (2015) Global citizenship education in Hong Kong. Int J Inf Educ Technol 5(2):136
Xing B, Marwala T (2017) Implications of the fourth industrial age for higher education. The_Thinker__Issue_73__Third_Quarter_2017

The Pennsylvania Environmental Resource Consortium: A State-Wide Collaborative Network for Sustainable Outreach, Education, and Action

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1 Introduction: Theoretical and Practical Basis for Higher Education Collaborations for Sustainability

Higher education organizations have long sought to address society's major issues. Addressing these issues has been focused through individual programs at colleges and universities, in the missions of the full institution itself, or through consortia.

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Cursory consideration of programs in social justice, human rights, or sustainability will bring to mind courses of study in many institutions around the world. Land grant universities in the United States were charged with helping to develop technologies, especially in natural resources, that would benefit society at large (Fitzgerald et al. 2012). Notably, the role of these institutions has evolved over time, moving from an academy that serves as sources of information, to now operating in more expansive and diverse roles, including innovation, revitalization, development, scientific advising/communicating, facilitating (Trencher et al. 2013), and entrepreneurial activities (Audretsch 2014). Certainly, this engagement has extended to the sphere of environmental sustainability, with academic institutions engaging in inward-looking as well as outward-looking initiatives (Lozano et al. 2015). These outward-looking initiatives take different forms. Importantly, this outward focus has warranted the creation of coordinating, collaborating, and cooperating institutions.

Organizations can work together to achieve objectives beyond the scale of their own immediate sphere of authority or influence. Keast et al. (2007) describe this continuum as moving from cooperation to coordination to collaboration. This continuum represents a sliding intensity of transaction costs and formality to achieve shared goals. Cooperating is low intensity and requires limited connections. Coordination requires sharing tasks but maintains organizational autonomy. Collaboration blurs organizational or institutional boundaries, creating a unified and unitary identity, merger of resources, and consolidation of tasks.

An example of a national-level collaborative organization is the Association for the Advancement of Sustainability in Higher Education (AASHE; (https://www.aashe.org). It exists independently of any individual higher education institution but serves the higher educational sector's sustainability preferences. AASHE staff, programs, and funding do not reside within any 2- or 4-year college or university, it has its own identity, and its tasks are distinct from its member institutions. Its board is comprised of staff and faculty from North American higher education post-secondary schools but its full-time staff are employed by AASHE. Historically, PERC's structure resembles a state-level organization like AASHE, made up of a Board from Pennsylvania college and universities, and staff employed by PERC itself. Since COVID-19, staffing has presented a minor challenge and members of the Board have had to do more administrative work than in previous years. However, the organization's mission has continued to remain largely independent of any single member school's preferences.

PERC is an organization of colleges and universities in Pennsylvania that enables collaboration for sustainability and encourages sustainability on member campuses, in local communities, and across the Commonwealth, differentiating it from larger national organizations, such as AASHE,, the Global Council for Science and the

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Environment (https://www.gcseglobal.org/), or the Association for Environmental Studies and Sciences https://aessonline.org/), which have national or global outreach. PERC is more akin to the New Jersey Higher Education Partnership for Sustainability (https://www.ramapo.edu/njheps/), whose members are New Jersey institutions that promote sustainability in operations and administration, outreach, student life, curriculum, and research. Like these organizations, PERC members share their success stories through conferences, workshops, webinars, web learning cohorts, and regularly emailed communications to help institutions learn from one another.

The purpose of this paper is to describe PERC's history, goals, and operations, and to evaluate challenges and lessons learned so that other organizations that seek partnerships among higher education institutions can profit from our viewpoints.

2 Methods: Positionality, PERC's History, Programming, Foci, and Challenges

To provide even tentative recommendations for future collaborative work for sustainability in higher education, we examine PERC's history, its current programming, topical foci, and multiple challenges. A review has been conducted by examining web-based documents, reviews of current and prior Strategic Plans, meeting notes and minutes, discussion and communication among PERC's leadership, and an examination of the last decade's programming.

The authors' account for their positionality, the positions they have "chosen to adopt within a given research study" (Savin-Baden and Major 2013). These positions influences how the research has been conducted, what its outcomes could be, and the recommendations that flow from the study (Rowe 2014). The authors' positions influence the subject, who participates, and the context for viewpoints. In this study, the authors all serve on PERC's Executive Committee and have done so for between three and more than ten years. Six of the authors are full-time employees of Pennsylvania institutions of higher education. Their positions range across those institution's organizational structure, including facilities management, inter-organizational and cross-functional centers or institutes that bridge curricular, co-curricular, or research functions with facilities or administration, as well as faculty in ceramics, educational policy, environmental science, and geography. The remaining two authors have served in administrative and director positions within PERC. All of the authors are seen as cis-gendered white people, eight male and one female.

The history of PERC can be instructive to learn of the challenges in forming, and even more so, maintaining a largely volunteer organization. PERC was formed by Donald Brown, a former employee of the Pennsylvania Department of Environmental Protection (DEP). Working in various environmental policy areas, Brown observed that there were many creative, valuable, and world-class environmental initiatives, teaching, and research efforts being conducted at Pennsylvania's colleges and universities. However, despite many policy efforts at the state level that would profit from

research input and collaboration, there were very few connections between academia and state natural resource or environmental agencies.

After visiting many of the academic institutions across the state, Brown initiated formation in 2000 of the precursor to PERC, known initially as the PA Consortium for Interdisciplinary Environmental Policy (PCIEP). It became a coordinating association of PA higher education institutions, with a set of by-laws, a governing committee, and institutional representatives, receiving administrative support from DEP. This initial formation as a DEP-supported initiative, was advantageous in directly linking the organization with the state agencies responsible for various elements of environmental policy. As Brown's responsibilities at DEP transitioned into retirement, the organization changed its name to PERC. Following strategic planning in 2010, PERC became a dues- and sponsorship-based consortium with a paid executive director, a committee structure formed under organizational by-laws, and formed as a 501(c)3 non-profit organization in the United States. Since early 2021, there has been a paid associate director, a president and president's council, secretary, treasurer, an executive committee, and institutional representatives. Organizational initiatives are organized primarily through the executive committee, a structure and membership with its advantages and disadvantages later.

In 2019, PERC fully engaged the United Nations' Sustainable Development Goals (SDGs) at its annual conference. The opening speaker, Caroline Fox, from the US Sustainable Development Solutions Network (SDSN) housed at Columbia University's Earth Institute, stressed the importance of state-level action on the SDGs. That conference lead to PERC's first explicit commitment to SDG #4: Quality Education's target 4.7 and 4.b that focus on education for sustainable development and commitments to higher education's potential. Other speakers and presentations covered health and well-being (SDG #3) and its connection to other goals, climate action and strong institutions (SDG's #13 and #16), solar energy and marginalized people (SDG's #7 and #10), as well as environmental justice issues related to food security, energy production and distribution, transportation and community planning, and governance (SDG's #2, 7, 10, 11, and 16). Overall, this effort was beneficial in providing a framework for organizational initiatives, as well as providing a common framework for PERC to partner with others also addressing the SDGs, making PERC an embodiment of SDG #17: Partnership for the Goals. The SDG framework continues to inform PERC's programming and our 2021–2025 Strategic Plan.

PERC acknowledges that institutions of higher education are also members of the community in which they are located. Programming encourages engagement and collaboration with local communities that are mutualistic and reciprocal. Programs for member institutions provide training, skills, and resources so that boundaries between the community and academy are blurred, and relationships can be strengthened. PERC actively seeks the guidance and expertise of community partners, and works actively with partners to advance sustainability in communities (SDG #11). When applicable, PERC provides information to the media on important issues pertinent to higher education, sustainability and/or topics of relevance. Additionally, PERC has worked to unite higher education institutions from across the

Commonwealth of Pennsylvania to provide policy-relevant research to state government. These include the 2016 Power Dialog (Buckland et al. 2018), meetings with state representatives regarding net zero climate change commitments, and programs created in cooperation with DEP's Energy Office and Office of Environmental Justice. Efforts have sought to enhance the technical and interdisciplinary expertise of government decision-makers through cooperation with academic institutions, emphasizing the interdisciplinary perspective of environmental issues.

3 Results

Major Efforts

In its more than 20 years of operation, PERC has spearheaded a number of major initiatives that have impacted sustainable campus operations, state and local level policy, community initiatives, and education. Such initiatives include food recovery, climate efforts, environmental justice, public environmental health, and campus sustainability champions. Through these initiatives, PERC member institutions can deepen their on campus, community, and state-level impacts and networks, demonstrating that a collaborative networking consortium can have a greater impact on education, operations, and outreach in sustainability and environment arenas than individuals or institutions acting alone.

Food Recovery

According to *Drawdown* (https://drawdown.org/) if food waste were its own nation, it would be the third largest emitter of greenhouse gases in the world after China and the United States. It is estimated that about a third of all food produced globally is wasted each year (FAO 2011). This is in addition to other environmental impacts from the agricultural sector (Bennetzen et al. 2016, Smith et al. 2014; Clark and Tilman 2017). In 2013, with the support of the United States Environmental Protection Agency (EPA) and Sodexo, PERC created the Pennsylvania Higher Education Food Recovery Challenge (PHE-FRC), the first statewide project of its kind in the country. PERC was honored by the EPA as Endorser of the Year in 2015 for the creative structuring of this initiative. Since then, several member institutions along with Sodexo have also received EPA "Waste Wise" honors as a result of participation in the Pennsylvania Higher Education Food Recovery Challenge.

Through the program, institutions have been encouraged and educated to utilize techniques to reduce food waste. These positively effect changes on SDG #12.3, to "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses compost any remaining unused, spoiled, or expired food; and donate unused food to food banks and shelters" by 2030 (UNESD 2015). The benefits to PERC member institutions and beyond include carbon footprint reduction, student engagement, sustainability awareness, community engagement, and cost savings. Institutions file a report each

year detailing progress in reducing the amount of food sent to landfills or incinerators. As an example, prior to the pandemic Franklin & Marshall College was sending more than 100 tons of food waste per year to be composted. Some of that food returned to campus for use on college grounds and gardens. By 2017, over 1100 tons of food were diverted from landfill, with a resultant 926 MTCO2E of carbon reduction.

Climate Efforts

The human causes and impacts of climate change are well documented, with widespread consequences to natural and human systems (IPCC 2021). To effect change on SDG #13: Climate Action, PERC has supported action across all scales of operations, governance, and sectors. PERC has attempted to position members in its network to leverage energy, knowledge and experience within Pennsylvania's higher education institutions to address climate change challenges and solutions. Additionally, PERC can provide the networking platform needed to make connections between higher education, local and state government, and industry. Three stand out regarding energy development, statewide and nationally coordinated climate change education, and engaged scholarship.

In the late 2000's, PERC worked with staff and graduate students at St. Francis University to provide consortium availability that allowed campuses to purchase wind power. This came at a time when renewable power purchases were in their infancy in Pennsylvania. St. Francis's Masters of Business Administration program and geographic proximity to the Allegheny Front of the Appalachian Mountains made this coordination possible. PERC provided access to knowledge experts at the annual meetings.

PERC has also supported coordinated climate change education inside and outside of the classroom. In 2015, PERC hosted a daylong symposium on climate change education at Susquehanna University. In 2016, PERC participated in and coordinate the Power Dialog in Pennsylvania. The Power Dialog, nationally organized by Eban Goodstein at Bard College, used the input process of the Obama administration's Clean Power Plan (CPP) to create an opportunity for students to offer policy approaches to state-level greenhouse gas mitigation. Through PERC's collaborative, Pennsylvania faculty afforded students the possibility to become climate policy entrepreneurs effecting change in state government. The Power Dialog created in-class "interdisciplinary learning possibilities in architecture, demography, ecology, economics, electrical and mechanical engineering, ethical theories and practical ethics, law, physics, policy theory, political science, public health, rhetoric, and visual art…[and] systems thinking that is so often emphasized in sustainability education was the only feasible approach to this Power Dialog (Buckland et al. 2018). PERC has gone on to support other statewide climate teach-ins, including the 2020 and 2021 "Solve Climate by 2030" events in coordination with Bard and others.

PERC has also sought to find ways to appropriately apply student learning in and for communities. Representatives on the Executive Committee have argued for the advancement of municipal, city, or county greenhouse gas inventories and climate action plans. For several years, PERC convened ad hoc and special committees, focus groups, and programming that provided important networking opportunities

to discuss inventory tools and methodology. Following these discussions, the PA DEP developed the Local Climate Action Plan (LCAP) program (DEP 2021) that partners local governments with faculty and students in Pennsylvania college and universities to create local and intergovernmental greenhouse gas (GHG) emissions inventories and climate action and adaptation plans (CAAPs). For the last three years, training has been delivered to faculty, students, and staff by ICLEI: Local Governments for Sustainability to 40 municipal and college teams. The cohorts learn about the global carbon budget, regional carbon intensity, the structure and timelines for CAAPs, how to use ICLEI ClearPath software, data gathering, trouble shooting for data and governmental navigation, and CAAP drafting. Currently, the LCAP is undergoing administrative approval for management through PERC member, Penn State University.

Environmental Justice

During the early days of US environmental legislation, passage of critical laws (e.g. National Environmental Policy Act, Clear Air Act, Clean Water Act), focused on environmental protection though pollution reduction, ostensibly to protect human health. However, the disparities of pollution impacts and a lack of protection for minority communities were not recognized. It was not until the 1980s that the first studies identifying environmental justice were published (Holifield et al. 2018).

Environmental Justice has come to occupy more of PERC's attention in recent years. It has provided inspiration to effect changes for SDGs #3: Good Health and Well-being, #9: Reduced Inequalities, #11: Sustainable Cities and Communities, and #16: Peace, Justice, and Strong Institutions. The empowerment of Black, Indigenous, people of color, (BIPOC) and other marginalized populations has inspired our current members on their own campuses and in our work at PERC. Like many environmental organizations, our membership has been overwhelmingly white and predominantly male. While historically explainable, PERC is taking concerted actions to diversify its programming and our membership and include BIPOC into all aspects of the organization. In 2020–2021, this took the form of supporting the Commonwealth's first annual summit on environmental justice in Pennsylvania, EJ in PA. The event, held virtually on a Harrisburg University platform on April 6, 2021, was done in cooperation with community, governmental, non-profit, and business leaders for environmental justice across the Commonwealth. The virtual one-day event brought together community members to build common language, to understand issues, to learn from national leader Mustafa Santiago Ali, and activated local Environmental Justice hubs around Pennsylvania. Going forward, PERC has committed to supporting EJ activities in higher education and in communities. This will manifest in membership, participation, financial investment, as well as integrating EJ into existing programming like the annual conference and regular webinars, as well as special programming focused exclusively on EJ.

Public and Environmental Health

Historically, human health was considered to include those issues related to human morbidity and mortality (illnesses, diseases) and community-related public health

issues (e.g. cholera). This has expanded to include environmental health deterioration due to pollution or improper disposal of waste that impacts both human and non-human health. Linkages between environmental health and human health have become much more explicit and well documented, with concerted efforts to explore synergies that promote human and environmental health (WHO 2022). Public environmental health came to occupy prominence in PERC's programming following the 2019 annual conference focused on the SDGs. The Director of the Pennsylvania Office of Rural Health documented overlaps between the social determinants of health and their connections to multiple SDGs, prompting PERC to agree that these connections warranted their own line of programming. This led to a working group that partnered PERC with Penn State's Sustainability Institute, the Pennsylvania Department of Health's Cancer Division, and Villanova College of Nursing faculty. This programming has featured experts on climate change and populations of concern, climate change and hazard response, housing and environmental justice, agricultural communities and mental health, and unconventional shale gas drilling's relationship to individual and community health. It continues with an educational cohort of 18 people from healthcare institutions, government, and universities who meet monthly to discuss issues of environmental health in spring 2022.

Campus Sustainability Champions

PERC initiated the Campus Sustainability Champions program to recognize students, faculty, administrators, and staff, as well as student and non-student organizations of Pennsylvania colleges and universities who have made meaningful contributions toward environmental sustainability on their campus, in their community, or in society at large. Student contributions have included a wide variety of efforts, including food rescue, campus gardens, recycling, bike-share programs, wind and solar initiatives, promoting carbon neutrality, and environmental education. Faculty are recognized for teaching, research, or campus or community-based environmental initiatives, including serving as campus sustainability coordinators, solar energy projects, sustainable foods, environmental dance marathons, campus tree planning, and modeling sustainable living practices. Awardees typically show leadership and measurable accomplishments, and are well respected on their campuses for their efforts. Since the initial program in 2013, 112 students and 57 non- students have been recognized. Six campus organizations were awarded, four of which were student groups. Nominees are presented by the PERC campus representatives to the PERC Executive Committee, which reviews the nominations and approves selections. Awardees are invited to attend the annual conference to serve on a panel to discuss their efforts.

The program has highlighted significant, novel, or high profile accomplishments and serves to help member schools promote environmental activities on their campuses, and to publicize more widely the wide array of environmental initiatives being conducted on college and university campuses. Many schools advertise the award on their campuses or in media within their community. Awardees names and lists of accomplishments are posted on the PERC website, thus publicizing some of the wide variety of efforts occurring in Pennsylvania colleges and universities.

4 Discussion

PERC confronts the same issues affecting higher education while more acutely facing issues related to sustainability. These include financial, operational, staffing, and educational challenges overlaid and exacerbated by COVID-19. Because PERC seeks to effect positive change in higher education, we face the vicissitudes of our organizations. Tied to sustainability, we have additional burdens of cost and complexity associated with wicked and super-wicked problems (Lazarus 2009). These issues are occurring in a socio-politically contentious field of play where highly technical information collides with widely divergent and deeply held beliefs and values. This socio-political conflict is hyperpartisan in the United States, as shown clearly by the January 6 Insurrection and the cleavages in United States society that preceded and followed it. Of course, PERC's part-time Associate Director, Presidents Council, Executive Committee, and other participants face challenges to their time and ability to fundraise and develop high-value programming.

COVID-19 has highlighted structural difficulties and inequities that were present in the system before 2020. According to Wiley University Services (2021), US universities face declining enrollment, financial difficulties, a shrinking pool of U.S. high school graduates, reduced state funding, decreasing rankings among institutions globally, and lower international student enrollment. An *Inside Higher Ed* and Hanover Research survey found that COVID-19 exacerbated funding insecurity and that the majority of the university administrators they surveyed were concerned with impacts on enrollment (88%), faculty and staff employment (81%), and declines in other forms of revenue. PERC member schools face these issues, though not equally. Those schools in the Pennsylvania State System of Higher Education (PASSHE) face a number of them more acutely as two sets of three schools in western and northeastern Pennsylvania are being merged and consolidated for the reasons discussed above (Owens and Rude 2021). As a dues-paid member organization, these challenges threaten our operations.

PERC seeks to effect positive changes for sustainability through higher education. Our membership is made up of a diverse group of colleges and universities of different scales and types. Our members range in size from liberal arts colleges with one campus like Dickinson, Haverford, Lebanon Valley College, and Swarthmore that serve between 1,600 and 2,500 students to Penn State University that serves about 100,000 students through online programs as well as on 24 campuses, two urban centers, and county-located extension offices.

No matter our participants' campus size, seeking to influence faculty, staff, students, and communities in academics and curricula, administration, operations, outreach, research, and student life presents logistical and cultural challenges. For example, PERC seeks to bring any faculty member in any discipline to approach sustainability and sustainability issues. These issues include, but are not limited to: climate change education, environmental in/justice, governmental and private climate action and adaptation planning, precautionary environmental actions or regulations, public health as it relates to the built environment, energy production, food production

and security, industrial siting, and transportation. With the levels of specialization present across our universities–whether Research I or II, liberal arts, or community colleges with technical foci–a single issue like "methane's role on a changing planet" can potentially bring faculty from chemistry, geology, geography, history, material science, meteorology, philosophy, photography, policy, and/or statistics together. Organizing and facilitating those interdisciplinary and transdisciplinary conversations creates epistemological challenges. When we add another dimension such as community-engaged scholarship or coordinated living labs with campus facilities, we invite additional logistical and linguistic challenges. Our municipalities or counties and their governments or community groups as well as our university buildings, grounds, food service, or energy services speak different languages and work on different calendars than the academic year.

On the previously named issue–"methane's role on a changing planet"–PERC would hope to assist or spur its member schools to connect with others. For example, to bring together faculty and students with physical plant operators to reduce fugitive methane emissions, photography faculty and students documenting shale gas development impacts in Pennsylvania with local museums, libraries, or community groups to create conversation, municipal sewer or transit authority staff to share with faculty and students about technologies that reduce methane emissions. As noted earlier, we can have students present to state government officials on methane's climate forcing potential and mitigation strategies that could be realized under the former Clean Power Plan or Governor Wolf's Executive Order 2019–01 or effect change through local climate action and adaptation plans. These examples highlight the epistemological and institutional challenges PERC faces in order to support coordination, cooperation, and collaboration for sustainability.

Sustainability issues are inherently political. In the United States, some of them–the climate crisis and environmental justice chief among them–are now part of the hyperpartisan culture wars. Pennsylvania author Seamus McGraw has written on shale gas drilling, climate change, and guns and gun-related identity in the United States. He frequently observed in the early- and mid-2010s that if he knew where a person stood on abortion that he could guess with over 90% accuracy where people stood on unconventional gas drilling and the human role in forcing climate change (McGraw 2015). While more citizens in the United States are becoming alarmed by and less doubtful about or dismissive of climate change since 2017 (Leiserowitz et al. 2022), the United States had easily the largest ideological divide between its right and left wings regarding climate action in a survey of ten developed nations (PEW 2021).

PERC is also coordinating with other organizations around the Commonwealth to support environmental justice programming. PERC takes it as a fact that minoritized communities in the United States, particularly Black, Indigenous, and other people of color (BIPOC) as well as religious, gender, and sexual-identity-related people have been deliberately disenfranchised and harmed by deliberate and legal means. Where environmental factors such as housing and transit planning, waste and industrial facility siting, governance, health access, and legacy pollution issues are concerned, PERC seeks to provide cooperative advocacy platforms, and create

educational programs and opportunities to redress wrongs. Because the United States has such an entrenched history of enslavement and a legacy of legalized and enforced racist policy as well as a culture rooted in and surrounding that racist policy, PERC is engaged in the personal, organizational, and highly political (but not party partisan) fields of race in America. This last challenge raises issues for our membership, our members, and the actions we take. It also presents our own leaders with the difficult task of confronting structurally-created distrust in their personal and professional lives and the moral challenges this creates.

From mid-2020 through February 2022, PERC has been run by a volunteer Executive Committee, Presidents Council, and part-time Associate Director. To accomplish our role for sustainability in Pennsylvania, we must put in many hours. Our membership has been stable for the last few years, but we must continue to innovate our programming and prove our value in outcomes and outputs to existing and potential member schools. Fundraising through meetings with sponsors or other means offers both opportunities and challenges. Like many volunteer organizations, this requires commitment. With the exception of our Associate Director, we are all full-time faculty and staff from universities. We are also people who serve in local or regional government or on other community boards. Though in different stages of life, we are all people with families and friends living through extraordinarily challenging times and world events.

Despite sharing our successes and baring our weaknesses, we also recognize and acknowledge the limits and constraints from an in-depth analysis of a single organization. PERC's structure and activities are driven by its location in the eastern United States, a diversity of institutional members with different goals and operational systems, and the values of its founders, leaders, and members. Political climates and the diversity and operations of academic institutions in other geographical locations worldwide will mean that PERC cannot be replicated intact into other locales; organizational structures and activities will undoubtedly vary. Nonetheless, we believe that our experiences provide useful insights for other organizations with similar missions.

5 Conclusion

PERC will continue to pursue its Mission and Vision as a collaborative organization of higher education institutions that:

- Supports integration of sustainability principles in campus operations and provide platforms,
- Disseminates best practices in sustainability teaching, research, outreach, student life, and operations, and
- Enables networking among higher education, community organizations, government, and other stakeholders across the commonwealth dedicated to working towards a thriving future.

We will continue to provide value to our member institutions and sponsors, connect institutions with one another and with their communities and the Commonwealth on sustainability best practices, motivate and activate Pennsylvania higher education communities to take action and make transformational changes, and integrate justice into all of our functions, including leadership, administration, initiatives, cooperative agreements, and sponsorship, and advocate for justice through our work.

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References

Audretsch DB (2014) From the entrepreneurial university to the university for the entrepreneurial society. J Technol Transf 39:313–321. https://doi.org/10.1007/s10961-012-9288-1

Bennetzen EH, Smith P, Porter JR (2016) Agricultural production and greenhouse gas emissions from world regions—the major trends over 40 years. Glob Environ Change 37:43–55. https://doi.org/10.1016/j.gloenvcha.2015.12.004

Clark M, Tilman D (2017) Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. Environ Res Lett 12:064016

Department of Environmental Protection (2021) Local climate action program. https://www.dep.pa.gov/Citizens/climate/Pages/Local-Climate-Action.aspx. Accessed 14 Feb 2022

Fitzgerald HEK, Bruns ST, Sonka AF, Swanson L (2012) The centrality of engagement in higher education. J Higher Ed Outreach Engage 16:7–27

Food and Agriculture Organization of the United Nations (FAO) (2011) Global food losses and food waste—extent, causes and prevention

Holifield R, Chakraborty J, Walker G (2018) Introduction: the worlds of environmental justice. In: Holifield R, Chakraborty J, Walker G (eds) The Routledge handbook of environmental justice. Routledge 711 Third Avenue, New York, NY, pp 1–11

Inside Higher Ed and Hanover Research (2020) Responding to the Covid-19 crisis: a survey of college and university presidents. https://universityservices.wiley.com/wp-content/uploads/2020/04/Wiley_IHE_COVID-19_SurveyofPresidents_20200327.pdf. Accessed 16 Feb 2022

IPCC (2021) Summary for policymakers. In: Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte V, Zhai P, Pirani A, Connors SL, Péan C, Berger S, Caud N, Chen Y, Goldfarb L, Gomis MI, Huang M, Leitzell K, Lonnoy E, Matthews JBR, Maycock TK, Waterfield T, Yelekçi O, Yu R, Zhou B (eds)]. In Press

Keast R, Brown K, Mandell M (2007) Getting the right mix: unpacking integration meanings and strategies. Int Public Manag J 10(1):9–33. https://doi.org/10.1080/10967490601185716

Lazarus R (2009) Super wicked problems and climate change: restraining the present to liberate the future. Cornell Law Rev 94:1153–1234. https://scholarship.law.georgetown.edu/cgi/viewcontent.cgi?article=1152&context=facpub. Accessed 14 Feb 2022

Leiserowitz A, Maibach E, Rosenthal S, Kotcher J, Neyens L, Marlon J, Carman J, Lacroix K, Goldberg M (2022) Global warming's six Americas, September 2021. Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication

Lozano R, Ceulemans K, Alonso-Almeida M, Huisingh D, Lozano FJ, Waas T, Lambrechts W, Lukman R, Hugé J (2015) A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey. J Cleaner Prod 108:1–18. https://doi.org/10.1016/j.jclepro.2014.09.048

McGraw S (2015) Betting the farm on a drought. University of Texas Press, Austin

Owens D, Rude L (2021) PASSHE unanimously votes for consolidation of 6 Pa. institutions. ABC News 27. https://www.abc27.com/news/this-week-in-pennsylvania/pennsylvania-politics/passhe-unanimously-votes-for-integration-of-6-pa-institutions/. Accessed 14 Feb 2022

Pew Research Center (2021) In response to climate change, citizens in advanced economies are willing to alter how they live and work

Rowe WE (2014) Positionality. In: Coghlan D, Brydon-Miller M (eds) The Sage encyclopedia of action research. Sage

Savin-Baden M, Major CH (2013) Qualitative research: the essential guide to theory and practice. Routledge

Smith P, Bustamante M, Ahammad H, Clark H, Dong H, Elsiddig EA, Haberl H, Harper R, House J, Jafari M, Masera O, Mbow C, Ravindranath NH, Rice CW, Robledo Abad C, Romanovskaya A, Sperling F, Tubiello F (2014) Agriculture, forestry and other land use (AFOLU). In: Climate change 2014: mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer O, Pichs-Madruga R, Sokona Y, Farahani E, Kadner S, Seyboth K, Adler A, Baum I, Brunner S, Eickemeier P, Kriemann B, Savolainen J, Schlömer S, von Stechow C, Zwickel T, Minx JC (eds)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Trencher GP, Yarime M, Kharrazi A (2013) Co-creating sustainability: cross-sector university collaborations for driving sustainable urban transformations. J Cleaner Prod 50:40–55. https://doi.org/10.1016/j.jclepro.2012.11.047

United Nations Department of Economic and Social Affairs (2015) Sustainable development goal 12: responsible production and consumption: targets and indicators. https://sdgs.un.org/goals/goal12. Accessed 15 Feb 2022

Wiley University Service (2021) Top challenges facing U.S. higher education. https://universityservices.wiley.com/top-higher-education-challenges/. Accessed 14 Feb 2022

World Health Organization (WHO) (2022) Compendium of WHO and other UN guidance on health and environment. https://www.who.int/health-topics/environmental-health#tab=tab_1. Accessed 31 Jan 2022

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Richard D. Bowden has a B.A. in Environmental Studies and Biology (Northland College), an MS in Aquatic Ecology (Michigan Technological University), and a Ph.D. in Forest Ecosystems

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Josh Hooper has been the executive director of the Pennsylvania Environmental Resource Consortium since 2010. Previously he had a career in broadcasting, marketing and advertising, owning a boutique advertising agency and a production company. He's been in principal management positions with other communications companies, including Harrisburg's JPL. In 2017, Josh was certified as a fellow in the Climate Reality Leadership Corps and now speaks to community groups about Climate Change. Josh lives in Camp Hill, PA and has two sons, ages 24 and 27.

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Dominic Scicchitano was a PERC program coordinator, and was an Environmental Law Institute research associate from 2019 to 2021. He was involved in projects connected to indoor projects and green buildings, wetlands, and oceans, and managed ELI's People Places Planet Podcast. He conducted research on microplastic pollution, organized focus groups to help incorporate nature play elements into plans for a new public park, and served on the Executive Board for the Middle Susquehanna Riverkeeper Association. He majored in Environmental Studies and Spanish, with a minor in Latin American Studies (Bucknell University, BA).

Ken Shultes has held leadership positions at Dickinson College for almost 30 years. Sustainability has always been a prime focus and absolute passion, and specifically reducing carbon emissions and connecting operations initiatives to the curriculum and the overall student experience. Ken oversees the college's organic farm and was instrumental in attaining LEED certification for seven projects at Dickinson, including six Gold and one Platinum. Ken has led the college's march towards carbon neutrality and achieving carbon neutrality in 2020, with offsets.

Tom Simpson (B.S., Horticulture; M.Ed., Biology; M.Ed., School Counseling) has served as Sustainability Coordinator at Franklin & Marshall College since 2008. Previously, he taught science and math in middle and high schools. At F&M he deals with solid waste, transportation, employee gardens, and more. Tom grew up in Lancaster, PA but lived in Italy for 23 years. Tom has served as PERC president-elect, president and immediate past president. Tom's activities include travel, gardening, running, and bicycling. Tom is married with two adult children. As an afternoon job, he coaches high school cross country and track.

University Green Offices at the Intersection of Movement, Network, Market, and Hierarchy: A Case Study on the Production of Knowledge on 'Sustainability' as the Generation of Compromises at an Organizational Level

Julia Elven

1 Introduction

The currently heightened public awareness of the environmental crisis the world faces has boosted interest in sustainability in political circles and societies at large. In its increased discursive currency, however, the concept of sustainability is expanding and losing definition, causing its meaning to become contested (Block et al. 2021; Leal Filho 2000). In very broad terms, we may define sustainability, in this sense, as "the quality of causing little or no damage to the environment and therefore [being] able to continue for a long time" (https://dictionary.cambridge.org/us/dictionary/english/sustainability). Beyond this definition, there is a wide variety of explicit concepts and also—and most significantly—implicit, practical understandings of "sustainability." Leal Filho (2000, p. 10) notes that "one's own definition [of the term] will be influenced by one's training, one's working experience and one's political and economic setting […] [t]here is nothing negative in that, but, equally, there is the need to establish some ground rules so that the search for a consensus […] may not be made hopelessly impossible due to individual differences in opinion and perspectives". The starting point of this paper is that it is only possible to practice such a conceptually guided way of perceiving, thinking, and "doing" sustainability in interaction with the aforementioned "individual" forms of doing sustainability. Everyday, discipline-specific, and interdisciplinary or integrative conceptions of sustainability are expressions of competing orders of knowledge and of worth (Boltanski and

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Thévenot 2006); their intersection and interaction give rise to the negotiation, specification, and coordination—therefore the production—of sustainable practices. This article presents a theoretical and analytical perspective that enables us to identify various values, bodies of knowledge, and "justifications" (Boltanski and Thévenot 2006) of and around sustainability, that specific practices may combine. In analyzing actual processes through which practices of sustainability emerge in universities, it reflects on their polysemy and relates them to the aims and strategies to which sustainability advocates and activists aspire. The approach presented here is therefore rich in potential for current and future actors in the field of sustainability management and leadership as it proposes a systematic, reflective perspective on the university as a context of socialization in which students, as future decision-makers, specifically experience sustainability in a practical way.

The article will provide a theoretical and empirical exploration of these considerations, opening with a theoretical outline of the multiplicity of knowledge on sustainability in the academic field and the intersections among these types of knowledge within higher education organizations. It will then proceed to discuss Laurent Thévenot's concept of "compromising device" (Thévenot 2001, p. 405), which proposes coordination, justification, worth-based negotiation, and finally compromise-building as instruments for analyzing the practical production of knowledge and conventions of action. In so doing, the paper follows a tradition established by French theories of practice and neo-pragmatism. There follows the outline of a case study on a university Green Office (GO) as such a compromising device, identifying structures of coordination and justification that enable the GO to connect to various orders of knowledge in the process of achieving consensus on practical sustainability and to generate compromises where necessary.

2 Sustainability in Academia

The literature on key roles in the implementation of sustainable development has identified a rich seam of potential insights in academia (see for example Barth et al. 2018; de Bremond et al. 2019; Leal Filho 2015; Schneidewind et al. 2016). This potential may stem from the fact that academic field revolves around the production, transfer, transmission, and utilization of knowledge for all sectors of society. This means, however, that the "intricate landscape of academia" (Wacquant and Bourdieu 1989, p. 1), as well as being markedly suited to initiating dialog among developments in sustainability in diverse sectors, faces the challenge of coordinating widely divergent perspectives on, bodies of knowledge about, and practices of sustainability (Salas-Zapata and Ortiz-Muñoz 2019; Thompson 2016; see also Block et al. 2021).

2.1 Knowledge on Sustainability and Complexity of Knowledge Within the Academic Field

Knowledge on sustainability and its production in academic research are phenomena that have no single definition. Theories of practice conceive of academia as a social field (Bourdieu 2008) and as a "unique space of struggles in that it is capable of yielding products (true knowledge)" (Wacquant and Bourdieu 1989, p. 16). The creation of "true knowledge" is bound to specific field rules that may differ from one discipline to another, but nevertheless remain recognizable as rules of academic production. Knowledge emerges in competition among different academic actors (in compliance with the field rules); likewise, the rules themselves are also contested within the field, as manifests, for example, in struggles around paradigm shifts (Kuhn 1962). As Latour and Woolgar (1979) have shown, scientific knowledge is socially constructed in everyday academic practice and therefore interlinked with its specific socio-historical settings.

As all social fields, academia is *relatively* autonomous from other social fields (Bourdieu 1993). It has its own, truth-centered logics and conventions of action, production, and valorization, conventions that enable the coordination of social practices within the field. However, academia's interconnectedness with other social fields (such as the political and economic fields) has increased in recent years, especially in the context of economistic models of governance and new public management (Hüther and Krücken 2016; Münch 2014), which relates to the transformation of the university "from being an institution to becoming an organisation" (Kehm 2013, p. 1). From a political (and fundamentally economic) point of view, universities seemed too inflexible, too slow, too expensive, etc., to be able to adequately fulfill their roles and remits in an increasingly globalizing and accelerating world. The hope behind the implementation of new systems of governance was "that the development of universities towards becoming organisations with more autonomy and professional leadership would provide opportunities to solve the problems […] or at least getting them under better control" (Kehm 2013, p. 2). Universities' organizational structures, then, are subject to the influence of competing field logics. In relation to sustainability, logics from beyond the field hold particular relevance due to the extremely high political, economic, and social interest currently attaching to the subject.

Taking the polysemy and contestation of academic knowledge production into account, we can draw a much more differentiated picture of the knowledge on sustainability in universities (Fig. 1).

Discipline-specific differing knowledge: Different academic disciplines (agricultural science, biology, sociology, economy, etc.) have differing interests and priorities and contribute to different systems of knowledge, theories, and research traditions within the discourse, variously defining sustainability as entailing a specific form of agricultural land use, a non-expansive societal constitution, or an economy that eliminates social and environmental problems via innovation and growth. Furthermore, many of the academic communities that engage in work on sustainability are

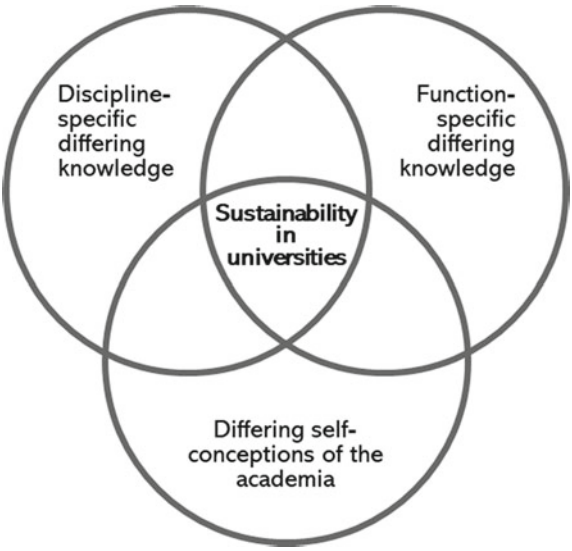

Fig. 1 sustainability knowledge in universities

interdisciplinary in their character (soil science, health sciences, postcolonial studies, etc.) and thus show in themselves different contextual references and conceptual and practical approaches to sustainability (Henkel et al. 2017). In many cases, it makes little sense to transfer the details of discipline-specific knowledge on sustainability into the order of knowledge of another discipline; while it may sometimes be possible to interrelate them or even incorporate them into a shared concept, they often compete for resources or attention, and in some cases they may even prove incommensurable and compete for hegemony (Adloff and Neckel 2019).

Function-specific differing knowledge: Organizations are social ensembles which approach complex, repeated processes on basis of functional differentiation and the division of labor and coordinate them to ensure the attainment of shared goals via the input of a range of knowledge and skills. Unsurprisingly, the terms of reference and conceptions around sustainability that emerge within an organization will differ in line with the specific contexts of work in which they arise. As the organizational character of universities increases, a perspective of intraorganizational differentiation of knowledge and practices on sustainability is established as well. In their meta-analysis of instruments for the assessment of sustainability at universities, Alghamdi et al. (2017) discuss a wide range of organizational structure models, each of which is intended to distinguish between different approaches to sustainable development in different parts of the organization: Sustainability within the curricular knowledge system means something completely different from sustainability in the universities' facility management.

Differing self-concepts of academia: Finally, the way academia conceives of itself also makes a difference to knowledge on sustainability. At an epistemological level, for example, sustainability may be embedded in a phenomenological or positivist manner, it may be founded on one universal rationality or various position-bound

rationalities. This again has implications for strategies of interdisciplinarity, for the reconstruction of micropolitical obstacles, for the management of divergent concepts and definitions, and not least for the role and form of academia and the university: What is the relationship between disciplinary, interdisciplinary, multidisciplinary, and transdisciplinary approaches (Stock and Burton 2011)? Is the role of academia that of a neutral observer, a critical reflector, or an active designer, and are these positions mutually exclusive (Block et al. 2021; Elven 2021)? Is it still possible to adequately and appropriately address sustainability issues within the context of the traditional order of academic disciplines; or would it be imperative instead to create a new, transformative academia (Schneidewind et al. 2016; Strohschneider 2014)?

Beyond the general definition of sustainability as a characteristic of action which is non-invasive towards the planet, the term covers a wide variety of potential practical references and specific manifestations. Ametowobla and colleagues (2021) therefore see sustainability as a central value that conveys societal aspirations, but, by and large, does not provide clear, uncontroversial, and explicit instructions on how to realize these aspirations in concrete terms. However, alongside their property of evidencing the polysemy of "sustainability" in a particularly clear manner due to the overlapping orders of knowledge they encompass, universities are spaces of social coordination enabling the concept's practical respecification.

2.2 Organizing Knowledge on Sustainability

The concept of organizations as institutions that reframe and add specificity to general objectives and criteria for action (such as "sustainability") has found prominent discussion in the work of Niklas Luhmann (2019), who enlisted Parsons' concept of respecification in this endeavor. Luhmann examines possibilities for respecifying criteria (of decisions, of judgement etc.) which are instantly plausible but too general to be applied in practice. Organizations continuously transform such general criteria into specific, decision-making ones, in other words, they respecify them. In terms of practice theory, the concept of respecification draws attention to the fact that organizations such as universities contribute to a context-specific sensemaking of sustainability in their discursive and everyday practices, for example when they establish sustainability management, participate in regional environmental projects, or develop a curriculum on Education for Sustainable Development (see also Ametowobla et al. 2021). Three qualities in particular predestine organization as a locus of respecification:

- *Potential for dissemination*: Organizations have a much broader reach than individual actors.
- *Potential for conventionalization*: Organizations are oriented toward the routinization of collective patterns of action, and thus strive to establish and perpetuate structures of practice.

- *Potential for compromise*: Organizations coordinate social processes by enabling the negotiation of decisions, which is often accompanied by a hybridization of divergent rationalities of action.

This last aspect finds marked emphasis in the work of Thévenot (2001, p. 405), who has described organizations as "compromising devices" (henceforth: compromise devices) mediating "between several modes of coordination which engage different repertoires of evaluation". It is precisely because of their situatedness at the intersection of various orders of knowledge, evaluation, and justification which predestines organizations to produce practical compromises among these spheres. In this context, the creation of compromises proceeds by the interweaving of elements from different orders of knowledge and worth.[1] Where there is disagreement about the actual meaning and worth of concepts and rules, about the relevance of various processes, or about the procedures appropriate to the situation, organizations open up a space for clarification and justification—or they generate a compromise "which suspends controversy, without having resolved it" (Thévenot 2001, p. 411). The investments an organization makes in the form of a compromise—in terms of time and other resources, the accumulation of knowledge, and the making of commitments—contribute to its stability by supporting (or forcing) the establishment of certain conventions of action and thought (see also Boltanski and Thévenot 2006). Compromises, then, rather than being individual matters, are ensembles of practices, with varying degrees of robustness or fragility, that conventionalize a specific area of activity, such as sustainability, via linking it systematically to various different orders of knowledge and worth. In so doing, and in interweaving different (conflicting) sets of social practices in a particular manner, a compromise enables coordination. The analysis that follows will apply this theory of organizations to Green Offices at universities, bringing them into view as organizational formations that operate as compromise devices. Therefore, it will enrich the view of sustainability taken by theories of practice, supplementing it with analytical concepts from the French concept of the economics of convention (Boltanski and Chiapello 2005; Boltanski and Thévenot 2006).

3 A Case Study of Green Offices as Compromise Devices

As outlined above, this exploratory empirical study centers on the production of knowledge around and action on sustainability as a practical compromise. The fundamental idea underlying this theory is that the establishment of sustainability-related agency and coordination requires, of necessity, a justification that is explicitly and implicitly negotiated and acknowledged by all (or at least most of) the actors

[1] For example, concepts stemming from the overarching notion of the green economy, such as the "Green New Deal," entail the creation of a compromise between the spheres of market and ecology, incorporating elements of both (expansion, economic activity, climate neutrality, regeneration) (Chiapello 2013).

involved. The research methodology employed in this context therefore connects to the conceptual repertoire of Thévenot, Boltanski and other researchers working in this area:

> The situational and collective process of coordination is the methodological center-piece of the sociology of conventions. The fact that there is always more than one possible way of relating to a 'right' and 'just' way of treating things and people, makes every situation an open and underdetermined one. Legitimation is not a given. (Knoll 2013, p. 40)

Although we may retrace justifications of, for example, a definition of sustainability or a strategy for action in that area to very general regimes of justification[2] (Boltanski and Thévenot 2006), the practice of justification is always situated; in other words, in relation to our case, the conventions and values that hold sway within the academic field help to determine the degree of success enjoyed by a justification's application. Like all approaches stemming from the tradition of practice theories, this view of justification "challenges the classical macro–micro distinction since judgments of worth are precisely ways of enlarging the scope of an evaluation from a local context and of crafting generalized statements" (Thévenot 2001, p. 418). In so doing, it points us toward the approach's central potential, to enable insights into practices of specification and simultaneously into the general legitimization of sustainability.

3.1 Empirical Approach and Methods of Analysis

This context suggests the advisability of a qualitative comparative case study entailing multi-level analysis and taking into account the transversal constitution of orders of knowledge and practices of justification (Elven et al. 2018). With reference to Green Offices (GOs) as compromising devices, a multi-level perspective means looking at each GO as a single case and simultaneously at the associated networks, movements, and (even more generally) underlying fundamental ideas. In this regard, the approach follows a multiple case study analysis method proposed by Stake (2006), who notes a dual movement in the exploration of the whole and its parts as the specificity of the case only becomes apparent in the analysis of its overarching context and vice versa. This therefore calls us to look for commonalities and differences shown by the various GOs and seek to uncover structural homologies with regard to organizationally superordinate or transversal networks and associations. The analysis that follows will center on a single case (GO_A), explored against the backdrop of the overarching structures (particularly the Green Office Movement, GOM). It will proceed in two stages:

[2] In 'On Justification', Boltanski and Thévenot (2006; originally 1991) detail various *orders of justification* (such as the *civic, market*, and *inspired*) that emerged in different historical periods and have a legitimizing character with a society-wide scope (related to modern culture). These orders represent different principles of justice and make it possible to evaluate individuals and things in accordance with their specific system of valuation. These orders are historically contingent: they can lose relevance, just as new orders can emerge and gain importance (Boltanski and Chiapello 2005).

(1) Case description: The first stage entails the description of the multi-case setting, both in the context of overarching networks and at the level of the single case. To this end, I will give a brief overview of the emergence of the GO idea, its discursive expansion and dissemination, largely on the basis of the literature, albeit supplemented by analyses of websites (Weber et al. 2019). I will then go on to briefly outline the single case at the center of the analysis and its relationship to other GOs, using information from expert interviews (see below) and information taken from the website of the university in question.
(2) Single case qualitative content analysis: The research underlying this paper examines three single cases of university GOs, relating them to the superordinate concept of a 'Green Office' and its discourse within overarching networks and contrasting each case with the others. As well as analyzing websites and documents, this work centers primarily on qualitative expert interviews with 2–3 staff members from each GO (a student staff member, a member of professional university staff, and, if appropriate, a representative of university management). As the study is ongoing, this paper will discuss initial findings from the first of the three cases. In line with the analytical centrality of the economics of convention, the case study engages with practices of coordination, justification, and compromise. To explore the relevance of the strategies of coordination and justification identified by Boltanski and Thévenot, I employ a particular form of qualitative content analysis (Kuckartz 2018), interlocking the use of deductive categories with the development of inductive categories. As deductive categories, I used (1) fundamental principles of coordination (market, network, hierarchy, movement), as discussed in organization studies (Godwyn and Gittell 2012) and (2) the regimes of justification (inspired, domestic, civic, opinion, market, and industrial, but also network and green) set out in the economics of conventions (Boltanski and Thévenot 2006; Thévenot et al. 2000). The analysis aims to show how various different strategies of coordination and regimes of justification are addressed in the context of GOs and brought together in compromises. This is done to illuminate the intersection and interference of divergent rationalities in processes of the production, negotiation, and enforcement of sustainable practices.

3.2 Limitations of the Analysis

The analysis' design as a qualitative case study means it is not based on a representative survey or hypothesis-testing procedures. Its intent is not to generate general statements on forms of different bodies of knowledge and its distribution in society, strategies of coordination, and structures of justification in GOs. Its aim, instead, is to reconstruct the modes of the practical production of the various patterns of knowledge, coordination, and justification. In this respect, the exploratory character of the study centers not the generation of hypotheses, but the generation of theory in a pragmatistic sense. The comparative analysis of different cases is rich in potential

in this regard, because comparison brings forth the practical structures underlying these cases, their homologies and variability, with greater clarity. The present paper draws on only one case due to the study's ongoing status.

4 Case Description: The Green Office as an Overarching Structure and a Local Agency

4.1 Green Office Network and Movement: From Maastricht to the World

A university GO, in a narrow sense, "can be defined as a university sustainability platform, usually led by students, that empowers them—and to a lesser extent research staff—to embed sustainability in the curriculum, operations, community and governance" of the institution (Leal Filho et al. 2019, p. 1396). The first GO originated from a student initiative at Maastricht University, which in 2010 established a student-led, university-funded sustainability office (Spira and Baker-Shelley 2015). The increasing number of similar initiatives, especially in Europe, transformed the GO from a best practice example into a "common model" (Grahl et al. 2020, p. 20). The non-profit organization 'rootAbility', founded in 2012, worked out six structural key elements of the GOs (students in the core team, support by university staff, office space, student volunteers, university mandate, funding) and provided support alongside its networking activities (UHS 2016). Over time, three structural variants emerged in the practical realization of GOs (Grahl et al. 2020, p. 20): the "student-led team with a staff contact", the "joint team of students and staff", and "separate teams of students and staff" (in some instances, these variants may intersect, as in a sustainability unit at institutional level with student engagement; cf. Adomßent et al. 2019). Whether or not we can consider all these manifestations of the concept to be GOs in the narrow sense (regardless of their self-designation), these structural differences affect the roles played by the GOs, their administrative processes, their integration into the wider organization, and other factors (Adomßent et al. 2019), including their policies and how they realize projects (Leal Filho et al. 2019).

The GO idea is strongly associated with networking activities and platforms for the exchange of ideas and the development of innovations; these, as the interviewees in this case study reported, take the form of loose, fairly small, and often relatively local social media-based networks. At the same time, the internet platform and the associated label of 'Green Office Movement' (GOM; http://www.greenofficemovement.org) serve as an umbrella organization and a hub. In August 2019, rootAbility was transferred into the international network 'Students Organizing for Sustainability' (SOS), a student-run non-profit association registered in Denmark (www.greenofficemovement.org/sos/). SOS took on the networking-related informational and educational roles of the GOM (workshops, event support, consulting). The GOM has links to numerous national networks of students, particularly in Europe. Further,

national and local structures of universities certainly play a major role in the constitution of GOs. However, overarching networks only promote unified and consistent processes and forms of operation to a certain extent. In their international survey on GOs, Leal Filho et al. (2019, p. 1397) come to the conclusion "that there is until now no common understanding of the term Green Office. The term might be used to describe in institutionalization of sustainability management at universities in general and/or to relate to other formal or informal forms of the cooperation with students."

4.2 Green Office a: One Piece of a Puzzle

The single case GO_A[3] is the GO of a German university. It has approximately 10 members, of which about two thirds are students and one third are university staff. This makes it one of the larger GOs (Leal Filho et al. 2019). This university has a relatively long-standing tradition of systematically incorporating sustainability issues into its organizational actions; it has had a sustainability coordinator and committee (voluntary) since the early 2010s (GOFOUND). Student initiatives and organizations working on sustainability issues at the university go back even further. In this context, the GO was able to form significant structures of cooperation extending into all of the institution's departments, involve campus management, and network with other universities and with organizations in the regional area. The institution has implemented sustainability projects in teaching and research, in campus operations, and in cooperation with local and regional organizations. In this way, the university has evolved action in the four areas the GOM highlights as essential (Grahl et al. 2020). In the mid-2010s, it created a regular, permanent position for a sustainability coordinator (GOSTAFF). Subsequently, in the late 2010s, the university set up a GO inspired by the GOM concept and incorporated it into its sustainability portfolio. Like most university-based sustainability structures, GO_A has been involved in various (publicly funded) research and development projects during the period of its existence to date.

5 The Coordination of the Green Office at the Intersection of Movement, Network, Market, and Hierarchy

In their instructive multi-level case study on Maastricht University's transition to an energy-efficient way of working, Spira and Baker-Shelley (2015, p. 208) analyze the

[3] I based this case study on information about the specific green office available on websites, and expert interviews with members of the Green Office in question. Two interviews were conducted as part of this exploratory research (GOSTAFF, GOSTUD) one was an already existing, public statement and was included as a secondary analysis (GOFOUND). I translated and anonymized the data, which I originally collected in German.

GO "as an organizational niche, a relatively unconstrained place in which experimentation with new practices can take place": As a "student-driven and staff-supported" working unit, a GO can evolve into an agent of organizational change that provides additional (students) work capacity and networking opportunities and exerts pressure toward transformation. The reconstruction of the GO in this case study as a compromise device will enable us to access the character of this organizational niche in terms of different, competing orders of knowledge, coordination, and justification. Green Offices are incorporated both into international network structures and into the organizational structures of their respective universities. This places them at points of the intersection of various differing logics of social coordination; they are in a structural overlap between movement, network, market, and hierarchy, a position which affects their practical implementation of sustainability. These various logics of coordination correspond to specific orders of worth and justification (Boltanski and Thévenot 2006). Logics of coordination follow different rationalities and work in different ways. They show varying degrees of agency, connectivity, and hybridization opportunities, in accordance with the specific context. The various logics of coordination that cross in the GO broaden the range of connectivity about different rationalities of action, making apparent various differing patterns of the respecification of *sustainability*.

5.1 Hierarchy

It is evident that GOs are located within the organizational hierarchy of their home institution. The importance of their incorporation into and their location within the university hierarchy appears in numerous narratives produced by my interviewees; GOSTAFF, for example, notes the crucial significance of "structural grounding" to any ability to articulate knowledge about and strategies for sustainable development. Only incorporation into the hierarchical structure of the university enables the inclusion of knowledge about sustainability in the organization as relevant and workable knowledge. Using Boltanski and Thévenot's terms, we can retrace this finding to the organizational potency of a bureaucratic order of knowledge, worth, and justification that has an affinity to standardization and schematization (industrial logic). This point of view reads the establishment of a GO as increasing the visibility of sustainability issues in the hierarchical structure of the university. One interviewee notes that "[t]he issue was that we had people who were responsible for sustainability, but there were no places to go to" (GOSTAFF). The GO therefore represents the self-reorganizing of the university's sustainability interests in a hierarchical manner, harnessing the associated coordination-related and symbolic advantages, such as an official mandate for the GO's activities from the university, planned funding, and continuity independent of particular individuals. The advantages are reflected in the GO idea and are addressed within the network, for example in the information material or workshops (www.greenofficemovement.org). Finally, this enables student activists and initiatives to connect to universities' organizational structures and processes. It is via the

GO that they become perceptible addressees within the bureaucratic-hierarchical structures, whereas previously they failed to meet basic requirements of university administration: "some of them were asked where their mailbox was" (GOSTAFF).

A GO indicates both the locus of sustainability endeavors within the structure and processes of an organization and its relevance within that organization. In this context, the industrial logic, with its schematic, criteria-based hierarchies, competes with other hierarchically organized logics of coordination and justification—in the university setting, where titles, principles of seniority, authority, and rank play a major role, this is specifically and traditionally the domestic logic:

> You realize that it is very important to be anchored in the university, so that you can write an email from a higher rank and then the matter is done. Several times it happened that no one answered the students' emails. [...] So sometimes you need a higher rank in the pecking order of the university in order to get things done. And on the one hand that's frustrating as a student, but on the other hand of course it's a total privilege to be able to fall back on something like this. (GOSTUD)

The fact that the mere lack of interest of a university president may endanger the institution's sustainability program, unless it has a structurally stable place within the organization, is demonstrative of the importance of a bureaucratic/hierarchical justification for GOs (GOFOUND) which—if necessary—may be positioned even against the authority of the *head of the house* (domestic logic). This institutionalization also strengthens the position of students, who otherwise have limited opportunities to stake a claim to university resources (GOSTAFF & GOSTUDENT). The establishment of a GO creates an administrative unit which (1) renders the issue of sustainability compatible with the bureaucratic organizational logic of standardization and schematic administration (industrial logic) and, at the same time, (2) protects the position of the GO's members, at least to a certain degree, from devaluation by other hierarchies effective in the field. This constellation is possible not least because the industrial regime of justification gains importance as universities are becoming organizations. In this way, the university's engagement with sustainability can be stabilized and simultaneously be transferred into the context of a primarily administrative logic. This brings the hybrid character of the GO into play.

5.2 Movement

The GOM presents itself proactively and explicitly as a sustainability movement, both referencing the *green order of justification* and drawing on the *logic of inspiration*, a distinctive feature of which is (youth) rebellion. Students become involved out of conviction and with passion, following a relatively immediate, affective logic of action that has little understanding of other rationalities, such as the bureaucratic. The GO responds to this by taking on a supportive role: "That's exactly our task, to relieve the students of such nonsense [such as application forms], because this reduces the budget of time, which is already tight as it is" (GOSTUD). The routine operations of GOs feature overlaps, in terms of the issues worked on and the people involved,

with movements such as Fridays4Future and Students4Future, which follow similar logics. Student initiatives are driven by an unconditional striving to bring about change and a vision of a better future, yet they are also relatively unstable and show weaknesses in their organization. In one instance, Students4Future presented a catalog of demands that included numerous points the university had already implemented (GOSTAFF; GOSTUD). This limited knowledge of specific circumstances, complex sets of conditions, or steps already taken is related to the instability of a movement. If the activities and initiatives go into hiatus for a semester, it may happen that a subsequently emerging new "wave" (GOSTAFF) will be unaware of advances made by its predecessors.

Student involvement in universities' sustainability projects, driven by the world of inspiration, has a particularly committed character: "there are volunteering guys everywhere who dedicate their heart and soul and so much time to this stuff" (GOSTUD). The movement character of the GOs not only allows them to acquire engaged and affected students as a work force, but it also offers two principal advantages in terms of the coordination of action: First, it increases the visibility of action on sustainability as student initiatives generate attention, keeping sustainability issues on the agenda and endowing them with increased visibility both within and outside of university. In turn, this points to the second advantage, the considerable activating potential of a movement:

> Fridays4Future was actually a huge wave here, our Students4Future worked closely with the Fridays4Future in town, organized the demos and actually even got the university moving, especially the students, who organized a general meeting where our auditorium was full with [more than a tenth of the student body] - so something you would say: ok, if we organized it - no chance, but with the students organizing it, it went ahead. (GOSTAFF)

Not only can students be mobilized as a resource (work force) for the implementation of sustainability projects (Spira and Baker-Shelley 2015), their emphatic articulation of demands can also provide a considerable justification potential and assertiveness.

5.3 Network

The practical coordination of GO activities works by means of projects and networks and via rather flat hierarchies. As such, it corresponds to the project-oriented logic that Boltanski and Chiapello (2005) set out in *The New Spirit of Capitalism.* GOSTUD emphasizes the project-oriented order of worth. She lists the various projects she is involved in, and indicates her preference for networks that share best practices and discuss specific projects over those that address general issues of governance and longer-term strategies. The sustainability projects observable in the single case analyzed here interconnect with various fields of practice and orders of knowledge; a project that maps the environmental footprint of cafeteria menus at the university links to (regional) food production, animal welfare discourses, and fair trade, etc.

(GOSTUD), while the development of a catalog for sustainability-centered lectures and courses relates to conceptual issues with the UN Sustainable Development Goals and curricular concerns (GOSTAFF).

This form of coordination is particularly suited to generating a high level of activity and produces a fairly wide variety of forms of action, generating both attention and recognition—not least as development efforts in the political sphere come to focus increasingly on sustainability issues. Further, the project-oriented logic is particularly well-suited for coordination in situations characterized by non-permanent funding, high levels of fluctuation in personnel, a diverse, shifting range of stakeholders, and rapid innovation and policy changes. In particular, the flexible involvement of student volunteers is most successful via project-based coordination, which enables students to "bring their projects and concerns with them" (GOSTAFF) and receive support from the GO in the form of organizational integration, resources, and expertise. Nevertheless, GOSTAFF expresses ambivalent views on the project-based coordination of the GO: On the one hand, the weak content-related systematization of the project work and the wide range of thematic possibilities, the activities can be increased almost infinitely. Therefore, she needs to set an individual limitation on her tasks: "I have a lot of projects and they all circle around sustainability, I can't start anything new now". On the other hand, the voluntary nature of the project work and the lack of continuity and consistency in the group of people conducting it results in relative inefficiency in terms of the projects' progress ("two of our most important fellows have graduated, and besides, it fell asleep during Corona [Covid], so now we're starting all over again").

5.4 Market

The project-oriented logic is also linked to a market-based coordination. The university supplies the GO with basic premises and staff resources; if, however, there are plans for additional activities, the GO must acquire alternative fundings. The current political attention to sustainability issues results in various research and development programs that are funding GOs and other sustainability units. This circumstance forces the work of GOs, at least in part, into a *market logic*, with three principal implications:

(1) Eligible projects have to be conceptualized, proposed to funding agencies and, if successful, coordinated. This in turn creates new requirements for resources on the part of the management: "You really can't focus on any one topic; you always have to keep all the balls in the air—somehow having the time to focus on just one project—that would be nice!" (GOSTAFF)
(2) Visibility and popularity, alongside being essential to raising the profile of sustainability as an issue, make success in obtaining funding more likely. Communication is therefore a crucial issue, not least from a market point of view.

(3) Like network logic, market logic contributes to a destabilization of processes. This is not simply an annoying triviality, but a serious, counterproductive disruption: "The project funding is a huge problem. You have to completely reinvent yourself every three years, even though the structures have only just developed in such a way that they have proved themselves, and then you have to redo everything in order to get money again." (GOSTAFF)

The market logic is associated with a whole range of positions within the sustainability discourse. Insofar, the connectivity to this order of knowledge and worth is of utmost importance for the creation of spaces for negotiation and compromise. Nevertheless, a strictly market-based coordination via project funding gives rise to the risk that evaluation of issues and topics will center exclusively on their marketability. The case study demonstrates the importance of other logics of coordination and orders of worth in creating an open space for sustainability development practices.

6 Conclusion

Proceeding from the diverse, plural character of knowledge on sustainability in the academic field, this paper has provided an empirical exploration of GOs as *compromise devices* with the capacity to organize negotiation around the practical meaning of sustainability at the intersections of differing orders of knowledge, worth and coordination. The individual case analysis has shown that the GO connects to four different logics of coordination (network, movement, market, hierarchy), can move within different corresponding regimes of justification, and can confront or combine them with each other.

Three lessons learned from the case study may be of considerable interest to student and non-student staff of GOs and to current and future decision-makers seeking to implement and manage sustainability in organizations:

- In order to successfully establish new, sustainable practices in an organization, it is crucial to understand the logics that coordinate and justify them. The theoretical approach and the empirical findings help to identify these and to relate them to different actors, and organizational subdivisions.
- The paper has further uncovered the advantages and drawbacks associated with a specific form of coordination in a particular situation, enabling actors in that situation to take a targeted approach to enhancing the advantages and to reduce the drawbacks. The interviews show that GOs are already doing this to some extent, by, for instance, combining the energy of movements with the stability of bureaucracy.
- Finally, the findings presented here may serve as guidance for GOs and universities in their outreach activities, supplying them with the sound understanding of the logics determining regional actors' positions that is necessary if a GO is to successfully recruit external stakeholders and stabilize collaborative relationships.

It will fall to further studies in this area to show how GOs, as compromise devices and providers of diverse logics of coordination, produce practical sustainability (and knowledge on sustainability). This is already indicated in the single case at hand: Even though the matter of defining sustainability is seen as the "elephant in the room" (GOSTAFF) by the GO's members, they in fact work on its practical (re-) specification every day.

References

Adloff F, Neckel S (2019) Futures of sustainability as modernization, transformation, and control: a conceptual framework. Sustain Sci 14(4):1015–1025. https://doi.org/10.1007/s11625-019-00671-2

Adomßent M, Grahl A, Spira F (2019) Putting sustainable campuses into force: empowering students, staff and academics by the self-efficacy Green Office Model. Int J Sustain High Educ 20(3):470–481. https://doi.org/10.1108/IJSHE-02-2019-0072

Alghamdi N, den Heijer A, de Jonge H (2017) Assessment tools' indicators for sustainability in universities: an analytical overview. Int J Sustain High Educ 18(1):84–115. https://doi.org/10.1108/IJSHE-04-2015-0071

Ametowobla D, Arnold N, Besio C (2021) Nachhaltigkeit organisieren – Zur Respezifikation von Nachhaltigkeit durch verschiedene Organisationsformen. In: SONA – Netzwerk Soziologie der Nachhaltigkeit (ed) Soziologie der Nachhaltigkeit. Transcript, Bielefeld, pp 355–389

Barth M, Michelsen G, Rieckmann M, Thomas I (eds) (2018) Routledge handbook of higher education for sustainable development. Routledge, London

Block K, Brand K-W, Henkel A, Barth T, Böschen S, Dickel S … Wendt B (2021) Soziologie der Nachhaltigkeit. Zwischen Transformation und Reflexion. In: Soziologie der Nachhaltigkeit. Transcript, Bielefeld, pp 135–152. https://doi.org/10.1515/9783839451991-006

Boltanski L, Chiapello È (2005) The New spirit of capitalism. Int J Polit Cult Soc 18(3/4):161–188

Boltanski L, Thévenot L (2006) On justification: economies of worth. University Press, Princeton

Bourdieu P (1993) Some properties of fields. Sociology in question. Sage, London, pp 72–77

Bourdieu P (2008) Homo academicus. University Press, Stanford

Chiapello E (2013) Capitalism and its criticisms. In: du Gay P, Morgan G (eds) New spirits of capitalism? University Press, Oxford, pp 60–81. https://doi.org/10.1093/acprof:oso/9780199595341.003.0003

de Bremond A, Ehrensperger A, Providoli I, Messerli P (2019) What role for global change research networks in enabling transformative science for global sustainability? A Global Land Programme perspective. Curr Opin Environ Sustain 38:95–102. https://doi.org/10.1016/j.cosust.2019.05.006

Elven J (2021) Varieties of ethics in academia. Rationalities of scientific responsibility in the (German) march for science. Knowl Cult 9(1), 21–34. https://doi.org/10.22381/kc9120212

Elven J, Schwarz J, Weber SM, Wieners S (2018) Organisation, Sozialisation und Passungsverhältnisse im wissenschaftlichen Feld. Potenziale qualitativer Mehrebenenanalysen für die rekonstruktive Laufbahnforschung. ZQF – Zeitschrift für Qualitative Forschung 19(1–2):307–322

Grahl A, Trappeser V, Strasser T (2020) Ten years Green Office movement. https://prezi.com/view/FSiKQimbAdZuuSBxerf7/

Godwyn M, Gittell JH (eds) (2012) Sociology of organizations: structures and relationships. Pine Forge Press, Thousand Oaks

Henkel A, Böschen S, Drews N, Firnenburg L, Görgen B, Grundmann M, … Wendt B (2017) Soziologie der Nachhaltigkeit. Soziologie und Nachhaltigkeit, Sonderband 1: Soziologie der Nachhaltigkeit 1–30. https://doi.org/10.17879/SUN-2017-2070

Hüther O, Krücken G (2016) Nested organizational fields: isomorphism and differentiation among European universities. In: Berman EP, Paradeise C (eds) The university under pressure. Research in the sociology of organizations. Emerald, Bingley, pp 53–83. https://doi.org/10.1108/S0733-558X20160000046003

Kehm BM (2013) Universities as specific and incomplete organisations? New theories of 'universities as organisations'. Presentation at the 4th international conference "University Traditions: A Resource or a Burden?" 26 to 28 September 2013. Moscow. https://ioe.hse.ru/data/2013/10/17/1279406489/Kehm_New%20Theories%20of%20Universities%20as%20Organisations.pdf

Knoll L (2013) Justification, conventions, and institutions in economic fields. Econ Sociol—Eur Electron Newsl 14(2):39–45

Kuckartz U (2018) Qualitative Inhaltsanalyse: Methoden, Praxis, Computerunterstützung, 4th edn. Beltz Juventa, Weinheim, Basel

Kuhn TS (1962) The structure of scientific revolutions. University Press, Chicago. http://archive.org/details/structureofscie00kuhn

Latour B, Woolgar S (1979) Laboratory life: the construction of scientific facts. Sage, Thousand Oaks

Leal Filho W (2000) Dealing with misconceptions on the concept of sustainability. Int J Sustain High Educ 1(1):9–19. https://doi.org/10.1108/14676300103070 66

Leal Filho W (ed) (2015) Transformative approaches to sustainable development at universities. Working across disciplines. Springer, New York

Leal Filho W, Will M, Salvia AL, Adomßent M, Grahl A, Spira F (2019) The role of Green and Sustainability Offices in fostering sustainability efforts at higher education institutions. J Clean Prod 232:1394–1401. https://doi.org/10.1016/j.jclepro.2019.05.273

Luhmann N (ed) (2019) Schriften zur Organisation 3: Gesellschaftliche Differenzierung. Springer, Wiesbaden. https://doi.org/10.1007/978-3-658-23212-2

Münch R (2014) Academic capitalism: universities in the global struggle for excellence. Routledge, New York. https://doi.org/10.4324/9780203768761

Salas-Zapata WA, Ortiz-Muñoz SM (2019) Analysis of meanings of the concept of sustainability. Sustain Dev 27(1):153–161. https://doi.org/10.1002/sd.1885

Schneidewind U, Singer-Brodowski M, Augenstein K (2016) Transformative science for sustainability transitions. In: Brauch HG, Spring ÚO, Grin J, Scheffran J (eds) Handbook on sustainability transition and sustainable peace. Springer, Cham, pp 123–136. https://doi.org/10.1007/978-3-319-43884-9_5

Spira F, Baker-Shelley A (2015) Driving the energy transition at Maastricht University? Analysing the transformative potential of the student-driven and staff-supported Maastricht University Green Office. In: Filho WL (ed) Transformative approaches to sustainable development at universities. Springer, Cham, pp 207–224. https://doi.org/10.1007/978-3-319-08837-2_15

Stake RE (2006) Multiple case study analysis. Guilford Press, New York

Stock P, Burton RJF (2011) Defining terms for integrated (multi-inter-trans-disciplinary) sustainability research. Sustainability 3(8):1090–1113. https://doi.org/10.3390/su3081090

Strohschneider P (2014) Zur Politik der Transformativen Wissenschaft. In: Brodocz A, Herrmann D, Schmidt R, Schulz D, Wessel JS (eds) Die Verfassung des Politischen. Springer, Wiesbaden, pp 175–192. https://doi.org/10.1007/978-3-658-04784-9_10

Thévenot L (2001) Organized complexity: conventions of coordination and the composition of economic arrangements. Eur J Soc Theory 4(4):405–425. https://doi.org/10.1177/136843101222 25235

Thévenot L, Moody M, Lafaye C (2000) Forms of valuing nature: Arguments and modes of justification in French and American environmental disputes. In: Thévenot L, Lamont M (eds) Rethinking comparative cultural sociology: repertoires of evaluation in France and the United States. University Press, Cambridge, pp 229–272. https://doi.org/10.1017/CBO978051162810 8.009

Thompson PB (2016) The many meanings of sustainability: a competing paradigms approach. In: Moore SA (ed) Pragmatic sustainability, 2nd ed. Routledge, London

UHS (2016) Studenten, setzt euch für mehr Nachhaltigkeit ein! Gruene-Startups.de. https://gruene-startups.de/studenten-setzt-euch-fuer-mehr-nachhaltigkeit-ein/

Wacquant LJD, Bourdieu P (1989) For a socio-analysis of intellectuals: on "Homo Academicus." Berkeley J Sociol 34:1–29

Weber SM, Wieners S, Grosse L (2019) Das Netz der Organisation und seine Oberflächen: Potenziale der Websiteanalyse zur Erschließung organisationaler Diskurse. In: Weber SM, Truschkat I, Schröder C, Peters L, Herz A (eds) Organisation und Netzwerke. SpringerVS, Wiesbaden, pp 83–91. https://doi.org/10.1007/978-3-658-20372-6_8

Development of a Network of Peruvian and Latin American Universities Committed to Risk Management and Adaptation to Climate Change

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1 Introduction

The emergence of COVID-19 is a clear reminder of how all living beings are part of nature and the environment we inhabit. In addition to ongoing crises triggered by the pandemic, we do not need to be remind us that the current climate crisis has plunged humanity into the most critical state of emergency. In recent years, we have witnessed incredible further deterioration of life on the planet. So much so that the term 'Anthropocene' has been coined to indicate that we live in the geological era where physical changes on our planet are the product of human activity. The

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Anthropocene is a neologism invented by Crutzen and Stoermer (2000) to designate a new geological era, in which human influences are so great that they affect the "dynamics of the entire earth", through a variety of biophysical and social processes, such as:

- Erosion and sediment transport, associated with anthropogenic processes (Agriculture, urbanization and global warming).
- Changes in the chemical composition of the atmosphere.
- Degradation of the biosphere on land and sea.

The above can be condensed into the following five key points reported by the Intergovernmental Panel on Climate Change (IPCC): (1) the global surface temperature was 1.09 C higher between 2011–2020 than between 1850–1900; (2) The last five years have been the hottest on record since 1850; (3) The recent rate of sea level rise has nearly tripled compared to 1901–1971; (4) Human influence is "very likely" (90%) the main driver of global glacier retreat and Arctic sea ice decline, since the 1990s; and (5) It is "virtually certain" that hot extremes, including heat waves, have become more frequent and intense since the 1950s, while cold events have become less frequent and severe.

It is therefore urgent that all sectors of society commit to taking action to reverse this trend. That said, it is known that, in general, from all sectors of society, there have been significant advances and efforts aimed at lessening the effect of the crisis facing humanity. Universities represent one of the sectors that have actively contributed to these efforts—creating and encouraging the formation of alliances and networks with various agents, to deal with the issue of risk and climate change.

Briefly, these are some examples of these commitments: The level of commitment of Higher Education Institutions in developing countries (ASIA), ASCENT project (Advancing Skills Creation and Enhancement), the result of three Asian countries: Bangladesh, Sri Lanka and Thailand, and regional initiatives need to be supported and stimulated for their growth. There is also a need for an international association to improve the science-policy interface in the DR and to achieve the objectives of the SFDRR ((Sendai framework for disaster risk reduction) Amaratunga et al. (2018).

One fundamental factor of change in Asia, is that up-to-date education will help the region and the countries to have successful students and well-informed citizens who can build resilience in society. Quality education not only helps generate economic prosperity in the region, but it also improves individual and institutional participation in mitigation, adaptation, and reduction of climate impact (Fanda 2019).

In recent decades, Latin America has been severely and frequently affected by floods and landslides (Lavado-Casimiro 2020; Ronchi and Arcidiacono 2018). Education at all levels, turns out to be a fundamental element when communicating, enabling the efficiency and capacity for disaster mitigation. Education is shown as a hope for society to establish the transformation aimed at sustainability and coexistence with risk (Lara and Martín 2016).

Since 2016, various Peruvian and Latin American universities have actively participated in the development of a network. A network was needed because in Peru, there are no procedures that lead to the implementation of policies, strategies, and actions

to work in communication networks capable of promoting risk management and adaptation to climate change.

Natural disasters are a constant and inescapable threat and one way of facing this is by formalizing commitments from multiple institutions. Additionally, the use of a multidisciplinary and transdisciplinary approach will help to mobilize shared knowledge, technology and financial resources, towards the goal of sustainable development (Fanda 2019). Risk awareness practices come from discourses that articulate a systemic approach, in which the interested agents fully participate and exchange experiences in developing comprehensive risk and disaster plans and programs; its dissemination emanates from the commitment of the participating universities in the network, both at a strategic level (Rectors and University Authorities) and staff in charge of implementing these actions.

The present study contributes to filling a gap by describing the process of creation and implementation of a Peruvian and Latin American Network for risk management and adaptation to climate change. The objective of this article is to explore, compile and evaluate the results of the plans and actions of the Peruvian Network of Universities committed to the 'Comprehensive Management of Disaster Risk and Adaptation to Climate Change'. Our main aim is to encourage future society leaders to be aware of the importance of planning risk management and adaptation to climate change.

We discuss the outcome of the different actions taken by the GIRD-ACC. Actions of the Ries GIRD act as motivators of activities leading to an awareness and sensitization to risk. This is amongst the different universities' stakeholders. In particular, we discuss how relevant material is incorporated into university programs to prepare graduates to understand the complexity of climate change in vulnerable communities.

The article is organized as follows: After this introduction, in Sect. 2 we advanced the conceptual framework of the problem to be tackled and the designed methodological strategy; In Sect. 3 we discuss the methodological stages of the study. Section 4 reports on phase 1 of the methodology. The start, early developments and action of the network are discussed in Sect. 5. In Sect. 6, the results of the survey, interviews with key actors in the network [National University Jorge Basadre Grohmann of Tacna (UNJBG), National University of the Altiplano Puno (UNAP), National University San Marcos (UNMSM)] are analyzed and discussed. In Sect. 7, final conclusions and further research directions are advanced.

2 Conceptual Framework of the Problem to Be Tackled and Methodological Strategy

The conceptual framework that serves as a study platform is based on the interrelation of the three basic questions of all research: (1) What is the problem(s) to study? (2) How do you plan to study it (methodology)? and; (3) Why is the problem important? (or what are the contribution to knowledge and practice). Following these three key

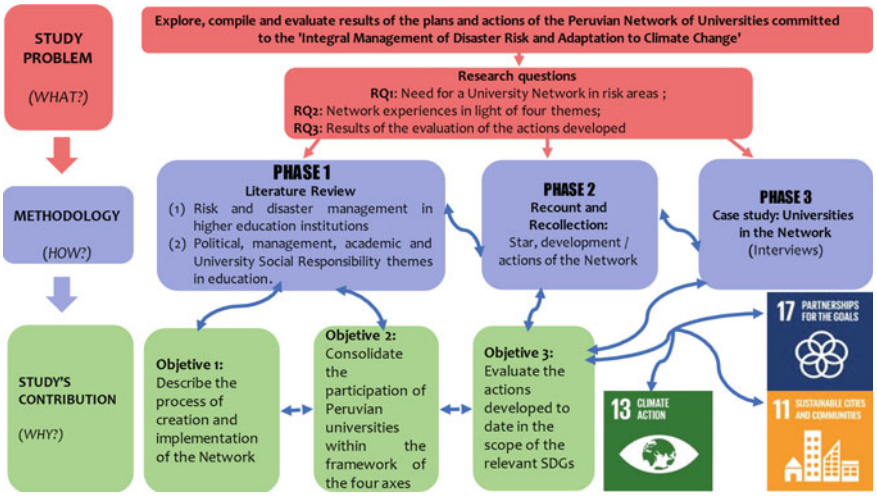

Fig. 1 Conceptual framework of the problem to be tackled and methodological strategy

questions, Fig. 1 shows the interrelated elements of the conceptual framework design for our study.

Problem to study: Explore, compile, and evaluate results of the plans and actions of the Peruvian Network of Universities committed to the 'Integral Management of Disaster Risk and Adaptation to Climate Change'. We extended this larger question or objective into the following three research questions (**RQs)**:

RQ1: How and when did the need arise to create/establish networks among universities in risk areas; to implement actions and, to mitigate damage and disasters?

RQ2: What experiences have been developed in relation to the management, training, research, and social responsibility (RSU) themes in the Peruvian network (such as comprehensive disaster risk management and adaptation to climate change in promoting universities in Peru—e.g., UNJBG, UNMSM, UNAP)?

RQ3: What is the current result of the evaluation of the actions developed by promoting universities of the network (e.g., UNJBG, UNMSM, UNAP—using the Political, Management, Academic and RSU themes in relation to relevant SDGs)?

In our study we attempt to respond to these three RQs by proposing a systemic methodological strategy contained in three interrelated phases. We believe these three phases have a systemic approach that encompasses the key elements rooted in this situation and that allow the objectives of the research to be achieved, as presented in Table 1.

Table 1 Research questions and their relationship with objectives and methodological stages

Research questions	Research objectives	Methodological phase/Activities
RQ1: How does the importance of creating or establishing networks between universities in risk areas arise in order to implement actions to mitigate damage and disasters?	**Objective 1**: Describe the process of creation and implementation of the Network of Peruvian Higher Institutions for the integral management of disaster risk and adaptation to climate change	**Phase 1**: Literature review – Risk and disaster management in higher education institutions – Themes: management, training, research and social responsibility in education
RQ2: What experiences have been developed in relation to the management, information, research and social responsibility themes in the IMDR-ACC network (NHEIIMDR-Peru) in the promoting universities (UNJBG, UNMSM and UNAP)?	**Objective 2**: Identify the participation of Peruvian and Latin American universities in IMDR-ACC (NHEIIMDR-Peru) networks within the framework of the political, management, training and Social Responsibility themes	**Phase 1/Phase 2**: Recount and compilation: birth, development/actions of the network – Documentary analysis using the reviewed literature complemented with interviews and analysis of relevant documents
RQ3: Using the political, management, academic and social responsibility themes in the related SDGs, what is the current result of the evaluation of the actions developed by the promoting universities that make up the network (UNJBG, UNMSM, UNAP?	**Objective 3**: Evaluate the actions currently carried out in the scope of the SDGs (11, 13, 18) related to IMDR-ACC (NHEIIMDR-Peru) in promoting universities that make up the network (UNJBG, UNMSM, UNAP)	**Phase 2/Phase 3**: Case study: universities in the network – Interviews with management actors at a strategic and operational level – Evaluate the opinions of the actors involved – Evaluate indicators – Discussion of results

3 Research Design and Methodological Stages

The research presents a qualitative study to evaluate the development and scope of the network formed by the Disaster Management and Adaptation to Climate Change Network in Peru.

As shown in Fig. 1, the methodological strategy of the research is based on the three phases: (1) Bibliographic and documentary review; (2) A recount and compilation of the events leading to the start and development of the network and; (3) The case study from three public accredited universities (e.g., UNJBG, UNMSM and UNAP), that constitutes the network. The research was carried out between the months of January and March 2022.

Phase 1: Bibliographic and documentary review

This includes the collection, organization, and analysis of information related to the objectives of the study. It was conducted between January and February 2022. Specifically, this phase included the following activities:

Search of information from various online databases; review of published research on the GIRD-ACC in Higher Education Institutions. We used the keywords: Network and Disaster Management and adaptation to climate change (Ries GIRD) and Higher Education Institution (IES). Further search strategies were carried out using combined keywords: Ries IRD *and* alliances; Ries GIRD *and* LAC; Ries GIRD *and* IES; Ries GIRD *and* Universities Peru; Implementation of Ries GIRD *and* University.

Phase 2: Compilation of network activities: Birth, development/actions of the Network

In this stage documents about the initial steps leading towards the formation of the Network were searched, read and analyzed. This was achieved by collecting information via reports and university web pages. We studied documents describing the initial events in the creation of the networks. Specifically, reports of four inter-university forums (developed as strategies for the creation of the networks under study) were reviewed and analyzed. Likewise, documents describing processes and strategies related to risk management and adaptation to climate change were examined. These allowed us to better understand the implementation policies, plans and collaborative strategies of action of Ries ISRM in the universities under study.

Phase 3: Case Study: Universities in the Network-Discussion of Results

We assembled information for each university and described their involvement in the network's development, as a case study. We followed the premises of a descriptive study based on the research by Cavalcanti-Bandos et al. (2021). In this phase, we proceeded to assemble opinions, impressions, and judgments from the interviews with the team of internal and external university staff who were/are involved in promoting the network. Via open ended interviews we attempt to capture their perception and knowledge about the network's plans, its current development, and its future. We also used a timeline which depicts the start and progression of the network, as to visual which records the most important events, chronologically. This is illustrated in Fig. 2. Finally, using the four themes (management, training, research and RSU), the results of the interviews with the university respondents were analyzed and discussed.

4 Literature Review (Phase 1): Risk and Disaster Management in Higher Education Institutions (HEIs)

In this section, we report on the literature review and the state of the art in the field of HEIs' alliances and risk management networks.

We all witnessed the daily natural disasters around the world as a constant threat that brings catastrophes. In the period 2005 to 2014 a total of 3,809 natural disasters with considerable human losses were registered (Fed. Internacional. de Sociedades

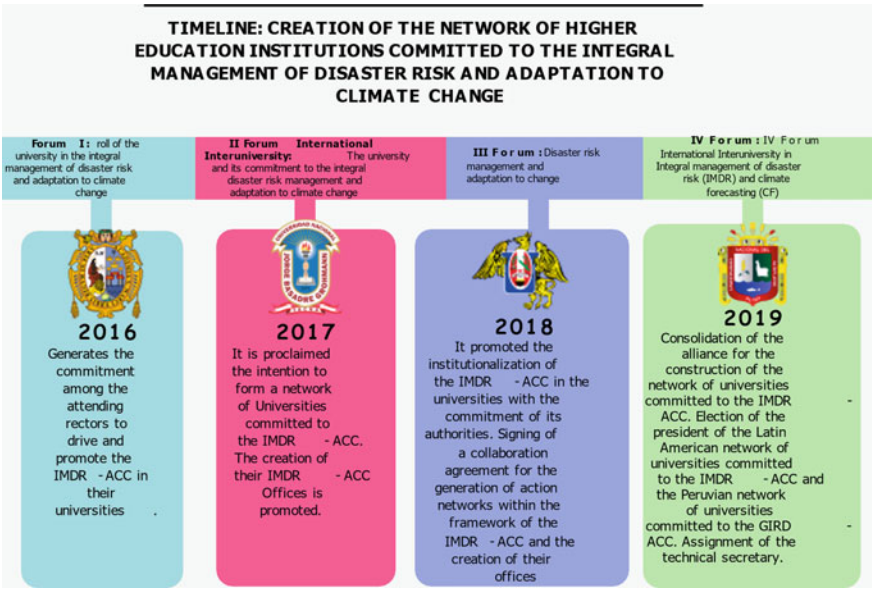

Fig. 2 Process of the development of the Ries GIRD and ACC network/alliances

de la Cruz Roja 2015). This highlights a problem that compel proactive responses based on a systematic approach to risk management.

In the section below, we briefly outline key literature sources about the development of risk management in recent decades. We then review the role of higher education institutions linked to sustainable development and, we also comment on the measure of SDG implementation.

4.1 The Role of Alliances and Networks as Coordinated Effort for Risk Management

In order to emphasize the importance of risk management and its implementation, it is necessary to analyze it in an integrated manner (Abedin and Shaw 2015; Tolmos et al. 2011). Disaster risk management (DRM) needs to be regarded as: '...a systematic process of using administrative directives, organizations, skills and operational capacities to implement strategies, policies, and improve coping capacities to reduce the adverse impacts of hazards and the possibility of disaster' (2009 Disaster Risk Terminology nd).

When referring to the 2005 Hyogo Framework for Action (HFA) given at the World Conference on Disaster Reduction in Japan, we note that it developed as an instrument for implementing disaster risk reduction. The framework brought together 168 member countries of the United Nations with the objective of increasing the

resilience of nations to disasters—achieving by 2015, a decrease in impacts on social, economic and environmental goods (Lara and Martín 2016).

Likewise, the Sendai Framework was consistent with this Hyogo Framework when an instrument for Disaster Risk Reduction 2015–2030 was created. Disaster management will henceforth be seen as disaster *risk* management (Framework of Sendai—UN 2015) as a strategy to minimize threats and to strengthen resilience. The idea being that by understanding risk in all its dimensions and stages, this would boost the efforts of nations, their societies and communities (Sendai Framework—UN 2015).

In 2015, the Paris Agreement was established at the Conference on Climate Change, which sought to join efforts between countries to face the global climate crisis. There were specific objectives towards Sustainable Development (SD) and the eradication of poverty (Sendai Framework—UN 2015).

The Inter-American Conference on Disaster Risk Reduction held in 2004 defined risk as a growing factor in danger and variability. It stressed the need to face such jeopardy in a responsible way. This implies the need to know its dimensions, to educate in a common language and to train societies about how to reduce peril (Inter-American DRR Conference 2004). Along this line, educators and researchers voluntarily formed this initiative, to consolidate the efforts of the Office of Disaster Assistance of the Government of the United States for Latin America and the Caribbean (OFDA/LAC) advising and encouraging risk management related contents in higher education (REDULAC/RRD 2016).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Strategy for Disaster Reduction (UNISDR) (under the Hyogo and Sendai Frameworks) considered education as an important element of relatively low resources, yet, efficient and capable enough to be implemented in all stages for disaster mitigation. This would then be the hope of society, leading towards transformation. As such, it would also be aimed at sustainability and continuous co-existence with risk (Lara and Martín 2016).

Education seeks strategies to contribute to enhance society by adopting adequate, responsible risk management. Shaw et al. (2011) argue that this impacts vulnerability reduction. In keeping with this vision, education for sustainable development (ESD) delivered through universities' curricula would mean that the teaching–learning process is carried out in an integral way. The implications would be that study plans, activities, evaluations and multidisciplinary teaching would be done as a comprehensive process. Educational programs would therefore become mechanisms for preparing and strengthening values, promoting responsible citizenship and social alertness (Quezada 2011).

USAID-OFDA affirms that higher education (HE) should aim to prepare interdisciplinary professionals as leaders and promoters of the future. In this capacity, they would work to craft creative spaces for creativity, open innovation and knowledge exchange in universities. These would be managers of the institutionalization of disaster risk reduction (DRR) in education. They would be able to consolidate the foundations (already laid), in order to increase the resilience and development of nations (REDULAC/RRD 2012).

The urgency around climate change suggests that forging international linkages, towards social transformation and sustainable development is imperative (Filho et al. 2022). These alliances mobilize resources and facilitate interconnections which span the social, economic and environmental fields. These linkages will contribute to achieving the SDGs (SDSN Australia/Pacific 2017) through collaboration and it is worth noting that possibilities extend at the local, regional and global levels (Filho et al. 2022). In short, alliances are powerful mechanisms for influencing change in all sectors.

Furthermore, Universities and related institutions will play a leading role in this scenario. This is because of their capacity for both theorizing, training and other actioning towards developing resilient and self-transforming societies. This is especially with regard to climate change (Baker-Shelley et al. 2017).

For example, networking is one expression of academia's commitment to developing sustainable and resilient societies (Pflitsch and Radinger-Peer 2018). In such cases, the realization of fora becomes a conduit for multidisciplinary teams to act in the face of these challenges.

According to Cavalcanti-Bandos et al. (2021) and university life can be closely aligned with several of the SDGs. When the university plays a leadership role, that contribution can very well encompass each SDG within the HE functions of: teaching/learning, research, helping to craft or to support governance frameworks, working through university management and extension policies, and also community and other social leadership.

4.2 Education and the Implementation of Sustainable Development Goals

Therefore, we argue that education should actively participate in the process of transformation of society and the fulfilment and implementation of the SDGs (UN 2015). It holds a strategic function in the search for processes which benefit society. However, we have established that stakeholder alliance is fundamental in order to achieve these goals. Co-learning or collaborative learning would be the basis for the inclusion of networks in education (Vargas et al. 2021). It is a major element explicitly mentioned in the tenor of SDG-17 (UN 2015) and can favorably influence organizational changes (Radinger-Peer and Pflitsch 2017).

Regarding alliances in HE, connections occur through networks (Vargas et al. 2019). Stakeholders influence higher education institutions (HEIs) (Radinger-Peer and Pflitsch 2017), by seeking solution strategies to the problems established in the SDGs. Abedin and Shaw (2015) view them as catalysts that significantly increase knowledge and contribute to the reduction of losses due to natural disasters. These promote the common action of the interested parties, based on the synergy of their participants (Shaw et al. 2012). Thus, strategic alliances are essential to promote education and obtain favorable results in the network (GIRD).

Universities are especially important when they are proactive in managing and implanting DRR, through the knowledge that they impart to students and other stakeholders. When universities encourage the exchange of experiences, such knowledge helps to improve the processes in the decision-making of policy actors and also, of practitioners (Abedin and Shaw 2015). For example, associations such as the University Network of the Americas and the Caribbean for Disaster Risk Reduction (REDULAC), promote the development of Sustainable and Resilient Universities in Latin America and the Caribbean. Its thrust is collaboration around policies and strategies pertaining to risk management issues, at different levels across the region.

As is well known, Central America has a high occurrence of disasters due to its geographical position and the increase in natural, socio-natural and anthropic threats (Lines of Action of the Education Sector 2012–2015 Central American GRD and ACC 2014). As a result of this, there have been definite efforts to enhance the curricula of the education sector with the intent that appropriate policies, programs and strategies would be employed. The goal is to introduce and to consolidate a regional culture of prevention, risk reduction and resilience, with a view to sustainable human development throughout the region (Lines of Action of the Education Sector 2012–2015 Central American GRD and ACC 2014).

Furthermore, the University Program for Disaster Risk Reduction and Adaptation to Climate Change (PRIDCA), was developed by the Central American Higher University Council between 2013 and 2018. The aim was to integrate approaches within a coherent framework of Central American policies on IDRM. In the meantime, the regional higher education plan incorporates ACC, with attention to: study plans, research, University Extension and the reduction of vulnerability on campus and, affecting university activities (Consejo Superior Universitario Centroamericano 2018).

Peru has a high vulnerability to disasters and the effects of climate change. This is because of its diverse climate. Its geomorphology, geodynamic activity, informal use of land, deforestation, soil degradation are among other reasons (Tolmos et al. 2011). Since natural disasters tend to disrupt the psychological, social, and economic stability of people and the nation, this emphasizes that vulnerability and resilience are key concepts in determining the process to recovery (Kushma 2021).

That said, Peru has made considerable progress in IDRM policies since 2010, with: the inclusion of State Policy 32 “Disaster Risk Management”; the creation of the National Disaster Risk Management System (SINAGERD); the approval of the National Disaster Risk Management Policy (PNGRD) and; the gradual implementation of the National Disaster Risk Management Plan, 2014–2021 (DS No. 038-2021-PCM 2021).

The above-mentioned statements represent the intention of the Peruvian Government to insert the PNGRD with a strategy towards 2050. These plans align with international commitments and agreements such as: the Sendai Framework for Disaster Risk Reduction (2015–2030) and; the Agenda 2030 for the DS (DS No. 038-2021-PCM 2021).

In accordance with the PNGRD and, with awareness of the importance of Sustainable Development, the Peruvian Government, establishes policies that address relevant social issues in different areas. The University Law 30220 emerged from this thrust to promote the continuous improvement of educational quality in HEIs. This was seen as fundamental for comprehensive national development (Law No. 30220—El Peruano 2014).

This regulation specifically focuses on vital areas of *management pertaining to; teaching and learning; research; and university social responsibility (RSU)*. Management is of interest as an institutional activity for achieving effective and efficient procedures. Teaching/learning is important because of its role in continuing education and its overall contribution to human development. Similarly, research provides an essential and mandatory function of universities and (as the foundation of university life), RSU collaborates with the SDGs and for the benefit of society.

As we explain in the following Section, the GIRD is framed in each area of the regulations. The HEIs assume and are directed towards the same end, which in turn directs the SDGs. In short, natural disasters are a constant and inescapable threat, which is why IWRM turns out to be the only effective strategy to face them successfully. Since 2005, with the World Conference on Disaster Reduction in Hyogo, Japan (and later in 2015 with the Sendai Framework), is geared towards implementing instruments for Disaster Risk Reduction and Climate Change, respectively. This is actually an international strategy. Against this backdrop, alliance becomes a powerful means for the fulfilment of the SDGs, while education is recognized as indispensable. This is because it provides some guarantee for co-existence *with risk*, in the interest of positive social transformation.

Finally, based on some university experiences, such as that of PRIDCA in Central America, we can conclude that SE makes it possible to strengthen knowledge oriented to IDRM and ACC. This is primarily through networks and, in the case of Peru, there and foundations and fundamental tools for strengthening society from the academy. This is taking: management, teaching and learning, research and RSU into consideration, as avenues moving towards change.

In the following sections, the review of these experiences (both in Peru and across the region) will serve as a backdrop. Here, we explore the development of networks of Peruvian and Latin American universities that are committed to risk management and adaptation to climate change (Ries GIRD).

5 Accounting and Compilation: Initiation, Development/Actions of the Network (Phase 2)

The information was collected from the GIRD archives; from the organizers of the forums and; from university websites. This was all directed to the first question. The researchers' objective was to find out more about the creation process and formation of the Ries GIRD.

The data that was analyzed corresponds to the objectives, results and conclusions of the four developed fora and, the scope of normative documents and reports. These have been developed within the framework of the UN SDGs in the 2030 Agenda, MAH 2015–2030, of the United Nations, and of the policies and national systems of IDRM-ACC.

5.1 Background of the Creation of the Ries GIRD and ACC

In September 2016, the Universidad Nacional Mayor de San Marcos (UNMSM) promoted the first Inter-university Forum entitled: 'The role of the university in comprehensive disaster risk management and adaptation to climate change'.

The objectives of the Forum were to: strengthen the capacities of the members of the universities involved; to encourage the development of a systemic and comprehensive vision of the problems in Disaster Risk Management and, adaptation to climate change; learn about projects for the institutionalization of GIRD-ACC in the country's universities and; commit guardianship institutions in GIRD-ACC so that they align to the network objectives.

The first Forum served to generate (among the attending rectors) the commitment to promote and to promote the GIRD-ACC in their Universities.

The second Forum, was international in nature, was organized by the Jorge Basadre Grohmann National University of Tacna (UNJBG) with the support of USAID/OFDA. It was held in 2017 and labelled as: '*II International Interuniversity Forum: The university and its commitment to Management Comprehensive disaster risk and adaptation to climate change*'. During this event, work was carried out in four thematic tables referring to the relationship between the fundamental objectives of the academy and the GIRD-ACC such as management, teaching and learning, research and university social responsibility.

At the same time, an Assembly of 19 rectors of national universities convened a gathering entitled: 'The Articulation of the National Risk Management System with Higher Education Institutions for National Development'. In terms of purpose, this was aimed at dealing with consolidating the participation of their institutions in the GIRD-ACC. Participants signed a declaration based on *four* essential points: (1) the promotion of the institutionalization of the Inter-university Fora; (2) the creation of the Inter-university Network; (3) the implementation of institutional policies within national universities and; (4) the creation of General Offices for Disaster Risk Management and Climate Change Conditioning (with a specific mandate to develop actions in: institutional management, academic training, university social responsibility and research).

The third Forum was labelled as: '*Disaster risk management and adaptation to climate change*'. It was organized by the National University of Trujillo in 2018. Important results were achieved at this event. These included: promoting the institutionalization of the GIRD-ACC in the universities, with the commitment of its authorities; a collaboration agreement was also signed by the universities. This

was for generating action networks within the framework of the GIRD-ACC. The latter spanned the continuation of both implementation actions of the inter-university network, as well as the creation of their GIRD Offices.

Finally, in September 2019, the **fourth Forum** was held in the city of Puno. It was organized by the National University of the Altiplano (UNAP). At this forum, an alliance of universities was consolidated for setting up the network of universities committed to the GIRD-ACC. It was agreed that a constitution would be drafted for the Peruvian Network and the Latin American and Caribbean Network of universities committed to the GIRD-ACC. The Rector of the UNMSM was elected as President of the Latin American Network of Universities committed to the GIRD-ACC and; of the Peruvian Network of Universities committed to the GIRD-ACC. A Technical Secretariat was assigned to support the President with the above duties.

After these four fora, the Network of Higher Education Institutions of Latin America and the Caribbean, (Ries GIRD—LAC) and the Peruvian Network of Universities emerged, dedicated to the GIRD-ACC (Ries GIRD—Peru). The immediate task was to draft a formal constitution of both networks to generate actions through the academy that promotes Comprehensive Disaster Risk Management and Adaptation to Climate Change as part of their role and institutional work.

5.2 Development Process of the Implementation of the Network of Peruvian and Latin American Universities Committed to Risk Management and Adaptation to Climate Change (GIRD Ries)

The current situation and state of agreements reached can be described as follows:

(1) The GIRD Ries—Peru seeks to promote the constitution of the national network of universities and higher education institutions. The goal is to establish the GIRD among its members.
(2) The GIRD Ries—LAC seeks to promote the institutionalization of the GIRD-ACC in the universities of Latin America and the Caribbean, as well as to generate alliances and collaborative actions between universities and, national and international organizations and institutions.
(3) In both networks, the election of the executive presidency takes place in the assembly of Rectors of the member universities, considering for this the founding universities and the adherents.
(4) At present, three work teams have also been established: Team 1, which works on the statute of the Ries GIRD—LAC and Ries GIRD—PERU in charge of the Columbia University of Paraguay. Team 2 sees the Base Line of the networks in charge of the Universidad Colegio Mayor de Antioquia, Colombia. Team 3 develops Projects and Innovation in charge of the UNJBG. These teams

conducted out the operational work within the networks, in addition to the technical support of the US Agency for International Development and its Office of Humanitarian Assistance (USAID/BHA) formerly USAID/OFDA.

6 Case Study—Universities in the Network and Discussion of Results of the Interviews (Phase 3)

As explained in the methodology section, four questions were addressed to the Rectors and those responsible in charge of IDRM and ACC. The adjourning took place during the 2016–2020 administration in the universities studied. In this section we summarized the responses to the interviews which we conducted. One should note that Interviews and recollection of answers were conducted in Spanish and ethic protocols set by the university (UNJBG) were followed and approval was gained. Questions were framed in Spanish and full answers to the four questions are shown in Appendix A.

Likewise, it is worth mentioning that the questions asked are developed within the framework of the Management, Training, Research and RSU axes and they matched with the functions of the University Law Art. 07 (Law No. 30220—El Peruano 2014). The second question about how Ries GIRD and ACC is being implemented, is answered within the framework of these axes.

6.1 Management

In terms of Management, two key factors have been identified within the implementation process. These are external and internal to the Universities and, both necessary and indispensable for implementation. There are exogenous factors as a result of support from institutions with greater experience in the process. These institutions collaborate about matters of advice re: implementing institutional policies for their inclusion in Risk Management. This was described by the one university as; 'In the same way, the advances of the UNMSM in this theme, such as the incorporation of the GIRD-ACC in the institutional policy, as well as in the Institutional Strategic Plan and one of the objectives'.

Likewise, they mention USAID-OFDA as an external consultant to the university. This is seen as a fundamental part in the inclusion, exchange and transfer of knowledge and resources for implementation Risk Management throughout universities.

The integration and recognition of the key actors in the academy is another potential element of the implementation process in risk management. One of the actors even describes it as '... very conducive due to the level of commitment and responsibility of the representatives of the universities'. When considering that the leadership

present in the institution is part of the decision-making and the execution of the same, it is expected that the actors mentioned become committed to the process.

6.2 Teaching and Learning

Thus, Universities already recognize the role that they have to play in the comprehensive education of students, so the commitment in this theme is evidenced by the actions conducted.

In the first university of the study, the Rector of the previous period (2016–2019) mentions '... the networks have allowed an agenda and a common commitment that materializes in various actions within the framework of the GIRD-ACC, (…) in professional and continuous training'. The operational unit makes it clear that the network has made it possible to "Socialize the training experiences (…) of the universities, which is why we set out to make a baseline of the progress of the GIRD-ACC….". Another action refers to "Mainstreaming the GIRD in the Educational Model and the incorporation of the GIRD subject in general studies".

On the other hand, in the second university they alluded to '...the process of Incorporating the GIRD in curricular plans has begun, in the reformulation of sommeliers in some committed schools, such as architecture, communication and veterinary'. One product of these developments is the Course of High Management. IRMRM competencies were also incorporated into the curriculum. This received technical support from USAID/OFDA".

At the same time, some respondents told us that the emergence of research, training and knowledge management has not been comprehensive and has not developed in an articulate way.

In the third university, the GIRD-ACC Office were created in 2019, giving rise to expanding and extending, in the different faculties and, actions in disaster risk management. According to the academic perspective of the Rector, during his presiding office (2016–2020): '...they assumed commitments to incorporate the GIRD-ACC within academic training' and; '...propose the incorporation in the undergraduate and postgraduate curricula'. However, despite some measure of action implemented through the Office, results have been limited by the pandemic situation.

As a product of the reflections of the IV Forums, the universities under study are committed to integrate GIRD-ACC in professional training. Likewise, there is evidence of efforts to integrate ISRM subjects at the level of all undergraduate and postgraduate programs and also, to involve the academic community. These updates are also shared in other university settings (Pal et al. 2019).

The complexity of challenges facing future professionals demands that they acquire transversal skills, competencies and ways of thinking (SDSN 2020), which progress problem solving in disaster and climate change scenarios. This means that their training would need to match specific educational needs. This alignment is necessary for meeting the expectations of the three policy frameworks (i.e., the

Sendai Framework for disaster risk reduction, the Sustainable Development Goals and the Paris Agreement on Climate Change) (Perera et al. 2018).

6.3 Research

It is fair to say that overall, sustainable developments efforts promote a culture of prevention and it makes sense that this would be closely linked to disaster risk mitigation. However, it should be noted that there is deficient research on IDRM issues (Geneva: Swiss Agency for Development and Cooperation 2020). The first university stated that, in research, the actions carried out have not been specified but there is an intention to strengthen the research line with this issue in mind. According to the interviews and the operational units of the second university which were studied, research is still a pending field. Notably, both universities reaffirmed the deficiencies in research and the need to strengthen knowledge in IDRM and ACC (Suazo and Torres-Valle 2021).

Such research turns out to be—a transversal theme and, in a formative period. Palacios Serna (2021) asserts that because of this, it is critical that research capacity is enhanced. In a reviewing the repository of the universities under study, it was possible to identify some works referring to IDRM and ACC, in the last 5 years. Yet, the majority of research was conducted by local entities or organizations.

At the same time, both universities show pending research work surrounding GIRD-ACC, the Ries GIRD-ACC. This has brought opportunity to strengthen alliances and, to work with strategic partners regarding multidisciplinary and inter-institutional tasks (Palacios Serna 2021).

It is important to emphasize scientific research to promote national development—in this case, linked to GIRD-ACC. Palomino (2017) points out that this blends well with enabling efficiently within science, technology and innovation to favors the urgent progress of Peru.

6.4 University Social Responsibility (USR)

With the deepening of the crisis of social instability, the ecological footprint of humanity is getting worse and worse, on a global scale. According to the gloomy thesis of Edgar Morín: “We are in a planetary titanic” and this conclusion has not been contradicted until now.

The SDGs (11, 13, 17) constitute a roadmap to guide educational policies, since Higher Education Institutions are still far from including these 17 SDGs in the curricula of their study plans (URSULA 2021). Regarding the specific question of the University Social Responsibility theme, the GIRD-ACC implementation processes are at the operational level. There is no clear understanding of the Social responsibility approach since the answers are focused on common actions of extension and

projection. Examples of these are: the formation of university brigades, recognition of volunteer organizations, the presence of the University at a local, regional and international level and the organization of international events.

However, in the interview with the Rectors of this period (2016–2019), the recognition of disaster risk due to global warming is implicitly observed. This invites reflection on the role of the university in these scenarios for the development and the well-being of society. Essentially, it makes essential the understanding that social responsibility is the foundation of university life, contributing to sustainable entire university community (Law No. 30220—El Peruano 2014).

Given the exposed problem, there is a clear need to address it, as shown by the authorities in successive academic events (e.g., national and international Forums), organized by the universities. This becomes an important example of the commitment assumed by the University System of Peru, America Latin and the Caribbean. It should be noted that these initiatives respond to what was agreed in the Sendai Framework for Disaster Risk Reduction 2015–2030 (Sendai Framework—UN 2015).

At another time, the authorities state that once the commitments have been assumed, they materialize in various actions within the framework of the GIRD-ACC. This is, consistent: with the role of universities, in terms of institutional policy and management, professional and continuous training, research applied and knowledge management, as well as the extension and university projection with social responsibility. These actions are recognized as implementation processes under this theme. University social responsibility is defined as the ethical and effective management of the impact generated by the university in society, as a result of exercising its functions. It includes the management of the impact produced by the relations between the members of the university community and interested parties in the environment (Law No. 30220—El Peruano 2014).

In the study entitled "University Community and Sustainable Campus: USR in the Framework of the 2030 Agenda", one of its conclusions refers to the fact that a sustainable campus enriches USR and vice versa. This is done by prioritizing actions and academic and research practices on economic balance, social and environmental causes. It also entails contributing to and favoring sustainable development and the welfare of society. Furthermore, it is expected that there is respect and equity in the link with the communities (Delgado 2021). Such a conclusion helps to specify the principles of USR and, how we contribute with USR to the SDGs of the 2030 agenda. It also provides guidelines for forming academic networks to promote sustainable development from the GIRD-ACC.

7 Conclusions and Final Comments

Coping with disaster risks and adaptation to climate change does not necessarily require only the use of technology. It demands the organization, collaboration and cooperation of the different social spheres that constitute networks. Moreover, this strategy exists at the local, national and international levels. Participation in networks

also enables the empowerment of its members. Our study confirms that Universities recognize the importance of their role in achieving the goals of the SDGs and have been joining efforts specifically in SDGs 11, 13 and 17, as in the case of Peru.

In higher education institutions, the fundamental aspects of the work of implementing commitments and actions in GIRD-ACC related to the SDGs, is evidenced in the promotion of education as a support for sustainable development. There are actions for implementing strategic alliances across academia, the public and private sectors and; for risk management and climate change in institutional policies and strategies. These actions are still in the process of implementation due to the characteristics of the administrative structure of the universities.

The interviews carried out senior university officials and operation managers indicate that, through the network formed here, universities guides its management processes for the benefit of its students and society, but it needs to set up alliances with internal and external stakeholders to achieve its objectives.

On the other hand, alliances mobilize resources for interconnections in the social, economic and environmental spheres, thus, contributing to the achievement of the SDGs. In the current management process, alliances are powerful mechanisms to establish an organizational, systemic, bi-directional change and in order to hone consistent feedback, with those involved. These are the crucial elements that allowed the elaboration of institutional management policies for their incorporation within the University.

The link between higher education and GIRD-ACC is key in strengthening the culture of prevention, in this sense the academy develops scientific research as a fundamental component, which promotes the development of the country, in search of achieving the SDGs. These important measures must be linked to quality education, sustainable cities and communities and, to climate action.

Although the participating universities have not made significant progress in this regard, they recognize that work in this field is essential for empowering social action re: IDRM and CCA issues. In this way, the Ries GIRD-ACC holds good potential for joining additional efforts and with alliances, to promote and to collaborate between Higher Education Institutions for a Sustainable and Resilient Development of the local, regional and international society.

Incorporating GIRD-ACC in professional training is a commitment assumed by the universities. Moreover, implementation differs from one university to another, there are universities that are in the initial phase, it is not yet evident as an institutional policy but as a product of the work of a group of directors or teachers sensitized to the subject.

There are training experiences outside the classroom through participation in activities organized at the university. These activities relate to environmental objectives (SDG 13). These add to the concern for global change and adaptation to the impacts of climate change that we are already suffering e.g., episodes of high-low temperatures, droughts, increased storms, floods, etc.

University Social Responsibility represents a suitable mechanism to channel the requirements of the 2030 Agenda, embodied in the SDGs. This is because USR is inherently about optimizing the effects that HEIs have on specific dimensions of their environment.

There is no consensus between the authorities and the operational part on the USR approach that allows the implementation of better IDRM and ACC processes, mainstreamed in the great functions of the university such as training, research, extension and projection.

The USR concept has not been internalized by most actors, it is often taken as concrete actions in the implementation of IRMW and ACC in universities. The lines of work most implemented and declared by the former Rectors are those of Management and training, which are consistent with the principles of the RSU.

Limitations

The limitation of this study is that not all the universities that participated in the creation of the Red Ries GIRD were studied. This was because of the lack of access to some of the authorities of that period. It is not prudent to generalize about the progress of actions of all the member universities. This is because this research only presents the experiences and good practices of the participating universities. It should also be noted that the interviewing was done with former university officials some of whom are no longer in those positions.

We consider that these findings allow us to provide informative data and experiences about networking and inter-university linkages. Yet, this may serve as a basis for further studies. Our research suggests that there is also the possibility that such relationships within an external environment might lead to partnerships involving academia and society as a whole.

The perception of academics and students about the topic is considered as an important complement to this study. Obtaining further contributions from graduates allows for additional viewpoints arising from their professional experiences and workstreams.

Appendix A: Full Answers of the Universities Representatives Interviewed: Open Ended Questionnaire (Spanish)

1. Interview with USAID Advisor

	USAID
¿Cómo estima que es la participación en la red Ries GIRD de las universidades peruanas y latinoamericanas?	• Promoviendo encuentros nacionales e internacionales, y lograr la INSTITUCIONALIZACION de la GIRD en sus organizaciones lo que le da la sostenibilidad, fortaleza, capacidad de autonomía y un proceso transversal al quehacer de las Universidades • Trabajar en las 4 funciones de las Universidades, en Gestión y Política Institucional, en Formación docente e incorporación curricular en todas las facultades y escuelas de pre grado y pos grado, en la investigación aplicada, que responda a las demandas de la sociedad y a resolver los verdaderos problemas de desarrollo • Encuentro de las Universidades con la sociedad a través de las Responsabilidad Social Universitaria, puertas abiertas para un encuentro entre la academia con el barrio, con las empresa privada, con los comités vecinales, entre otros
¿Cómo se da el proceso de implementación de las rede Ries GIRD en las universidades peruanas?	En primer lugar es preciso señalar que el Perú ha sido el pionero en fomentar, crear, organizar y liderar la Red de Instituciones de Educación Superior comprometidas en la Gestión Integral de Riesgo de Desastres, que la integran más de 30 universidades de América Latina y el Caribe, hoy conocida como RiesGIRD Inicialmente la Universidad Nacional Mayor de San Marcos, en el 2016 promovió un primer foro con el propósito de integrar no solo a las universidades sino también a organismos técnico – científicos e instituciones tutelares como INDECI que tiene la responsabilidad de orientar, dar la pautas y directrices para que los Gobiernos Sub nacionales, asumen su rol de promover la construcción de modelos comunitarios más seguros y resilientes, La Universidad Nacional Jorge Basadre Grohmann de Tacna, en el 2017, asume el compromiso de ser el organizador del II Foro en Septiembre del 2017 y es ahí donde se forma la Red Peruana de Universidades comprometidas con las GIRD y ACC que hoy la integran más de 30 universidades peruanas y se crea la comisión para evaluar la creación de una red latinoamericana A partir de este encuentro, se inicia un proceso de intercambio, de relacionamiento entre Autoridades, Docentes, Investigadores, Alumnos, Brigadas, entre otros, que da pie para que en el III Foro organizado por la UNT de Trujillo en el 2018 se elabore una compromiso de intención para crear una red latinoamericana, que se concretiza y formaliza en el IV Foro de realizado en Puno el 2019

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	USAID
¿Cuál es la percepción del avance de la red Ries GIRD en las universidades peruanas?	El avance en el Perú, personalmente lo calificaría del óptimo en toda la región, en el Perú son las autoridades, los rectores de las Universidades los que están liderando el proceso de la Red Peruana y promoviendo en sus pares de la RiesGIRD a nivel de Latinoamérica, aportando a través de los 4 foros interuniversitarios realizados, seminarios, conversatorios, encuentros y diversas actividades tanto presenciales como virtuales. La tarea debe seguir a todo nivel, donde las Oficinas de GIRD Universitarias vienen teniendo un rol integrador, que permita el fortalecimiento de uno de los puntos más críticos que es la sostenibilidad

2. Interview with University Senior Officialsde Universidades

	Primera universidad	Segunda universidad	Tercera universidad
¿Cómo surge la necesidad de crear redes en las universidades sobre GIRD y ACC?	La Red surge el año 2016, en la oportunidad en que la Universidad Nacional Mayor de San Marcos decidió organizar el Primer a través de nuestra Oficina General de Gestión del Riesgo con el apoyo y asistencia técnica de USAID-OFDA. Este evento se constituía con la finalidad de generar el compromiso de la academia para promover el desarrollo humano sostenible y resiliente sustentada en el devenir de las acciones y actividades desarrolladas por nuestra comunidad académica. Para evitar duplicidad de acciones y unirnos en equipos multidisciplinarios que respondan a los desafíos que nos presentaba el marco de acción de Sendai, así como las políticas y los sistemas nacionales de Gestión del Riesgo de Desastres y Adaptación al Cambio Climático en nuestros campos de acción (Gestión institucional, la formación profesional, la investigación y la extensión y proyección social)	Teniendo en cuenta la Ley Universitaria y que propone como eje transversal, en este contexto se ve la necesidad de que la universidad asuma ciertos compromisos sobre todo por lo que vive la humanidad, el cambio climático que afectan al ser humano, la naturaleza cambiante, los fenómenos naturales que son impredecibles y en mucho de los casos generan pérdidas humanas, en los medios de vida y bienes productivos Por otro lado nuestra Región Tacna no está exenta a esta problemática, ya que es característico de la zona el ser altamente sísmica También por los resultados de los Foros Nacionales e Internacionales en este tema y que en año 2017 fue desarrollado por nuestra universidad que dio el inicio a la formación de la Red, teniendo como aliado estratégico a USAID-OFDA	Se articula con la presencia de los riesgos de desastres, que son una constante en el espacio puneño, peruano, latinoamericano y mundial, conforme se reporta cotidianamente por los medios de comunicación, cuyas manifestaciones más frecuentes son los sismos, huracanes, sequías e inundaciones. A ello se suma, las complejas manifestaciones del Niño y la Niña Esta problemática, se recogió en sucesivos eventos académicos organizados y realizados en la Universidad Nacional Mayor de San Marcos (I Foro), la Universidad Nacional Jorge Basadre Grohmann (II Foro) la Universidad Nacional de Trujillo (III Foro), y el IV Foro internacional Interuniversitario, llevado a cabo en la Universidad Nacional del Altiplano de Puno, “El Alma Mater de los Puneños”

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	Primera universidad	Segunda universidad	Tercera universidad
Durante su gestión ¿Cuáles fueron los compromisos asumidos por la Universidad para la implementación de la GIRD y ACC?	1. Compromiso de continuidad a los espacios de intercambio en acciones de GIRD y ACC 2. Desarrollo mide alianzas estratégicas con universidades nacionales y extranjeras. Así como instituciones de apoyo y asesoramiento técnico 3. La continuación al apoyo a los Foros interuniversitarios con la visión de construir la red de universidades comprometidas en GIRD y ACC 4. Asumir el compromiso de la dirección de la Red, tanto en la Presidencia como en la Secretaría Técnica	1. Compromiso y liderazgo de la UNJBG basado en el trabajo en equipo 2. Incorporación de la GIRD como política institucional 3. Impulso institucional a la red Ries GIRD 4. Desarrollo e impulso a alianzas estratégicas con instituciones universitarias y técnicas nacionales y extranjeras 5. Compromiso a la creación de la Oficina de gestión de riesgo de desastre UNJBG	1. Incorporación del GIRD y ACC en formación académica, investigación y RSU 2. Proponer la incorporación en los currículos de pre y post grado 3. Promover e impulsar la investigación científica y tecnológica 4. promover e incentivar la GIRD y ACC como parte de la RSU 5. Fortalecer la Red peruana de Universidades comprometida con la GIRD Y ACC 6. Compartir la experiencia de la Academia sobre conocimientos ancestrales en la ecorregión andina

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	Primera universidad	Segunda universidad	Tercera universidad
En su experiencia ¿Cuáles fueron los retos en este proceso de desarrollo de la Red de GRD y ACC para la universidad?	1. Establecer los lineamientos generales para la conformación y denominación de la Red 2. Conformar el equipo estatutario de la RiesGIRD-Perú, alineada a la normatividad peruana, la misma que serviría de modelo para el equipo técnico que elaboraría el Estatuto de la Red Latinoamericana 3. Dinamizar la participación de las universidades, mediante reuniones contantes de los equipos técnicos 4. Conformar el equipo estatutario de la RiesGIRD-LAC, El equipo de estudio y análisis para la elaboración de la línea de base de las Universidades de la RiesGIRD, y El equipo de proyectos e innovación de la RiesGIRD	1. Realización del Foro Internacional interuniversitario 2. Convocar a todos los participantes, la gestión de la autoridad fue importante 3. Fue beneficioso contar con el apoyo de USAID y de UNMSM 4. Vinculación con el grupo de interés (Gobierno Regional, locales, INDECI, sector educación), generando diálogo 5. Contar con alianzas estratégicas con distintos sectores dentro de la Universidad	1. El mayor reto fue la creación de la Oficina de Gestión del Riesgo de Desastres y Adaptación al Cambio Climático (OGRIDAC), en la Universidad Nacional del Altiplano de Puno, que nace días después del Foro organizado por la UNAP. Según el organigrama, es una oficina adscrita al rectorado, con las siguientes unidades: Riesgos antrópicos, riesgos biológicos, riesgos geológicos y riesgos climáticos 2. El cambio de gestión y la pandemia limitó su avance

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	Primera universidad	Segunda universidad	Tercera universidad
¿Cuál fue el impacto en su experiencia en este proceso de desarrollo de la Red de GIRD y ACC para la universidad?	"Ha permitido integrar a las universidades del país y de Latinoamérica en una agenda y un compromiso común que se materializa en diversas acciones en el marco de la Gestión del Riesgo de Desastres y la Adaptación al Cambio Climático, concordantes con su el rol de las universidades en cuanto a: • La política y gestión institucional • La formación profesional y continua • La investigación aplicada y la gestión del conocimiento, así como, • La extensión y proyección universitaria con responsabilidad social"	1. "La creación de la red es un impacto" 2. "El posicionamiento de nuestra universidad creo que es el mayor impacto, el posicionamiento a nivel nacional e internacional…posicionamiento muy definido" 3. "El Liderazgo ejercido". "Hemos llegado a una excelente vinculación que perdura hasta hoy con grupos de interés como ser el gobierno municipalidad provincial … INDECI con sector educación entonces era un trabajo de hacer advocacy generar espacios de diálogo conversatorio" 4. "Proceso de ir transversal izando en varias escuelas, les ha permitido ir incorporando en su inclusión curricular, riesgos y desastre" 5. "Las alianzas estratégicas lo que tenemos Y todavía continúa, ¿no? " 6. " Y el apoyo total que tenemos con USAID, yo creo que eso es el mayor impacto, no, el que hemos generado en todo este tiempo"	El que asumiera la UNAP "la realización el IV Foro Internacional Interuniversitario en Gestión Integral del Riesgo de Desastres (GIRD) y Previsión Climática (PC), 2019. Este importante foro contó con el apoyo valioso de USAID-OFDA" Acciones estratégicas: 1. Plan de Gestión de riesgos implementados, en beneficio de la comunidad universitaria 2. Programa de sensibilización oportuna en riesgos de desastres a la comunidad universitaria

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	Primera universidad	Segunda universidad	Tercera universidad
¿Cuál cree que es el resultado de las acciones desarrolladas en el marco de la red GRD y ACC?	El principal resultado es que se ha logrado construir una comunidad académica nacional y regional comprometida con la GIRD y ACC, que se proyecta a institucionalizarse en cada una de las entidades participantes, con la visión ser un actor clave a nivel continental que promueva desde la academia, propuestas generadoras para el desarrollo humano sostenible Esto sin duda, se ha venido construyendo gracias al esfuerzo de las autoridades que se comprometieron con estas acciones y con los equipos de técnicos constituidos desde la secretaría técnica. Existe a la fecha, una mayor visualización en los compromisos con la GIRD y ACC a nivel institucional de las universidades que debemos impulsar y promover para la acción	1. El compromiso y concientización que ha tenido la comunidad Universitaria 2. Se ha logrado una sensibilización a nivel institucional y personal; que genera compromisos, proyectos y espacios con autores sociales de la región 3. La red es un resultado promovido por la educación, son resultados tangibles que pueden medirse con algunos indicadores	En el IV Foro Internacional Interuniversitario en Gestión Integral del Riesgo de Desastres (GIRD) y Previsión Climática (PC), las siguientes actividades: Revisión, actualización y aprobación del acta de consolidación de la RPU/GIRD/PC Incorporación de nuevos miembros a la RPU/GIRD/PC Aprobación y seguimiento al Plan de Acción 2019–2020 de la RPU/GIRD/PC Elección de la universidad de la RPU/GIRD/PC, encargada de la organización y realización del V Foro Internacional Interuniversitario en Gestión Integral del Riesgo de Desastres (GIRD) y Previsión Climática (PC)

3. Interviews with University Operations Managers

	Primera universidad	Segunda universidad
¿Cómo encargado del área cuál fue su participación en la red GRD y ACC?	Ser responsable principal de la Secretaría Técnica de la RiesGIRD, en mi calidad de jefe de la OGGRAC por encargo del señor rector de la UNMSM; el mismo que me permitió articular e integrar a los representantes de las universidades en las actividades y acciones que se coordinaban de manera conjunta y armonizada, así como de los equipos técnicos conformados	Una vez que, la red se empieza a impulsar, la Universidad ya se había establecido e incorporado, se había fortalecido el sistema de gestión y el acondicionamiento al cambio climático. Existía la normatividad, habían las bases, dentro de esta organización Nosotros estamos trabajando en los cuatro grandes rubros que tiene como misión en la universidad; uno los elementos en el cual se empieza a trabajar especialmente en el tema de gestión y el tema académico, vimos que una de las necesidades dos necesidades grandes, sabías el tema de alianzas estratégicas y el tema de relacionarnos con universidades fuera del Perú, esto se impulsó mucho a raíz del segundo foro internacional de gestión de riesgo que realizó la universidad en el cual estuve a cargo de la organización. Fue como una especie de punto de explosión el cual fu bueno., porque ese foro fue el primer foro internacional de universidades, entonces hubo una presencia bastante importante Universidades a nivel nacional e internacional, que desembocaron en un documento

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	Primera universidad	Segunda universidad
En su experiencia, ¿Cuáles fueron las acciones para la implementación de la GRD y ACC en el eje de gestión?	Iniciar los procesos de institucionalización de la GIRD-ACC de las universidades y el reconocimiento e integración de sus actores clave a estas acciones, es decir con quienes se sostiene y se construye los objetivos y lineamientos institucionales en este marco Del mismo modo se compartió los avances de la UNMSM en este eje, como son la incorporación de la GIRD-ACC en la política institucional, así como en el Plan Estratégico Institucional como uno de los objetivos También mencionar la socialización de los planes operativos institucionales en GIRD-ACC con los que la OGGRAC se acciona	1. Fue importante y desarrollar todos los instrumentos internos dentro de la universidad para incorporar y fortalecer este sistema. Se necesitó de las políticas 2. Todos los documentos de la formación de la misma oficina, 3. Documentos las políticas gestión de riesgo 4. Los documentos normativos que deberíamos tener para impulsar fue un trabajo esencial que se desarrolló primeramente desde la desde el área que estoy en la parte operativa 5. Establecer una base normativa esencial para poder seguir trabajando, en este caso los elementos fue el apoyo Interinstitucional especialmente con la universidad de San Marcos que nos dio el apoyo para poder desarrollar todo estos instrumentos creo que ese es el punto de partida y fue el tema importante al inicio 6. Se fue gestionando algunos recursos económicos que también se han conseguido para ir. fortaleciendo y desarrollando todo ese sistema
En su experiencia, ¿Cuáles fueron las acciones para la implementación de la GRD y ACC en el eje de formación e investigación?	1. La socialización de la experiencia desarrollada en investigación en San Marcos 2. Se propuso desarrollar un estudio de línea de base del avance GIRD y ACC dentro de las universidades de las Ries GIRD y ACC 3. Difundir el avance de la investigación en la UNMSM como resultado de la transversalización de la GIRD en el Modelo Educativo San Marcos 4. La inclusión de la asignatura GIRD en Estudios Generales 5. Impulsar la incorporación de la GIRD y ACC como línea de investigación universitaria	– Incorporación de la GIRD en planes curriculares y en la reformulación de sumillas. Producto del desarrollo del Curso de Incorporación de competencias en GIRD en currículos con el apoyo técnico de USAID/OFDA. El desarrollo en investigación formativo y de gestión de conocimiento no ha tenido un desarrollo articulado, siendo el avance más individual. El desarrollo articulado de la investigación es un trabajo pendiente aun

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	Primera universidad	Segunda universidad
¿Cómo se dieron los procesos para la implementación de la GRD y ACC en el eje de responsabilidad social?	1. Conformación de brigadas universitarias 2. Reconocimiento de las organizaciones de voluntariado de las universidades	1. Presencia de la Universidad a nivel local, regional, internacional 2. Organización de un evento Internacional - Chile Perú
¿Cuál cree que es el resultado de las acciones desarrolladas en el marco de la red GRD y ACC?	1. las universidades y sus autoridades se han comprometido a sumar esfuerzos para el desarrollo humano fortaleciendo las capacidades humanas y físicas en temas de GIRD y ACC, en todos los niveles, institucional, regional, nacional, continental y hasta global 2. Inicio de una agenda de acción con objetivos y metas como: Fortalecer la gestión y política institucional, la investigación y gestión del conocimiento y actividades y acciones de extensión universitaria y proyección social; enlazadas de forma transversal y enfocadas a la GIRG y ACC	1. la presencia de la universidad dentro de la red, somos uno de los fundadores e impulsores de este sistema que viene trabajando con otras universidades como la de Tumbes, Puno y otras 2. dentro de la red latinoamericana, nuestra universidad está a cargo de la comisión de eventos internacionales; lo que afirma la importancia del rol de la universidad 3. Esta condición posibilita una oportunidad de desarrollo, en esta nueva etapa de presencialidad que está por iniciar

References

2009 UNISDR Terminología sobre Reducción del Riesgo de Desastres (n.d.)

Abedin MdA, Shaw R (2015) The role of university networks in disaster risk reduction: perspective from coastal Bangladesh. Int J Disaster Risk Reduct 13:381–389. https://doi.org/10.1016/j.ijdrr.2015.08.001

Amaratunga D, Liyanage C, Haigh R (2018) A study into the role of international collaborations in higher education to enhance research capacity for disaster resilience. Procedia Eng 212:1233–1240. https://doi.org/10.1016/J.PROENG.2018.01.159

Baker-Shelley A, Van Zeijl-Rozema A, Martens P (2017) A conceptual synthesis of organisational transformation: how to diagnose, and navigate, pathways for sustainability at universities? J Clean Prod 145:262–276. https://doi.org/10.1016/j.jclepro.2017.01.026

Cavalcanti-Bandos MF, Quispe-Prieto S, Paucar-Caceres A, Burrowes-Cromwel T, Rojas-Jiménez HH (2021) Provision of education for sustainability development and sustainability literacy in business programs in three higher education institutions in Brazil, Colombia and Peru. Int J Sustain High Educ 22(5):1055–1086. https://doi.org/10.1108/IJSHE-07-2020-0247/FULL/XML

Conferencia Interamericana sobre Reducción del Riesgo de los Desastres (2004) Declaración de Manizales

Consejo Superior Universitario Centroamericano (2018) Aprendizajes, buenas prácticas y recomendaciones para incorporación ACC Y GIRD

Crutzen PJ, Stoermer EF (2000) The 'Anthropocene'. In: Robin L, Sörlin S, Warde P (eds) The future of nature: documents of global change. Yale University Press, New Haven, pp 479–490. https://doi.org/10.12987/9780300188479-041

Delgado S (2021) Comunidad Universitaria y Campus Sostenible: La RSU en el Marco de la Agenda 2030. https://doi.org/10.5281/ZENODO.5108894

D.S. N° 038-2021-PCM (2021) Política Nacional de GRD al 2050 PERU. Trans Tech Publications Ltd

Fanda RB (2019) Policy brief policy brief. Pancanaka 1(01):14. https://kebijakankesehatanindonesia.net/images/2019/policy_brief_wujudkan_keadilan_sosial_dalam_jkn.pdf

Fed. Internac. de sociedades de la Cruz Roja (2015) Informe mundial sobre desastres 2015: Agentes locales, clave para la efectividad de la acción humanitaria (Resumen) - World | ReliefWeb. https://reliefweb.int/report/world/informe-mundial-sobre-desastres-2015-agentes-locales-clave-para-la-efectividad-de-la

Filho WL, Wall T, Barbir J, Alverio GN, Dinis MAP, Ramirez J (2022) Relevance of international partnerships in the implementation of the UN sustainable development goals. Nat Commun 13(1). https://doi.org/10.1038/S41467-022-28230-X

Geneva: Swiss Agency for Development and Cooperation (2020) Analysis of international practices in disaster risk management higher education first edition 2020

Kushma J (2021) Recovery from disasters. In: Oxford research encyclopedia of politics. Oxford University Press. https://doi.org/10.1093/acrefore/9780190228637.013.1651

Lara A, Martín S (2016) Educación superior en América Latina y el Caribe para la Gestión y Reducción del Riesgo de Desastres: ¿Estamos preparando a nuestra población? Revista de Estudios y Experiencias En Educación 15:49–63. https://doi.org/10.21703/rexe.20162949633

Lavado-Casimiro W (2020) Estudios Hidrológicos del SENAMHI: Resúmenes Ejecutivos -2020. Lima: Servicio Nacional de Meteorología e Hidrología del Perú. Recuperado de. https://www.senamhi.gob.pe/load/file/01401SENA-90.pd

Ley N°30220 - El peruano (2014) Ley Universitaria - Ley N° 30220

Líneas de Acción del Sector Educación 2012–2015 Centroamericana GRD y ACC (2014)

Marco de Sendai - ONU (2015) Marco de Sendai para la Reducción del Riesgo de Desastres 2015–2030

Pal I, Shaw R, Oda T, Shrestha S, Ghazali M, Ichinose T, Zohir M, Shaari A, Yakob N (2019) Higher education institution network in disaster resilience—a critical game changer in Asia

Palacios Serna LI (2021) Una revisión sistemática: Actitud hacia la investigación en universidades de Latinoamérica. Comunicación: Revista de Investigación En Comunicación y Desarrollo 12(3):195–205. https://doi.org/10.33595/2226-1478.12.3.533

Palomino Leon J de DA (2017) El portafolio, recurso didáctico para mejorar las actitudes hacia la investigación en estudiantes universitarios

Perera S, Adeniyi O, Babatunde SO, Ginige K (2018) Mapping built environment professionals' educational needs to international policy frameworks for disaster risk reduction—community stakeholder perspective. Int J Disaster Resil Built Environ 9(4–5):368–384. https://doi.org/10.1108/IJDRBE-02-2017-0016/FULL/XML

Pflitsch G, Radinger-Peer V (2018) Developing boundary-spanning capacity for regional sustainability transitions—a comparative case study of the Universities of Augsburg (Germany) and Linz (Austria). Sustainability 10(4):918. https://doi.org/10.3390/SU10040918

Quezada RG (2011) La responsabilidad social universitaria como desafío para la gestión estratégica de la Educación Superior: el caso de España. The university social responsibility as a challenge to the strategic management of Higher Education: the case of Spain. 355

Radinger-Peer V, Pflitsch G (2017) The role of higher education institutions in regional transition paths towards sustainability: the case of Linz (Austria). Rev Reg Res 37(2):161–187. https://doi.org/10.1007/S10037-017-0116-9/TABLES/5

REDULAC/RRD (2012) I Foro Latinoamericano de RRD en la Educación Superior

REDULAC/RRD (2016) Estatuto REDULAC/RRD

Ronchi S, Arcidiacono A (2018) Adopting an ecosystem services-based approach for flood resilient strategies: the case of Rocinha Favela (Brazil). Sustainability 11(1):4. https://doi.org/10.3390/su11010004

SDSN (2020) Accelerating education for the SDGs in universities: a guide for universities, colleges, and tertiary and higher education institutions. https://resources.unsdsn.org/accelerating-education-for-the-sdgs-in-universities-a-guide-for-universities-colleges-and-tertiary-and-higher-education-institutions

SDSN Australia/Pacific (2017) Getting started with the SDGs in universities: a guide for universities, higher education institutions, and the academic sector. Australia, New Zealand and Pacific Edition. Sustainable Development Solutions Network—Australia/Pacific, Melbourne. www.acts.asn.au

Shaw R, Mallick F, Takeuchi Y (2011) Chapter 5 Essentials of higher education in disaster risk reduction: prospects and challenges, pp 95–113. https://doi.org/10.1108/S2040-7262(2011)0000007011

Shaw R, Takeuchi Y, Krishnamurthy R, Jacqueline Pereira J, Mallick F (2012) Chapter 4 Universities and community-based disaster risk reduction, pp 55–66. https://doi.org/10.1108/S2040-7262(2012)0000010010

Suazo LE, Torres-Valle A (2021) Percepciones, conocimiento y enseñanza de cambio climático y riesgo de desastres en universidades Percepciones, conocimiento y enseñanza de cambio climático y riesgo de desastres en universidades hondureñas. 14(1):225–236. https://doi.org/10.4067/S0718-50062021000100225

Tolmos CA, Lacambra S, Tsuneki H, Quijandria G, Ludeña C, Grunwaldt A, Fernandez-Baca J (2011) PERÚ: GRD y ACC - Estrategia 2012–2016 del BID en Perú

URSULA (2021) Manual de responsabilidad social universitaria. www.unionursula.org

Vargas VR, Lawthom R, Prowse A, Randles S, Tzoulas K (2019) Sustainable development stakeholder networks for organizational change in higher education institutions: a case study from the UK. J Clean Prod 208:470–478. https://doi.org/10.1016/J.JCLEPRO.2018.10.078

Vargas VR, Paucar-Caceres A, Haley D (2021) The role of higher education stakeholder networks for sustainable development: a systems perspective. World Sustain Ser 123–139. https://doi.org/10.1007/978-3-030-63399-8_9

Collective Leadership Toward Sustainability Innovations: An Organizational Education Professionalization Approach

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1 Introduction

> We will create educational frameworks, materials processes and environments that enable effective learning experiences for responsible leadership (UN Global Compact 2007, Principle 3).

In 2007, the UN Global Compact called on educational institutions, explicitly universities and colleges, to adapt their curricula and teaching methods to the requirements of sustainability-oriented leadership, developing them accordingly (Stoltenberg and Burandt 2014, p. 570). Here, the aspect of responsibility is highlighted: "We will create educational frameworks, materials processes and environments that enable effective learning experiences for responsible leadership" (UN Global Compact 2007, Principle 3). By formulating these claims, the UN responded to the implementation-oriented demands articulated by the education for sustainable development (ESD) movement. Since the alarming analysis of the Club of Rome at the beginning of the 1970s and the Brundtland Report, "Our Common Future" (1987), educational strategies have been regarded as an integral part of sustainable development.

Sustainability research and publications have steadily increased since the 1980s (Turker 2009), and much more of the literature on ESD nowadays is available (Michelsen and Godemann 2007). However, the crucial role of leadership has not been addressed sufficiently. As we will see in the following discussion, leadership debates primarily focus on the private sector, still refer to "heroic" (Baecker 1994) concepts of leadership, and often lack a focus on sustainability (Galpin and Whittington 2012). Morsing and Oswald (2009, p. 83) stated that "the literature on sustainability and corporate social responsibility has not paid much attention so far to how leaders enact a corporate sustainability strategy among organizational members."

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In general, leadership and ESD are rarely brought into a systematic context. Although an increasing number of studies have highlighted the need for qualifying managers for sustainability (e.g. Galpin and Whittington 2012; Kopp 2013; Hind et al. 2009), they have primarily referred to corporate leadership and strategic management in the private sector and intercompany cooperation. The term "sustainability" is often used micro-economically to address a corporation's persistence and market share rather than the ecological dimension of sustainability.

Thus, a consistent ecological framework of regional leadership is missing. Leadership for sustainable development in a networked and regional setting appears to be largely underresearched. This seems surprising since regionally establishing economic cycles is particularly relevant for sustainability objectives. Regional circular economies support local value creation and production, contributing to alternatives to linear-oriented economies (BMEL 2019; Heidelmann and Klös 2022). How can regional cooperative networks be established and supported with regional professionals enabled to initiate regional circuits for sustainable development? From an organizational education perspective, comprehensive educational approaches should refer to the individual regional professional as a leader and to collective leadership, too. Moreover, ESD must address the organizational dimensions and focus on organizational education for sustainable development (Göhlich et al. 2018; Weber and Heidelmann 2019). How can integral organizational education approaches contribute to a curriculum that addresses regional stakeholders as much as students and contributes to collective sustainability leadership, research and regional transformation? Leal Filho et al. (2019) have discussed "Universities as Living Labs for Sustainable Development" and highlighted the important role, universities have to play. Universities as well as their members can take the role of sustainability leadership and by this contribute to the collective transformation towards sustainability (Leal Filho et al. 2020).

Designing academic training programs intends to support this common goal. With a one-year training program, designed and piloted at Philipps-Universität Marburg, Germany, the university intended to take leadership in connecting regional stakeholders for sustainability innovations (Weber and Heidelmann 2019). The program called "Learning to Shape Sustainable Futures" included regional stakeholders and MA-students from different disciplines. Aiming at regional circular economies, a transdisciplinary and transprofessional setting for a one-year design innovation process was created.

The program aimed at developing methodical, social, and self-related abilities based on de Haans' (2008) "designability" approach (*Gestaltungskompetenz*). This paper offers insights into the theoretical and curricular foundations of this academic training program. The "innovation learning" approach supported experience-based, problem-based, real-time learning in a transdisciplinary, transprofessional setting (Weber et al. 2019).

The paper first addresses leadership development and its sustainability-related challenges (Part 1). A collective leadership approach needs to take into account the governance dilemmas, which emerge in the transformation toward regional

networked sustainability innovations (Part 2). We discuss the curriculum for collective leadership for sustainable development and present organizational education theoretical foundations with their didactic and methodological implications (Part 3). Finally, we give an outlook on how the collective leadership approach taken here can be institutionalized in universities, which re-imagine themselves as "living labs" for sustainable development (Leal Filho et al. 2019) (Part 4).

2 Leadership for Sustainable Development

Traditionally, leadership has been addressed in business administration and management studies (Kopp 2013, p. 128), marking a shift from formal positions to role-taking. Over the decades, perspectives and theoretical debates on good and successful leadership have significantly transformed. In the following section, a brief overview over different perspectives on leadership is given and organizational education leadership perspectives focusing on collective leadership are given.

2.1 Leadership

Leadership has long been a core topic of business administration and management studies (Schröer 2018). Traditional trait-theoretical approaches have assumed that the physical and psychological characteristics of a leader are decisive for successful leadership. During 20th-century debates, the emphasis shifted from physical characteristics, such as height and age, to mental characteristics, such as knowledge and resilience. Social abilities and competencies, such as flexibility, creativity, and environmental sensitivity, have become increasingly crucial (Kopp 2013, p. 128). Most approaches have regarded leadership from a psychological perspective as stable over time. In contrast, behavioral approaches have emphasized the learnability of leadership traits (Katz 1955). Contingency and situation-theoretical approaches (Fiedler 1967) have further extended this perspective by focusing on societal conditions, discussed as "situational leadership" (Schröer 2018).

Since the 1970s, leadership has been viewed more as an interaction process. The leader-member exchange theory (Danserau et al. 1975) emphasizes that leadership behavior is individual and specific in each situation (Kopp 2013, p. 129). Apart from functional perspectives on leadership, ethical dimensions have entered the leadership discourse. Theories like the responsible leadership approach (Maak and Pless 2006) discuss these ethical questions and refer to the leader's integrity. From this perspective, leadership must be morally sound to handle heterogeneous and even conflictive norms and values of the stakeholders involved. Social responsibility includes advocating sustainable or social values. At the beginning of the twenty-first century, the concept of sustainability leadership (Ferdig 2007) emerged, demanding to balance

economic, ecological, and social concerns as an essential managerial task (Kopp 2013, p. 129).

Social sciences and organizational education discuss leadership as a social practice, taking place in the daily routines of organizing (Schröer 2018). From a sustainability innovations perspective, leadership no longer refers to "heroic" individuals (Baecker 1994) but to the joint efforts of multiple stakeholders in regional settings (Weber 2018).

2.2 Sustainability

Regarding leadership in the sustainability field, Leal Filho et al. (2020) have marked the role of universities and general higher education to assume an institutional leadership for sustainability. However, the notions of sustainability that are to follow are still in question concerning individual, collective, and institutional leadership. Müller-Christ and Hülsmann (2003) have defined three alternative developmental paths of sustainability, each of which implies specific leadership abilities related to rationality and practice.

The first path addresses sustainability as an *innovation task*, where the economy and ecology are fundamentally compatible, seeking "win–win solutions". This approach, currently pursued by the political strategy of the "green deal" programmatic, sees innovation as crucial for maintaining the agenda of economic growth and resource consumption (Kopp 2013, p. 130).

The second path sees sustainability as a *normative social concept,* where the responsibility for society comes into play. Participatory decision-making is crucial since social stakeholders are at the core, negotiating alternative futures (ibid.).

The third path, *sustainability as rationality*, leaves a growth-based approach behind. Considering the preservation of our natural resources, it aims to secure a sustainable supply of resources. The core is a permanent conversion to regenerative energy sources and renewable raw materials (ibid.).

Leadership requirements in the first path prioritize innovations, participation in the second path, and sustainability in the third path. All three paths commonly must deal with the "multi-dimensionality and complexity of systems, with different time horizons, with ambiguities and contradictory stakeholder interests" (ibid., p. 130).

2.3 Leaders for Sustainable Development

Against this backdrop, professionals must broaden their abilities in sustainability strategies, policies, and practices. Whatever path is followed requires systematically considering the ecological dimensions within economic, social, political, and cultural activities and strategies. While short-term strategies are practiced in many fields, management decisions must be reflected while considering long-term relevance.

The topic of intergenerational justice has become relevant in many professional fields. Moreover, regarding the spatial dimension, management responsibility is increasingly directed toward more global contexts, resource consumption, and supply chains. Since many social groups are formulating demands that must be considered in management decisions, stakeholders are also becoming increasingly important. Sustainable development as a value-based concept must serve as an orientation for responsible and ethical leadership.

Therefore, sustainability-oriented leadership is a core issue for training and collective professionalization. In general, topics such as "dealing with complexity", "integrative approaches", "innovation and creativity", "vision, persuasiveness, and shaping change", "emotional intelligence and self-awareness", and "dealing with uncertainty, ambiguities, and dilemmas" are regarded as core skills for sustainability-conscious and sustainability-promoting leadership. The challenges for higher education and the transformation of universities have been largely discussed by Leal Filho et al. (2020) and Veiga Ávila et al. (2017).

While Leal and colleagues primarily focused on transforming the discourses in higher education and the field of institutional leadership, the approach suggested here also refers to regional stakeholders. From an organizational educational perspective, the concept of "sustainability leadership" proposed by Mary Ferdig represents an interesting approach for institutional leadership in higher education and regional professionals. Leadership in both settings and for both stakeholder groups is not limited to formal roles of organizational decision-making but refers to social responsibility regardless of the formal position held:

> Sustainability leadership tests common assumptions about who counts as a leader and proposes that anyone who takes responsibility for understanding and acting on sustainability challenges qualifies as a "sustainability leader," whether or not they hold formal leadership positions. (Ferdig 2007, p. 25).

Against expert modes of intervention, to create participatory and dialogic spaces is regarded as an essential task of leaders:

> Rather than providing all of the answers, sustainability leaders create opportunities for people to come together and generate their own answers – to explore, learn, and devise a realistic course of action to address sustainability challenges. Instead of giving direction, sustainability leaders develop and implement actions in collaboration with others, modifying them as needed to adapt to unforeseen changes in the environment over time. This approach to leadership does not assume an ability to control activity with any degree of certainty and predictability. Instead, sustainability leaders embrace the inevitability of continually changing dynamics in everyday life, while developing reasonable actions with others within an integrated framework that provides coherent direction, clear accountability, and enough flexibility to allow for mid-course corrections. Sustainability leaders recognize that the experience of change itself, and the dissonance it creates, fuels new thinking, discoveries, and innovations that can revitalize organizations, communities, and ultimately the earth. (Ferdig 2007, p. 32)

In this sense, leadership deals with volatility and ambiguity. It addresses dynamic, paradoxical social systems that are difficult to control or predict. Compared to classical leadership theories, it is not about directional decision-making in specific disciplinary expertise but refers to the ability to shape and its accompanying processes.

This perspective on leadership was affirmed and even extended by Scharmer's "Theory U" (2007) and Scharmer and Kaeufer's (2013) "leading from the emerging future". Leadership abilities here refer to cooperative qualities and knowledgeability, integrating different sources of knowledge, knowing the limits of knowledge, and dealing with non-knowledge to lead so that desired futures emerge. Leadership is not only regarded as a social practice, but as a practice of futuring in any present moment. This becomes relevant especially, when it comes to addressing the complex and challenging transformations needed on the way towards circular economies.

3 Addressing the Challenges of Collective Leadership in Circular Economies

Especially in rural areas, circular economies are new development perspectives, combining ecological, economic, social, and cultural goals. Circular economies are considered regenerative systems that help integrate economic performance, social inclusivity, and ecological resilience in a balanced way (Weber and Heidelmann 2019). While product-based cycles focus on recycling and product lifespan, "simple" value chains focus on exchange relationships between economic and private actors. However, cyclical economic models of shared value creation require the cooperation of many heterogeneous actors and thus mandatory network formation (Asheim and Coenen 2006; Doloreux and Parto 2005).

Against this background, networks are essential for the successful and effective implementation of local governance and collective leadership at the regional level. As a strategic process and instrument for implementing a socio-ecological transformation and sustainable development in regional structures, regional governance is largely dependent on the involvement of relevant actors and thus on systematic stakeholder cooperation (WBGU 2011). Nischwitz et al. (2002, p. 16) identified that the "establishment of communication processes as the constituting element of spatial development processes" (ibid.) must be forced to enable "innovation by its own power" (ibid.) in these structures in the medium term. The "formation and recording of new actor constellations, networks, and cooperations" is, therefore, the basic prerequisite for the "development of new and change of existing institutions and instruments" (ibid., p. 16) in regional structures. However, concerning the problem-solving and governance capacity of networks, specific challenges arise, especially at the regional level, which has so far only been partially addressed in research (Nischwitz et al. 2002; BMEL 2019) and may ultimately result in nothing less than a complete "network failure" (Messner 1994, p. 566). Messner dealt early on with the fundamental problems of network governance that have to be addressed accordingly by sustainable development leaders and especially by collective leadership. The specific dilemmas addressed here highlight the specific needs for professionalization programs for collective leadership in circular economies (Weber 2005; Weber and Heidelmann 2019).

Messner (1994) mentioned the problem of the large number of actors involved in a network. The often heterogeneous participants are in different interdependent relationships, which can enormously delay and complicate communication, coordination, and, ultimately, decision-making processes (Messner 1994, p. 568), precisely because the roles of affected parties and decision-makers largely coincide, and the particular interests of individual network participants often run counter to the overall interests of the network. As Messner emphasized, long-term network cooperation is often unsustainable in a "field of tension of disintegration, danger of adaptation and endless disagreement" (p. 572).

In networks, the network partners are only willing to compromise to a limited extent, so consensus-building is often blocked. From the point of view of organizational education, finding common perspectives is made possible by imagining common visions, methodically initiated and accompanied by trained executives to appropriate consulting interventions. Thus, institutional consolidation can only occur in network alliances, whereby stable cooperative relationships emerge generated by a pattern of mutually accepted organizational identities, competencies, and spheres of interest.

However, Messner (1994) saw a downside to stabilizing cooperation networks and increasing social cohesion processes as a productive resource for functioning networks. These would lie in cognitive constrictions through the strong forcing of unified views accompanied by symbiotic relationships between individual network actors. New development paths, alternatives to the existing, and strategies beyond established options are often no longer sufficiently acknowledged, so thinking and acting in the network often threaten to become path-dependent, structurally conservative, and narrow-minded (ibid., p. 573).

Our organizational-education training program is committed to a discursive understanding of consulting and tries to enable sustainable cooperation and network building by acknowledging and dialogizing as many voices as possible, especially marginalized ones. Messner said that the common rules, conventions, and routine actions emerging in networks and the trust, reciprocity, and ability to anticipate other actors' behaviors could lead to exclusionary logic and closed network structures. From an organizational educational perspective, such tendencies must be addressed by sustainability-oriented managers and novices who need to be trained in organizational education (Heidelmann 2020; Weber and Heidelmann 2021). The coordination problem of the Pareto optimum named by Messer, where according to the logic within the network, no more advantageous changes are conceivable in favor of at least one network participant without another participant having to be placed in a worse position as a consequence (ibid., p. 577), is addressed in organizational educational work through deep-set imagination formation. In the innovation labs used during the consultation process, the participants are encouraged to develop common visions of the future so that consensus-building occurs based on argumentative balancing while deeper needs and desires are "lifted up" through image-based methods. Messner described the control problem as a "negotiation dilemma" (Messner, p. 583), in which the open communication necessary for the overall result of the negotiation within a network, the trusting cooperation and the negotiation style directed toward a common

problem solution are constructive prerequisites. However, this exact behavior in the negotiation process can easily become the victim of exploitation and overreaching, caught up in organizational education. Organizational-education-trained leadership is fundamentally based on the question of the extent to which exclusions are produced in the space of discourse, which brings about not being able to speak. Hence, the question of power and knowledge is highly significant for network training and consulting, especially for collective leadership behavior. In networks, control and thus power resources are distributed among different actors. However, unlike in hierarchical decision-making structures, decisions in networks are often difficult or impossible to enforce against resistance from affected network participants. Messner emphasized that imbalances exist in network structures to the extent that the actors' options for action are larger or smaller (i.e., some actors have more power than others). The complex and ambivalent situation in networks, characterized by power imbalances and mutual dependencies between the actors, with the simultaneous absence of power and domination, led Messner to conclude that power-free communication and domination-free relationships dominate in networks.

On the contrary, network governance produces winners and losers in which the relatively more powerful within networks can prevail over the weaker (ibid., p. 586). Organizational education leaders for sustainable development are trained to "grasp the positivity of acceptability within networks" (ibid., p. 34), to "work out the conditions of acceptability of a system" (ibid.), and finally, by creating transformative spaces for reflection, to make all voices in the room audible. From the perspective of organizational education, only then can ethical standards, such as justice and equality, be adequately carried along in constructing network structures.

The tension between cooperation and conflict emphasized by Messner, which especially manifests itself in network structures, for the future can become another starting point for organizational educational interventions. Instead of striving for complete social cohesion, Messner saw the potential of networks primarily in dealing with conflicts and making productive use of them (ibid., p. 591). Organizational educational network consulting and leadership goes beyond this perspective. The beginning of collective transformational practice goes beyond existing positions (Heidelmann 2020) and thus transgresses conflict. Organizational educational network consulting and leadership for sustainable development tries to ensure this via designing innovation labs as a place of collective boundary crossing (Weber 2020, 2022). Thus, organizational education approaches for collective leadership for sustainability imply present potential as much as future challenges. They address unquestioned normalities, inscribing themselves into the emerging collective leadership structure and cultures—and re-imagine collective leadership toward a sustainable future.

From an organizational education perspective, it is of interest to design a curriculum for sustainability leadership that references the "design-ability" of all stakeholders (de Haan 2008; Weber and Heidelmann 2020) and refers to collective leadership. As we will see in the following section, the approach presented here orients toward problem-solving, acting flexibly in volatile situations, the "ability to cooperate and negotiate," the "personal responsibility and the ability to reflect,"

the "handling of ethical problems," and especially the "ability to participate" and the "ability to deal with differences" (Stoltenberg and Burandt 2014, pp. 575–576). These are some of the essential educational contents of a transdisciplinary curriculum for sustainability leadership. As mentioned above, the ability to design and lead "from the emerging future" (Scharmer and Kaeufer 2013) is also core to our program.

4 "Learning to Shape Sustainable Futures": Theoretical Foundations for a Collective Leadership Curriculum Between the University and Region

Stoltenberg and Burandt (2014, p. 580) argued that educational processes for sustainable development should enable participation. Methods should support experience and reflection in a multi-perspectivity setting. Indeed, sustainability leadership didactics must go beyond traditional approaches since participatory and collaborative forms of problem-oriented learning best occur in real-life learning settings (ibid.). A problem-oriented (ibid., p. 579) and real-life context for learning supports dealing with uncertainty, heterogeneous stakeholders, multi-perspectivity, and the multiple expertises of the whole system. Thus, a trans-disciplinary setting was created between the university and region to support complex and system-oriented communication and cooperation. Our discourse-oriented design research approach interconnects learning, design, and research (Weber and Keller 2022), promoting creativity, alternative, and anticipatory thinking, where innovation labs offer excellent methodologies and learning conditions for professionalizing collective leadership for sustainability. The innovation lab is a methodized space of experiential learning that includes multiple perspectives, interests, and forms of knowledge.

In the following section, the theoretical foundations of the curriculum for collective sustainability leadership are presented. As an interlocking professionalization program, we use a design-oriented approach and interlink academic higher education, the experiential learning of regional stakeholders and professionals, and leadership for sustainability research (Weber et al. 2020). When establishing such transdisciplinary and trans-professional higher education programs, the university itself may become a "living lab" (Leal Filho et al. 2019).

4.1 Collective Leadership: Foundations of Our Innovation Learning Approach

From an organizational education perspective, professionalization for collective leadership in sustainability offers a theory-based and practice-oriented training and innovation setting, interweaving theory and practice (Weber and Heidelmann 2019). Hence, we close the gap between programs lacking theory and programs being too

tool-centered (Königswieser and Hillebrand 2004). Moreover, the program closes the so-called "practice-absence" gap in academic training. It answers the calls for lifeworld-oriented and experiential learning arrangements (Elsholz 2019; Gruber and Rehrl 2005).

Our "innovation learning" approach (Weber et al. 2019) refers to the demands of sustainability leadership discussed in Part 1 and the organizational education perspective on sustainability-oriented education. Innovation learning serves as a conceptual foundation, a basis for the didactic-methodological design, connecting to and, at specific points, distinguishing itself from the (1) societal-normative approach of service-learning, (2) the learning-theoretical approach of problem-based learning, (3) the epochal- and design-oriented rationality of ESD, and (4) the methodology of design-oriented learning (Weber et al. 2019, p. 136). In the following, we will shortly explain the theoretical foundations of the curriculum.

4.2 Organizational Education for Collective Leadership: More than Service-Learning

At first sight, the debates about service-learning appear to match the goals formulated within the program. Service-learning follows the US tradition of experimental learning, described by Lester et al. (2005, p. 278) as "one type of experiential learning that helps students prepare to become contributing members of society." In this sense, students may take responsibility and leadership for societal issues. From a history of ideas perspective, service-learning is often connected to Dewey's pragmatist foundations and his approach to experience-based learning. In this sense, service-learning is about creating the necessary learning spaces in which the individual, integrated into social communities, can reflexively experience the "challenges of thinking and acting, plurality, multiculturalism and all other differences" (Reich 2005, p. 55). From a service-learning perspective, it aims to strengthen students' sense of responsibility and willingness to participate in social problems. Larger studies with students, such as those conducted by Giles and Eyler (1994), demonstrated that it is primarily the experiential nature of service-learning that can lead to deep learning moments and even fundamental changes in attitude: "The majority of the student participants indicated that their preconceptions had been changed by experience and these subsequent perceptions appeared to be much more positive." (Giles and Eyler 1994, p. 334).

Our approach of innovation learning differs from service-learning because "service" is understood as the university serving the community. From an innovation learning perspective, we prefer interlocking knowledge creation between the university and society. Innovation laboratories offer "hybrid-regional-interlocking" (Weber and Heidelmann 2019) learning arrangements. In this approach, the university offers the potential for social innovation, not only service, to society. Nevertheless, this collective leadership approach relates to and works with community topics and problems "for which mostly nonprofit organizations from the region of the respective

university seek practicable solutions" (Slepcevic-Zach and Schlicht 2016, p. 88). By facilitating topic-specific groups in the innovation labs, a professionalization process for regional stakeholders and students is addressed and a closer, more efficient collaboration for circular economies is supported.

4.3 Organizational Education Toward Collective Leadership: More than Problem-Based Learning

Notably, the widely discussed debates on problem-based learning primarily connect to higher education and less to the leadership education of regional stakeholders. Nevertheless, our innovation learning approach is useful for connecting to problem-based learning elements. Zumbach (2006, p. 245) listed four basic goals of problem-based learning:

> The knowledge to be acquired is to be taught in a structured way for use in an application context. Learners should acquire effective, subject-specific problem-solving competence. Knowledge acquisition processes should also include the acquisition of competencies in the area of self-directed learning. Motivation in learning shall be increased.

As previously mentioned, innovation learning refers to the innovation lab learning setting that offers an experiential and direct reference point for multiple theoretical and practice-oriented knowledge sets. As students facilitate and organize various regional innovation labs, while regional professionals connect to the given problems of their institutional and organizational settings, the learning experiences go beyond learning, similar to simulation approaches in the counseling field (Bauer and Weinhardt 2014). This leadership learning approach enables experiential learning that happens in real-time and largely authentic conditions.

4.4 Organizational Education Toward Collective Leadership: More than Reflective Learning

From the early 1980s, the reflective learning approach became prominent through Schön's (1983) work, "The Reflective Practitioner", which addressed learning as coping with problem situations in practice contexts. Schön's approach became influential in higher education (Schön 1987), with practitioners in concrete action situations initially drawing on existing knowledge (knowing-in-action) but then reflecting on the action performed during (reflection-in-action) and after (reflection-on-action) to draw implicit conclusions and improve their practice (Geithner and Krüger 2008, p. 138). Especially in complex, uncertain, and structurally emergent practice situations that regularly occur in innovation labs and sustainability-oriented leadership situations (Weber 2018; Kopp 2013), Schön's approach is needed to deal with

the differences between arising expectations and realities that require higher-level reflection processes (ibid., p. 193).

From an organizational education perspective, innovation labs provide spaces for reflection, imagination, and transition. As transitional spaces, they can even be regarded as "rituals of transformation" (Weber 2005) that support collective transitions and transgressions where students and regional stakeholders design alternative futures and solutions—like in our case in food policy and regional economic circuits.

4.5 Organizational Education Toward Collective Leadership: An Imagination-Based Approach

This applied process refers to the nexus between action and reflection and the imaginary practice applied here. In a one-year longitudinal process (Brake 2018), based on qualitative approaches before and after the innovation labs, regional stakeholders and students underwent image-based interviews, peer interviews, and group discussions. The following graph shows the nexus of action, reflection and imagination applied in our program.

At different points in time (research points T1 to T10, see Fig. 1), the innovation labs became the reference point of imagination and reflection so that the primary object of reflection expanded beyond the past. Our approach applied here focused on re-imagining the emergent future (Scharmer and Kaeufer 2013). A process of imagination and design was used, applying an image-based approach (Weber and Heidelmann 2021) where images were used for their "elicitive" (Harper 2002; i.e., narration-producing) function. Through the images, participants spoke about what was meaningful to them, their experiences, the processing of their limits and hurdles, and their emergent professional self-image (Weber and Heidelmann 2020). The fundamentally polysemous quality of the images (Przyborski 2017, p. 58) enabled regional professionals and students to spontaneously design future potentials by the associative act of choosing images with the verbal articulation of "their" image content.

The image-based approach allowed for relating to the experiences made in the innovation labs, the enacted rationalities of practice (Küllertz 2007), and the challenges of transforming one's world and self-references (Koller 2012).

The innovation learning approach involves the interplay of imagination, reflection, and action (Weber and Heidelmann 2021; Heidelmann 2022). The iterative loop of future-oriented vision and imagination refers to practical action in the innovation

Fig. 1 The organizational education professionalization program. *Source* Heidelmann (2021, 2022)

lab and distancing engagement (with experiences made there; Mörth et al. 2018, p. 30) in the image-based inquiry formats. Theoretical perspectives are immediately connected to real-life experiences with regional stakeholders, interlinking theory and practice for direct reflection. (Self-) reflection was reintegrated into action, what Elsholz (2019, p. 15) called the "scientifically reflected ability to act."

4.6 Organizational Education Toward Collective Leadership: An Organizational Education for Sustainable Development Approach

Innovation learning assumes the claim of ESD in promoting responsibility and participation in the sense of an "education for citizenship" (Singer-Brodowski 2016, p. 46). With its normative foundation of sustainability, the approach aims at a "future-oriented general education," where learners are promoted to become "capable of cognition, sensitive, i.e., capable of empathy, capable of judgment and capable of action for their present and their future" (Klafki 1995, p. 9). This notion of ESD implies strong normative claims regarding leadership training and action. Singer-Brodowski (2016, p. 29) saw ESD as focused on "questions of justice and distribution" toward the goal of a societal transformation, which should succeed, not least by individuals "proactively engag[ing]... in individual and societal processes of change" (ibid., p. 32). In this sense, leadership is already inherent in ESD approaches. Thus, education plays a "decisive role in promoting this leadership concept." From the perspective of educational theory, it is ultimately a matter of "reflecting on one's own attitudes and values as well as discussing the resultant actions" (ibid., p. 46).

Our approach here refers to the various levels of individuals, groups, organizations, and institutions. Our value-based approach is grounded in a power-knowledge critical discourse perspective (Weber and Wieners 2018), which is interested in bringing about new and "game-changing storylines" (Marshak and Grant 2008). Scharmers (2007) approach toward collective co-creation and leadership is especially relevant here. Scharmer and Kaeufer (2013) described this intended learning process as emerging from the emergent future:

> It is a shift from an ego-system awareness that cares about the well-being of oneself to an eco-system awareness that cares about the well-being of all, including oneself. (Scharmer and Kaeufer 2013, p. 2)

Adding to the aspects of responsibility and participation, our approach of innovation learning connects to ESD in its motivation-theoretical aspects. Subject-oriented and learning-theoretical perspectives refer to debates, such as "self-directed learning," emphasizing the motivational and intentional aspects of learning. In contrast to the psychological "reactive model[s] of human learning" (Faulstich 1999, p. 29), Faulstich (1999, p. 27) referred to an "interest-led, active appropriation of the world by the acting persons," whereby the "self-determination" (ibid.) of learners is core. Moreover, the theory of "expansive learning" developed by Holzkamp (1995)

is of interest. Here, the experiences of limits, discrepancies between possibilities for action, and the abilities necessary to cope with problems lead to the intrinsically manifested motivation to learn. Accordingly, Holzkamp (1995, p. 190) saw a basic prerequisite of learning as the "inner-connection between learning to understand the world, expanding one's disposition, and directly experiencing or anticipating an increased quality of life."

Ferdig's sustainability leadership, explained in Sect. 2, sees leaders as taking responsible sustainability leadership due to intrinsic motivation and interest, regardless of their formal roles. Our curriculum ties in with this leadership conceptualization, committed to responsibility for all of society. Thus, sustainable development is understood as a task of organizational educational strategies.

In contrast to an exclusively subject-oriented ESD, we see organizations and network organizing as a core focus (Weber and Heidelmann 2021; Heidelmann and Klös 2022). Therefore, we suggest an "organizational ESD" approach, where learning in, of, and between organizations is systematically addressed.

4.7 Organizational Education Toward Collective Leadership: A Consciousness Design Approach

Our approach of innovation learning references the "ability to shape one's own future" and "the future of others" (Weber et al. 2019, p. 165). Scharmer and Kaeufer (2000) called for higher education to create and think from the emerging future, contrasting with past learning patterns. Consciousness-raising starts with people's inner attitudes, so organizational education is interested in this consciousness practice of "leading from the desired future" (Scharmer and Kaeufer 2013; Scharmer 2007).

Following Scharmer, a future orientation relates to the openness of the future and its need for shaping (Weber 2005, p. 99) while referring to the desideratum of enabling the professionalization of organizational education and collective leadership. This leadership intervenes in existing 'storylines' and discourses (Marshak and Grant 2008; Weber and Wieners 2018). As previously explained, while reflecting on experiences, imagination and vision become central methodologies for organizational-educational professionalization.

Strong narratives of the future may contribute to addressing the challenges of the regional food cycle. Meaningful images can support imagining one's present value and contribution to the future (Scharmer and Kaeufer 2013). Shifting our attentional structures toward listening and speaking with an open mind, heart, and will contribute to collectively shaping the future (Weber et al. 2021, p. 192). For Scharmer (2015, p. 129), the question of "why my thinking could not take in what my eyes and ears had nevertheless seen and heard so clearly" points to a fundamental problem in the human structure of perception. In the often applied mode of unquestioned reasoning, reflection is mostly lacking, and judgements are made based on mental projections of the world. We remain entrenched in our own "old world of thought" (ibid.). "[W]hen

actors begin to see their own assumptions and subsequently perceive connections that they could not see before this opening" (ibid., p. 44), Scharmer sees a self-reflexive learning process taking place. Concerning circular economies, we intend to bring forth "the best of what is possible and thinkable" (Weber et al. 2020, p. 27). We train to think in alternatives and the context of professionalization.

4.8 Organizational Education Toward Collective Leadership: A Discourse Intervention Approach

From a discourse-intervention perspective, we promote alternative, "heterotopian" thinking (Foucault 2005; Adler and Weber 2018; Weber and Heidelmann 2019). Professionalization, in this sense, is understood as future-oriented leadership for sustainable development (Schneidewind and Singer-Brodowski 2013). Our approach of innovation learning leads toward organizing collective leadership networks and future and design ability.

We intend to support bringing forth social realities by transforming the emergent conditions of listening and speaking. Cross-border change processes happen as "deep innovation", which Scharmer saw as the most important goal of higher education and professionalization in collective leadership development (Weber et al. 2021).

Innovation laboratories in our professionalization program are seen as cross-border and networked learning arrangements. These formats, referred to as "experimental spaces" by Schneidewind and Scheck (2013), have been discussed as rituals of transformation (Weber 2005) and boundary objects (Weber 2022; Weber and Heidelmann 2021). The professionalization process enables participants to organize, facilitate, and support such a regionally networked future and innovation labs between the university and region (Weber et al. 2020, p. 23). In making discursive-institutional rationalities of action dialogically accessible (Marshak and Grant 2008), our discourse-intervention approach to professionalization theorizes innovation labs as 'heterotopic spaces' (Foucault 2005; Adler and Weber 2019). Innovation labs offer alternative spaces, which allow to transgress the given singled and bounded rationalities. Against the given normalities of disciplines and sectors, institutions and professions our series of innovation labs are to be understood as "epistemic interventions" (Weber and Heidelmann 2021). Our three layered approach addresses the layers of products and processes, system-development and consciousness-development (Weber and Heidelmann 2021; Weber and Keller 2022). By this, the series of three labs refers to three different rationalities of design (Weber 2019). Design, from this complex understanding, refers to economical, social and educational dimensions—and integrates different epistemes of transformation and change. Like this, the complex challenges of emerging circular economies can be addressed.

5 Collective Leadership: Towards Crossing Epistemic Boundaries

The organizational education approach presented intends to intervene in existing discourses (Weber and Heidelmann 2019; Heidelmann and Klös 2022), enabling a co-productive creation of network structures in which the relevant actors participate (ibid.). From an organizational education perspective, it is about crossing organizational, social and epistemic boundaries (Weber 2018; Weber and Heidelmann 2021; Weber and Keller 2022). The organizational education approach can contribute to collective leadership by increasing organizational networks' complexity, resulting in necessary shifts of governance (Howald 2007, p. 206). Hence, collective leadership should focus on "enabling and accompanying self-organized learning processes of the actors and organizations involved" (ibid.).

The transdisciplinary curriculum between the university and region involves practice- and action-oriented learning and training arrangements on real problems and academic analysis. Leadership needs evolving factual, temporal, and spatial abilities. As well stakeholder management and value orientation are increasingly important factors. The complex challenges in successfully leading collective transformational processes toward circular economies refer to the specific area of collective leadership and network development (Weber 2005). The three-layered approach of sustainability innovation leadership offered the methodologies to further collaborate and move on with a circular regional food cycle.

Regarding educational theory, the curriculum is grounded in experiential and problem-oriented learning for individuals and collective leadership (see Part 3), which is why we consistently train professionals and students in real-life situations, promoting the academicization of collective leadership education, which often lacks theoretical foundations. Interlinking theoretical foundations, practical preparation, and socio-political transformation at the regional level (Weber and Heidelmann 2019; Heidelmann 2021, 2022) supports the trans-professionalization of professionals and students.

The curriculum approach can be integrated into regular training programs of corresponding organizational education and sustainability-related curricula and can also be implemented as a continuing education format (Weber et al. 2020). These implementation varieties combine discourse-oriented content like consulting theories, leadership, and process design with experience-based practice. Learning in real situations is core for learners and their attitudes in the situation of collective leadership practice. While this increases the pressure on the learner, it ultimately leads to transformational turning points that holistic professionalization aims at (Heidelmann 2022). Collective Leadership for sustainable development thus becomes an object of professionalization and an attitude formed from the first moment of training as the basis for one's individual leadership.

Thus, the organizational education approach for collective leadership for sustainability questions unquestioned normalities, inscribing themselves into ourselves as much as into the emerging regional circular economy structures and cultures.

The approach allows to re-imagine ourselves towards collective leadership into sustainable futures and to re-invent our organizations, too (Laloux 2015).

6 Conclusion

Against limited notions of leadership in corporate management, strategic management in the private sector and inter-company cooperation, the largely under-researched field of leadership development for sustainability has been addressed. By highlighting and starting from the typical problems of network management, which will condition and possibly limit collective leadership for circular economies, the article provided an extensive educational theoretical foundation of the organizational education approach to leadership in the specific field of regional development. From a scientific as well as from a transformational point of view, this article has presented a trans-disciplinary and trans-professional approach of leadership development. This approach targets at creating and shaping collective leadership networks for sustainable development at a regional level.

With its systematic embeddedness between university and region, this approach goes beyond traditional silo approaches of disciplinary and professional learning. The intermediary space between university and region contributes to overcoming the duality of academia and professional practice. The intergenerational learning setting of students and regional actors professionalizing together supports the diffusion of design oriented strategies of collective leadership for sustainability innovations.

The existing extensive empirical findings can't be explained here, which is a limitations of the paper. These findings refer to the successful professionalization processes both of students (Heidelmann 2021, 2022) and regional professionals involved (Heidelmann and Klös 2022; Klös 2022/forthcoming). Another limitation is the desiderate to discuss the challenges of institutionalization of such approaches in contexts of higher education. Leal Filho et al. (2019) have shown the potentials—and at the same time have highlighted the challenges of sustainability leadership in higher education institutions (Leal Filho et al. 2020). The organizational education approach suggests to address unquestioned normalities. It suggests to re-invent our organizations. For this, leadership between universities and regional stakeholders not only will be crucial. It needs to be re-imagined as collective leadership toward circular economies.

References

Adler A, Weber SM (2018) Programmatiken und Semantiken als Gegenstand der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 433–442

Asheim B, Coenen L (2006) Contextualising regional innovation systems in a globalising learning economy: on knowledge bases and institutional frameworks. J Technol Transf 31:163–173

Baecker D (1994) Postheroisches Management. Merve, Leipzig

Bauer P, Weinhardt M (2014) Perspektiven sozialpädagogischer Beratung. Beltz Juventa, Weinheim

BMEL - Bundesministerium für Ernährung und Landwirtschaft (2019) Ländliche Regionen verstehen -Fakten und Hintergründe zum Leben und Arbeiten in ländlichen Regionen. https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/LaendlicheRegionen-verstehen.pdf?__blob=publicationFile&v=7. Last accessed 22 Apr 2022

Brake A (2018) Prozessorientierung und Längsschnittdesign als Forschungsstrategie der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 307–319

Danserau F Jr, Graen G, Haga WJ (1975) A vertical dyad linkage approach to leadership within formal organizations. Organ Behav Hum Perform 13:46–78

Doloreux D, Parto S (2005) Regional innovation systems: current discourse and unresolved issues. Technol Soc 27:133–153

Elsholz U (2019) Hochschulbildung zwischen Fachwissenschaft, Praxisbezug und Persönlichkeitsentwicklung. In Jenert T, Reinmann G, Schmohl T (eds) Hochschulbildungsforschung. Theoretische, methodologische und methodische Denkanstöße für die Hochschuldidaktik. Springer, Wiesbaden pp 7–22

de Haan G (2008) Gestaltungskompetenz als Kompetenzkonzept für Bildung für nachhaltige Entwicklung. In: Bormann I, de Haan G (eds) Kompetenzen der Bildung für nachhaltige Entwicklung. Springer, Wiesbaden, pp 23–44

Faulstich P (1999) Einige Grundfragen zur Diskussion um selbstgesteuertes Lernen. In: Dietrich S, Fuchs-Brüninghoff E et al (eds) Selbstgesteuertes Lernen – Auf dem Weg zu einer neuen Lernkultur. DIE, Bad Homburg, pp 24–39

Ferdig MA (2007) Sustainability leadership: co-creating a sustainable future. J Change Manag 7(1):25–35

Fiedler FE (1967) A theory of leadership effectiveness. McGraw-Hill, New York

Foucault M (2005) Die Heterotopien. Suhrkamp, Frankfurt am Main

Galpin T, Whittington JL (2012) Sustainability leadership: from strategy to results. J Bus Strateg 33(4):40–48

Geithner S, Krüger V (2008) Hochleistungsteams: Lernen durch Reflexion. In: Pawlowsky P, Mistele P (eds) Hochleistungsmanagement. Leistungspotenziale in Organisationen gezielt fördern. Gabler, Wiesbaden, pp 133–149

Giles DE, Eyler J (1994) The impact of a college community service laboratory on students' personal, social, and cognitive outcomes. J Adolesc 17(3):327–339

Göhlich M, Novotný P, Revsbæk L, Schröer A, Weber SM, Yi BJ (2018) Research memorandum organizational education. Studia Paedagogica 23(2):205–215 http://www.phil.muni.cz/journals/index.php/studia-paedagogica/article/view/1802/1968. Last accessed 30 June 2022

Gruber H, Rehrl M (2005) Praktikum statt Theorie? Eine Analyse relevanten Wissens zum Aufbau pädagogischer Handlungskompetenz. Journal für LehrerInnenbildung 5(1):8–16

Harper D (2002) Talking about pictures: a case for photo elicitation. Vis Stud 17(1):13–26

Heidelmann MA (2020) Verantwortung (in) der Organisationsberatung – Organisationspädagogisches Proprium im Plural theoretischer Perspektiven. In: Fahrenwald C, Engel N, Schröer A (eds) Organisation und Verantwortung. Springer, Wiesbaden, pp 259–273

Heidelmann MA (2021) Organisationen und Netzwerke beraten lernen. Theoretisierung und Analyse organisationspädagogischer Professionalisierung im Feld der Organisations- und Netzwerkberatung. Dissertationsschrift. Philipps-Universität Marburg

Heidelmann MA (2022) Vom „wilden Fluss“ zum „Sieg“: Organisationspädagogische Professionalisierung als transformatorischer Bildungsprozess. In: Mensching A, Engel N, Fahrenwald C, Hunold M, Weber SM (eds) Organisation zwischen Theorie und Praxis. Springer, Wiesbaden, pp 1–15

Heidelmann MA, Klös T (2022) Optimierung des regionalen Wirtschaftskreislaufs – Die Anerkennung organisationspädagogischen Wissens im Theorie-Praxis-Transfer ländlicher Räume. In: Weber SM, Fahrenwald C, Schröer A (eds) Organisationen optimieren – Optimierung organisieren? Organisationspädagogische Beiträge zum DGfE Kongress ‚Optimierung‘ 2020. Springer, Wiesbaden, pp 1–16

Hind P, Wilson A, Lennsen G (2009) Developing leaders for sustainable business. Corp Gov 9(1):7–20

Holzkamp K (1995) Lernen: Subjektwissenschaftliche Grundlegung. Campus, Franfurt am Main

Howald J (2007) Von der Organisationsberatung zum Lernen in Netzwerken. Arbeit 2(16):205–217

Katz RL (1955) Skills of an effective administrator. Harv Bus Rev 33(1):33–42

Klafki W (1995) „Schlüsselprobleme“ als thematische Dimension einer zu-kunftsbezogenen „Allgemeinbildung“. Zwölf Thesen. In: Münzinger W, Klafki W (eds) Schlüsselprobleme im Unterricht. Thematische Dimensionen einer zukunftsorientierten Allgemeinbildung. Die Deutsche Schule, Zeitschrift für Erziehungswissenschaft, Bildungspolitik und pädagogische Praxis, Beiheft. Beltz Juventa, Weinheim, pp 9–14

Klös T (2022 forthcoming) ‚Ereignishafte Begegnungen‘ im regionalen Wissenskreislauf. Potenzial und Beitrag transdisziplinärer Innovationslabor. In: Mensching A, Engel N, Fahrenwald C, Hunold M, Weber SM (eds) Organisation zwischen Theorie und Praxis. Springer, Wiesbaden

Königswieser R, Hillebrand M (2004) Einführung in die systemische Organisationsberatung. Carl Auer Verlag, Heidelberg

Koller HC (2012) Bildung anders denken: Einführung in die Theorie transformatorischer Bildungsprozesse. Kohlhammer, Stuttgart

Kopp U (2013) Systemische Nachhaltigkeitskompetenzen für Führungskräfte: Erfahrungen mit Aufstellungsarbeit in der Managementaus- und -weiterbildung. Die Unternehmung 67(2):126–151

Küllertz D (2007) Überlegungen zu einer bildungstheoretisch inspirierten Diskursanalyse multimedialer Artikulation. Bildungsforschung 4(2):26

Laloux F (2015) Reinventing Organizations: Ein Leitfaden zur Gestaltung sinnstiftender Formen der Zusammenarbeit. Vahlen, München

Leal Filho W, Salvia AL, Pretorius RW, Brandli LL, Manolas E, Alves F, Azeiteiro U, Rogers J, Shiel C, Paco DA (2019) Universities as living labs for sustainable development. Springer, Wiesbaden

Leal Filho W, Pires Eustachio JHP, Ferreira Caldana AC, Will M, Lange Salvia A, Rampasso IS, Anholon R, Platje J, Kovaleva M (2020) Sustainability leadership in higher education institutions: an overview of challenges. Sustainability 12(9):3761

Lester SW, Tomkovick C, Wells T, Flunker L, Kickul J (2005) Does service-learning add value? Examining the perspectives of multiple stakeholders. Acad Manag Learn Educ 4(3):278–294

Maak T, Pless NM (2006) Responsible leadership in a stakeholder society—a relational perspective. J Bus Ethics 66(1):99–115

Marshak RJ, Grant D (2008) Organizational discourse and new organization development practices. Br J Manag 19:7–19

Messner D (1994) Fallstricke und Grenzen der Netzwerksteuerung. PROKLA. Zeitschrift Für Kritische Sozialwissenschaft 24(97):563–596

Michelsen G, Godemann J (eds) (2007) Handbuch Nachhaltigkeitskommunikation: Grundlagen und Praxis. Oekom, München

Mörth A, Schiller E, Cendon E, Elsholz U, Fritzsche C (2018) Theorie und Praxis verzahnen in Studienangeboten wissenschaftlicher Weiterbildung. Ergebnisse einer fallübergreifenden Studie.

Thematischer Bericht der wissenschaftlichen Begleitung des Bund-Länder Wettbewerbs "Aufstieg durch Bildung: offene Hochschulen", p 61. https://www.pedocs.de/frontdoor.php?source_opus=15711. Accessed 4 Sep 2020
Morsing M, Oswald D (2009) Sustainable leadership: management control systems and organizational culture in Novo Nordisk A/S. Corp Gov Int J Bus Soc 9(1):83–99
Müller-Christ G, Hülsmann M (2003) Quo vadis Umweltmanagement: Entwicklungsperspektiven einer nachhaltigkeitsorientierten Managementlehre. Die Betriebswirtschaft 3(3):257–277
Nischwitz G, Reimar M, Rohne S (2002) Local and Regional Governance für eine nachhaltige Entwicklung. Schriftenreihe des IÖW - Institut für ökologische Wirtschaftsforschung 161(2)
Przyborski A (2017) Bildkommunikation: Qualitative Bild- und Medienforschung. De Gruyter, Berlin
Reich K (2005) Demokratie und Erziehung nach John Dewey aus praktisch-philosophischer und pädagogischer Sicht. In: Burckhart H, Sikora J (eds) Praktische Philosophie. Philosophische Praxis. Wissenschaftliche Buchgesellschaft, Darmstadt, pp 51–64
Scharmer CO (2007) Theory U. Leading from the future as it emerges: the social technology of presencing. Society for Organizational Learning
Scharmer CO (2015) Theorie U. Von der Zukunft her führen: Presencing als soziale Technik. Carl-Auer, Heidelberg
Scharmer CO, Kaeufer K (2000) Universities as the birthplace for the entrepreneurial human being. MIT Sloan School of Management
Scharmer CO, Kaeufer K (2013) Leading from the emerging future. From ego-to eco-system economies. Berrett-Koehler Publisher, Oakland, California
Schneidewind U, Scheck H (2013) Die Stadt als „Reallabor" für Systeminnovationen. In: Rückert-John J (eds) Soziale Innovation und Nachhaltigkeit. Innovation und Gesellschaft. Perspektiven sozialen Wandels. Springer, Wiesbaden, pp 229–248
Schneidewind U, Singer-Brodowski M (2013) Transformative Wissenschaft: Klimawandel im deutschen Wissenschafts- und Hochschulsystem. Metropolis, Marburg
Schön DA (1983) The reflective practitioner. How professionals think in action. Basic Books, New York
Schön DA (1987) Educating the reflective practitioner. Toward a new design for teaching and learning in the professions, 1st edn. Jossey-Bass, San Francisco, California
Schröer A (2018) Führung als Gegenstand der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 479–490
Singer-Brodowski M (2016) Studierende als GestalterInnen einer Hochschulbildung für nachhaltige Entwicklung. Berliner Wissenschaftsverlag, Berlin
Slepcevic-Zach P, Schlicht J (2016) Research-Based Learning und Service Learning als Varianten problembasierten Lernens. Zeitschrift Für Hochschulentwicklung 11(3):85–105
Stoltenberg U, Burandt S (2014) Bildung für eine nachhaltige Entwicklung. In: Heinrichs H, Michelsen G (eds) Nachhaltigkeitswissenschaften. Springer, Wiesbaden, pp 567–594
Turker D (2009) Measuring corporate social responsibility: a scale development study. J Bus Ethics 85:411–427
United Nations (UN) Global Compact (2007) Principle tree: labour. https://www.unglobalcompact.org/what-is-gc/mission/principles/principle-3. Last accessed 30 June 2022
United Nations (UN) (1987) Report of the world commission on environment and development. Our common future. https://www.netzwerk-n.org/wp-content/uploads/2017/04/0_Brundtland_Report-1987-Our_Common_Future.pdf. Last accessed 30 June 2022
Veiga Ávila L, Leal Filho W, Brandli L, Macgregor CJ, Molthan-Hill P, Özuyar PG, Moreira RM (2017) Barriers to innovation and sustainability at universities around the world. J Clean Prod 164:1268–1278
Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (2011) Welt im Wandel: Gesellschaftsvertrag für eine Große Transformation. https://www.wbgu.de/de/publikationen/publikation/welt-im-wandel-gesellschaftsvertrag-fuer-eine-grosse-transformation. Last accessed 30 June 2022

Weber SM (2005) Rituale der Transformation: Großgruppenverfahren als Pädagogisches Wissen am Markt. VS Verlag, Wiesbaden
Weber SM (2018) Innovationsmanagement als Gegenstand der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 517–527
Weber SM (2019) Change by design. In: Peters M, Weber SM (eds) Organization and newness: discourses and ecologies of innovation in the creative university. Brill Sense, Leiden, pp 233–247
Weber SM (2020) Genese, Institutionalisierung und Proprium organisationspädagogischen Wissens: Zur Konstitution und Etablierung einer Diskursfigur im pädagogischen Feld. In: Fahrenwald C, Engel N, Schröer A (eds) Organisation und Verantwortung. Springer, Wiesbaden, pp 355–370
Weber SM (2022 forthcoming) In Blickordnungen Intervenieren? In: Engel N, Schröder C, Peters L, Rosenow-Gerhard J, Rundel S, Schreiner T (eds) Aktuelle Herausforderungen der Organisationspädagogik. Springer, Wiesbaden
Weber SM, Heidelmann MA (2019) Towards regional circular economies. 'Greening the university canteen' by sustainability innovation labs. In: Leal Filho W, Bardi U (eds) Sustainability in university campuses. Springer, Wiesbaden, pp 415–436
Weber SM, Heidelmann MA (2020) Lernziele bestimmen? Kompetenzen erfassen? Prozesse imaginieren? Zur „Messung" individueller und kollektiver Transformation im Kontext Organisationspädagogischer Professionalisierung. In: Dörner O, Iller C, Schüßler I, von Heide F, Lerch S (eds) Erwachsenenbildung und Lernen in Zeiten von Globalisierung, Transformation und Entgrenzung. Barbara Budrich, Opladen, Leverkusen, pp 251–262
Weber SM, Heidelmann MA (2021) Im Dispositiv ‚Diskursiver Gestaltung': „Grenzüberschreitung" als Telos organisationspädagogischer Professionalisierung im Feld der Organisations- und Netzwerkberatung. In: Schröer A, Köngeter S, Manhart S, Schröder C, Wendt T (eds) Organisation über Grenzen. Springer, Wiesbaden, pp 77–91
Weber SM, Keller A (2022 forthcoming) Doing Knowledge: Ein organisationspädagogischer Ansatz transepistemischer Design-Forschung und Diskursgestaltung. In: Mensching A, Engel N, Fahrenwald C, Hunold M, Weber SM (eds) Organisation zwischen Theorie und Praxis. Springer, Wiesbaden
Weber SM, Wieners S (2018) Diskurstheoretische Grundlagen der Organisationspädagogik. In: Göhlich M, Weber SM, Schröer A (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 635–647
Weber SM, Heidelmann MA, Adler A (2019) Mit der Engagementwerkstatt Studierende und Freiwilligenorganisationen vereinen: Organisationspädagogische Professionalisierung in der Organisations- und Netzwerkberatung. In: Möller C, Rundnagel H (eds) Freiwilliges Engagement von Studierenden – Analysen, Konzepte, Perspektiven. Springer, Wiesbaden, pp 131–152
Weber SM, Heidelmann MA, Klös T (2020) Zukunfts-Wissen im Diskurs: WWB-Didaktik für organisationspädagogische Professionalisierung. Zeitschrift Für Hochschulentwicklung 14(4):18–36
Weber SM, Heidelmann MA, Klös T (2021) Hochschule als digitale Heterotopie: (Organisations-) Bildung für nachhaltige Entwicklung. In: Leal Filho W (ed) Digitalisierung und Nachhaltigkeit. Springer Spektrum, Heidelberg, pp 187–213
Zumbach J (2006) Problembasiertes Lernen: Überlegungen und Ansatz für eine lernerzentrierte Didaktik. In: Krampen G, Zayer H (eds) Didaktik und Evaluation in der Psychologie. Hogrefe, Göttingen, pp 245–260

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Rainwater Management in a Context of Sustainable Cities: Six Possible Roles of the University in Building Water Sensitive Communities

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1 Introduction

Climate change in the twenty-first century is accelerating the problems of cities, such as heat waves, local floods or water shortages in the urban landscape. These problems are associated with a relatively high proportion of artificial and impermeable areas and a centralized system of technically designed water management infrastructure. Therefore, changes in rainwater management (RWM) and the development of blue-green infrastructure are the adaptive responses of cities to climate change. These approaches help to increase the proportion of functional greenery and elements supporting the natural circulation of water in the urban landscape. This trend of current development can be evidenced by a number of systemically implemented water treatment concepts in cities worldwide (Howe and Mitchell 2012; Woods-Ballard et al. 2015; Hoang et al. 2018; Urich et al. 2017).

Conceptual changes in rainwater management are a big challenge for the education system, as it is necessary to change the understanding of the role of water in society. In higher education, there is also a challenge to create new programs that will prepare professionals for new water management systems so as to ensure a sustainable future for the urban landscape.

An important prerequisite for sustainable urban development is the question of a responsible and adequate response of society to climate change (United Nations 2015). Changes in attitudes towards greater involvement in tackling climate change have recently been recorded to varying degrees in different cultures around the world (Dean et al. 2016; Fig. 1). For example, according to the results of a representative

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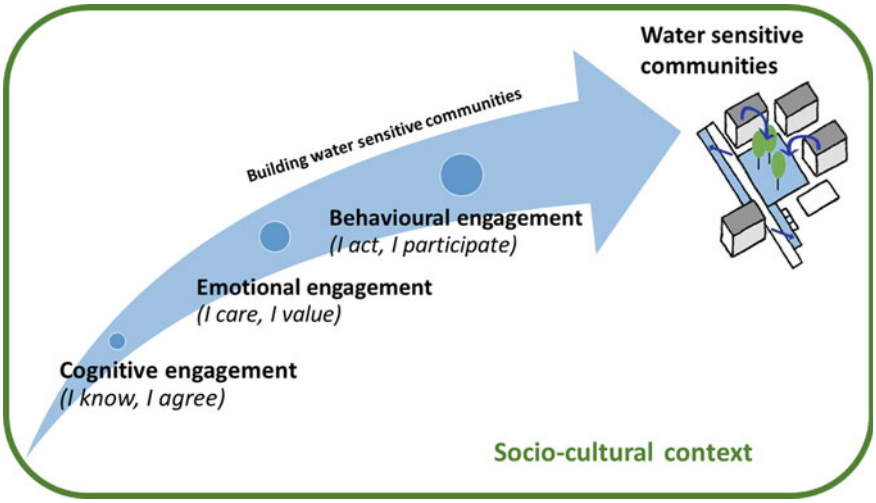

Fig. 1 Scheme of community involvement in the adaptation process to support water sensitive cities and regions. *Source* Own elaboration, based on Dean et al. (2016)

public opinion survey in the Czech Republic (Krajhanzl et al. 2021), a significant majority of people associate climate change with specific manifestations, such as drought, heat waves, torrential rains or floods. Subsequently, in response to these risks, there is support for adaptation measures in cities, but rather in a passive level of agreement with city administration measures in the Czech Republic. A large part of Czech society does not feel like to be actively involved, because it believes that climate change will harm future generations in particular, yet mostly not current generation (Krajhanzl et al. 2021). Therefore, young people who are personally affected by future developments are more active in responding to the current challenges of climate change. Young people—pupils and students—are also more open to new ways of thinking.

Multidisciplinary support for new sustainable urban development measures in rainwater management is not only about normative and economic instruments, but it also applies to ethical tools aimed at changing thinking (Kopp et al. 2021a). Universities should be at the forefront supporting a change of public opinion in a society (Leal Filho 2011). Their role is to support the growth of new leaders in the field of RWM. However, this support is not just about changing curricula. It is the field of RWM that is an example of how universities can apply a multidimensional impact on society to steer it towards a sustainable future.

The goal of this text is to assess the possible application of universities in introducing new approaches to rainwater management in cities and to define the basic roles that universities have in this regard. The partial objective is then to show through the example of UWB (Czech Republic) how these roles can be fulfilled. The case study evaluates the current situation and suggests ways to strengthen the role of UWB in building a water sensitive community.

2 Water Sensitive Cities and Communities

The water management importance of implementing blue-green infrastructure of the cities can be summarized in three objectives: (a) retain and use rainwater effectively where it falls; (b) to limit the accelerated surface runoff into the unified sewerage system and its overflows into watercourses and (c) to support evaporation from water bodies, wetlands and greenery, and thus reduce the impact of city's heat island. The implementation of rainwater management (RWM) and blue-green infrastructure (BGI) develops cities towards strengthening their sustainability. In this context, following SDGs are especially supported: 6 Clean Water and Sanitation, 9 Industry, Innovation and Infrastructure, 11 Sustainable Cities and Communities, 13 Climate Action and 15 Life on Land (Kopp et al. 2021a). It is clear that the needs of new RWM varies according to the environmental, economic and social conditions of specific cities.

Consequently, there is a need for a broad impact of new technologies on a number of fields of education for a sustainable future. One of the important requirements for education for sustainability is the ability to combine knowledge from different disciplines (Leal Filho 2011). This requirement is crucial for universities, because in the past their domain was mainly detailed specialization in sub-disciplines (Zalewski 2015). Universities today, on the other hand, must prepare multidisciplinary future leaders for sustainable society.

Conceptual approaches to strategic urban planning in terms of water management are implemented at the most sophisticated level in economically and technologically developed countries (Morison and Brown 2011; Wong 2013; WEF 2014). In current international practice, a number of conceptual approaches to water management in cities can be identified. Although these approaches, such as Sustainable Urban Drainage Systems (Hoang and Fenner 2016). Water sensitive urban design (Woods-Ballard et al. 2015), Best management practices, Clean Water, Low Impact Development or Naturnahe Regenwasserbewirtschaftung, differ in the details of their focus, climatic and technical conditions of particular countries or in part with different tools for their own management, they basically head in the same direction (Fletcher et al. 2015).

The Water Sensitive Urban Design (WSUD) concept, defined and developed by the Australian National Water Initiative as "water management of the city, sensitive to natural water circulation and ecological cycles, which integrates urban planning with management, security and protection of water circulation in the city", is quite progressive in implementing systemic water management measures in cities.

The water management of cities is often determined by social needs, which are transforming due to economic, technological and especially social progress. The basic needs of cities in the field of water management (water supply, wastewater treatment) are gradually being met, flood protection is ensured, and the environment is improving (quality of water corridors, water quality). The current visions promote the tools of adaptation to climate change, efficient use of rainwater and strengthening of the amenity functions of water in the city (recreational, social,

aesthetic, cultural) in the mutual synergy of the ideal water sensitive city. Fulfilling these visions is not possible without the participation of society (water sensitive communities), consisting of cooperation between city government, residents and the corporate sector (Novotny et al. 2010; Morison and Brown 2011; Ferguson et al. 2013).

3 The Role of Universities in the Development of Sustainable Cities

The university's key missions summarize the Quadruple Helix model into four interconnected pillars: education, research, talent development and knowledge transfer (Pinheiro and Stensaker 2014). In terms of the contribution of universities to the fulfillment of SDGs, in addition to traditional education and research, emphasis is placed on (1) the inward application of sustainable principles in university governance (internal action) and (2) the outward role in sustainable regional development (external action) (Kestin et al. 2017). External leadership gives universities a key role in moderating cooperation between the private sector, government and society (Yun and Liu 2019).

Building cooperation between universities and the region comes gradually and is related to their historical position in the region's identity (Webber 2012). However, the role of universities cannot be generalized without distinguishing the type of universities focusing on research, education, business development, etc. (Gunasekara 2006). The cooperation of universities with the local community is significantly determined by their position in the regional system, which differs in location and involvement in the core areas of agglomerations, in technology centers, in rural or peripheral regions (Withycombe Keeler et al. 2018; Gunasekara 2006). Quality university support can play a key role in the environmental transformation or economic restructuring of regions, as it helps to remove mental barriers, increase human capital capacity and provide innovative incentives (Withycombe Keeler et al. 2019).

In order for universities to play a key role in the transformation of regions, they must not only strengthen the economic and technological contribution to regional development (Pinheiro and Stensaker 2014), but also fulfill a social and cultural role leading to social and political change at the regional level (Trippl et al. 2015). Key characteristics of university roles in regional human capital formation are associated with increasing the knowledge level of the population in the lifelong learning process, with the creation of incentives and environment for the creation of new companies, and also in the development of regionally-focused learning processes (Gunasekara 2004). The development role of the university in the field of associative governance is focused on (a) strengthening regional networking, (b) analysis to support decision-making and (c) making links between national and international contacts and key regional actors (Gunasekara 2006). In addition to the integration of education and

knowledge, cross-institutional mobility by organizations and people is important towards the formation of human capital (Gunasekara 2006).

4 Methodology

The elaboration of the study can be divided into a general part and an empirical case study. The general definition of the roles of universities in building water sensitive communities is based on the identification of the intersection between (a) roles of universities in a sustainable development of the cities and regions and (b) requirements for water sensitive cities (WSC) as cities of future. Based on the previous analysis, we chose the definition of the roles of universities in the basic variant (Kestin et al. 2017).

The methodology uses a scheme of urban development in terms of water management and water care in the urban landscape expressed as City State Continuum (Wong and Brown 2009; Howe and Mitchell 2012; Ferguson et al. 2013; Wong et al. 2020). Based on these methodological approaches, definitions of sub-objectives for the development of Water sensitive cities (WSC) were used. The achievement of WSC goals can then be assessed according to the system of indicators for individual cities and expressed as a Water sensitive cities index, which allows you to determine the degree of development of the city according to the City State Continuum model (Urich et al. 2017; Rogers et al. 2020). The WSC evaluation methodology is applicable to cities around the world, at various stages of development, but has primarily been tested in cities in Australia and Southeast Asia (Urich et al. 2017; Rogers et al. 2020). In our study, a qualitative assessment of possible intersections between the roles of universities and the goals of the WSC was made. We used a contingency table evaluating the potential of the four basic roles of universities in fulfilling the SDGs (Kestin et al. 2017) in the context of individual WSC goals (Rogers et al. 2020). Based on significant intersections, six key roles of universities in the process of supporting the goals of the WSC were defined.

At the empirical level, we verified the identified roles of the university in the case study. The defined roles were applied in a case study of the University of West Bohemia (Czechia). As the state of involvement of the University of West Bohemia is influenced by the national as well as local levels of society, the level of the current rainwater management of the city of Pilsen was first evaluated. The City State Continuum scheme was methodically used for this (Wong and Brown 2009).

Then, the degree of fulfillment of these potential roles of the university was assessed and shown on examples. For this, the available methodologies for assessing the sustainability of universities (Ribeiro et al. 2017; Herzner and Hommerová 2022), our own expert assessment based on foreign experience were used. Besides that, discussions with the university management, experts in relevant fields, the project department and technical staff, were also conducted. The authors' experience in teaching and supervising students' research in the field of RWM also contributed to the assessment.

5 Results

5.1 Six Key Roles of Universities in Building Water Sensitive Communities

Based on an assessment of the potential contributions of universities to meeting the goals of the WSC, we can identify possible roles of the university in building water sensitive communities. As Table 1 shows, universities can engage in multi-level WSC development. Of course, some involvement options are more important than others. As a result, we can identify six key roles of the universities in building water sensitive cities and communities.

(1) Professional education and training

In response to the demand for new specialists, universities are strengthening education in the fields, such as rainwater management, ecohydrology, green urbanism,

Table 1 Contributions of universities to WSC development

	Contributions of universities to the SDGs			
WSC goals	Education	Research	Operations & governance	External leadership
Ensure good water sensitive governance				(2) Urban planning support
Increase community capital	(1) Professional education and training (5) Education and awareness raising			(3) Expert activity
Achieve equality of essential services				
Improve productivity and resource efficiency		(4) Research and innovation		
Improve ecological health		(4) Research and innovation		
Ensure quality urban scpace			(6) Blue-green campus development	
Promote adaptive infrastructure		(4) Research and innovation		

Note major role, minor role

Source the authors

sustainable urban planning (Kopp et al. 2021a). These are not only new specialized educational programs, but also the supplementation, transformation or interdisciplinary integration of existing educational programs. For example, students of economics are developing skills in applying economic instruments in the field of the environment, or students of pedagogical disciplines should be able as teachers to support new approaches to urban development in future generations of children.

(2) Urban planning support

Universities, as partners in municipal or regional government, can contribute to the development of water sensitive governance. New planning documents, that are being created, such as urban concepts or rainwater management standards, torrential rain management strategies, blue-green infrastructure plans, require the application of new methodological and process procedures. Universities can find their role in this regard especially in the field of innovative approaches to geodata processing, spatial planning, risk analysis or participatory (mental) mapping.

(3) Expert activity

New findings from the development of innovation and the professional capacity of universities create an opportunity to increase community capital as one of the goals of the WSC. Not only municipal and regional administrations are involved in building water sensitive communities, but also other stakeholders, such as development agencies, NGOs or representatives of the private sector (Morison and Brown 2011). In this regard, the role of universities as an expert organization is important, which offers motivated people interested in the development of WSC the possibility of professional support in the form of assessments, analyzes, training and consulting. At the same time, the academic sphere is perceived not only as an actor in tertiary education, research and development, but also as a credible guarantor of professional quality for the local community.

(4) Research and innovation

University research centers are becoming a place for the development, design and testing of new technologies in the field of rainwater management. The ability to form teams integrating technical and scientific experts (Zalewski 2015) is important in this regard, as the new measures for the development of the WSC are hybrid in nature, using nature-friendly practices linked to the technical nature of urban infrastructure (Depietri and McPhearson 2017). And again, the need for innovation in the pedagogical, economic or social sciences can be recalled, because the path to the WSC is not just a matter of technological transformation, but above all a matter of changing societal attitudes. When transferring knowledge and technology from the university environment into practice, we must seek a balance between our own economic benefits from research and the support of the local community in terms of free cooperation within the third role of the university.

(5) Education and awareness raising

Enhancing community capital is crucial across the generations (Dean et al. 2016). Universities can in particular use their expertise in developing awareness and lifelong learning. At the same time, it is not only a question of applying professional knowledge and innovative approaches in the field of water sensitive cities, but also of innovation in the field of education. Special programs for school education, eco-education programs, promotion of new study programmes at universities, education of seniors or green marketing are opportunities for innovations in pedagogy, environmental education or marketing.

(6) Blue-green campus development

An important part of building sustainable cities is the development of university campuses as hotspots for the development of the city's blue-green infrastructure (Gulwadi and Scholl 2017; Ribeiro et al. 2017). Projects such as Green Campus or Smart Campus should naturally also include sustainable and technically sophisticated rainwater management solutions. This is essential not only for the experimental development and testing of new solutions, but also as an example of best practice for the urban community and especially for the university's own students across all fields of education.

5.2 Case Study UWB (Czechia)

The University of West Bohemia (UWB) is located in the city of Pilsen, which is the capital of the Plzensky kraj, the region in the western part of the Czech Republic. It was founded in 1991, so it has been educating at 9 different faculties both Czech and foreign students for more than three decades.

The mission of UWB is "to ensure high-quality comprehensive education, including doctoral studies for Czech as well as international students, based on objective knowledge and scientific and creative activity at a high level; to be an independent platform for a society-wide discussion and also a driver of the education potential in West Bohemia, transcending not only geographical borders, but also those of various fields of knowledge and ingrained concepts" (UWB 2022). According to Herzner and Hommerová (2022) UWB in general, however, does not have "sustainability" incorporated into their missions due to the lack of awareness and understanding of this term.

The role of UWB in the development of the WSC is closely related to the development of the city of Pilsen and to the level of RWM area in the Czech Republic (Stránský and Kabelková 2015; Kopp and Ježek 2018; Lehnert et al. 2021b). The Pilsen city has a population size of 170,000 inhabitants and a dominant position in the settlement system of the western part of the Czech Republic. We can show the schematically outlined development of water care in the city of Pilsen according to the "City State Continuum" (Wong 2013; Rogers et al. 2020; Wong et al. 2020). The

history of the development of water management in the city of Pilsen so far includes four phases of the WSC development (Kopp et al. 2017). Currently, the city of Pilsen is in the fifth phase, when in the planning and first implementations it supports the circulation of water in the urban landscape as a prerequisite for further development of cities towards the WSC (Fig. 2).

Fig. 2 Developmental stages of ecohydrological management of the city of Pilsen in relation to the development concept of Water sensitive cities. *Source* Adapted according to Kopp et al. (2017), general development concept WSC adapted from Wong and Brown (2009). *Note* For each phase, the time classification of the development of Pilsen is given, as well as general social needs (left column) and requirements solution tools (right column)

From the point of view of the current ecohydrological management of the city, the emphasis in the current phase is on the planning mechanisms of the city, with an effort to involve local actors, including the public, in planning and supporting water management (Morison and Brown 2011; Wong and Brown 2009). In the years 2008–2011, for example, Pilsen participated in the international project REURIS (Revitalization of Urban River Spaces), the aim of which was to restore the embankments of the Pilsen rivers to function as ecological corridors and human-friendly areas. Several sub-projects have been created combining nature-friendly elements with a flood control function and the recreational use of river corridors in a network of so-called greenways. Efforts to integrate water elements of the urban landscape into public space (e.g. revitalization and community events on the embankments) were also supported by the Pilsen—European Capital of Culture 2015 project. In addition to the development according to planning documents such as the Rainwater Management Concept (UPDICP 2020), the regulation of institutional relations in the area of RWM is also currently important (Lorencová et al. 2021). In Pilsen today we can find the first examples of successful projects for the implementation of blue-green infrastructure, which serve as examples of good practice in other cities in the Czech Republic and Europe (Macháč and Louda 2019; EURE 2022).

So far, UWB has partially used the potential of possible support for the development of the city of Pilsen as a water sensitive community (Table 2). Environmental education and awareness across the generations works best. The issue of RWM in the context of the city's adaptation to climate change is included in regular presentations and discussions with the public within the Science and Technology Days, training of teachers, summer children's camps organized by the university or topics of the university of the third age. Experts from UWB have been involved in urban marketing through blue-green practice videos. These videos were very well received at the European level in the exchange of good practice within the Interreg EURE project "Effectiveness of Environmental Urban Policies to Improve Resource Efficiency" (EURE 2022). There is also active cooperation on NGO's eco-pedagogy projects, including involvement in bilateral projects with Bavarian partners aimed at sharing experiences in environmental education. (Endowment Fund "Zelený poklad" 2022).

In part, UWB uses the potential to support RWM planning as a municipal partner. Experts from the university prepared ecohydrological maps of the city in relation to local climate zones (Kopp et al. 2021b) an overview of the potential of rainwater ponds (Kopp and Preis 2019), a search of the development of ponds in the city (Frajer et al. 2021), or mental maps of thermal stress in the city (Lehnert et al. 2021a). These studies, together with the participation of experts in the city's advisory commissions, have contributed, for example, to the creation of planning documents such as the Concept of Drainage Conditions of the City of Pilsen. The concept has become a planning document promoting an integrated and territorially comprehensive solution for rainwater management in the city.

UWB is involved in scientific teams dealing with topics of applied research in the field of RWM at the national level. An example is the ongoing project "Interdisciplinary approaches to efficient rainwater management on development sites of

Table 2 Fulfilling UWB roles in the process of building a water sensitive community

University role	Community partners	Practical examples	Potential utilization level
(1) Professional education and training	Generation of students	New specialization: modern buildings, environmental design for architecture, strategic planning of cities and regions, building information modeling	1
(2) Urban planning support	Pilsen city hall, urban planning and development institute	Ecohydrological maps of the city, mental maps of thermal stress	2
(3) Expert activity	Municipal organizations, NGOs	Study for the revitalization of the city core, grant commission Zelený poklad, involvement in the EURE project	2
(4) Research and innovation	Public administration, corporate sector	Development of an application for RWM design, analysis of precipitation-runoff processes	2
(5) Education and awareness raising	All generations	Science and technology days, university of the third age, video presentation of the city's blue-green infrastructure	3
(6) Blue-green campus development	City administration, public, students	General plan of the campus development with blue-green infrastructure, Smart campus	1

Note Potential utilization level: 1—basic; 2—medium; 3—high
Source The authors

urban areas in the economic, social and environmental context". The project focuses on creating support for promoting effective rainwater management in development areas of towns and municipalities through a multidisciplinary approach. A software application and a handbook to optimize the selection or assessment of appropriate measures on individual functional types of development areas should be the most important outputs (Technology Agency of the Czech Republic 2021). The results will combine research and practice knowledge in the fields of spatial planning, economics, urban planning, hydrology, landscape engineering, water supply and sewerage. A

partial goal is to prepare specialized maps as model variant solutions for five pilot sites of different types of development areas. The pilot studies will serve the specific needs of the practice of towns and municipalities (Technology Agency of the Czech Republic 2021).

6 Discussion and Implications

UWB has so far made limited use of the potential of RWM's involvement in specialized education programs, which is related to the absence of fields focused on environmental sciences and water management in the faculties' portfolio. Nevertheless, the issue of RWM is one of the progressive topics applied in some new specializations (Modern Buildings, Environmental Design for Architecture, Strategic Planning of Cities and Regions, Building Information Modeling). The university campus is not yet an excellent example of RWM practice. Rainwater from building roofs is retained in underground tanks, but only temporarily to reduce the load on the sewer system (Kopp and Preis 2019). The campus therefore does not meet the criteria for sustainable water management (Ribeiro et al. 2017). The university management is aware of this shortcoming and is promoting the priority of blue-green infrastructure development in the new general campus development plan. Currently, in 2022, the tender documentation for the change of the concept of rainwater management from existing buildings has been prepared and a proposal for a modern RWM for the newly planned construction has been submitted. An important support for the systematic solution of RWM within the campus is the monitoring of precipitation and runoff established within the Smart Campus project (Kopp and Preis 2019), as well as the effort for participatory procedures in campus planning. The development of the university in this important direction shows the need for cooperation across university workplaces in fields such as hydrology, spatial planning, architecture, geography, geomatics, informatics, energy, economics, design and pedagogy (Kopp et al. 2021a). There is a significant difference between UWB and for example most of Bavarian universities (Herzner and Hommerová 2022). UWB due to its heterogeneous nature and structure shows heterogeneity also in various numbers of sustainable centers and departments, whereas Bavarian university has one strategic center for sustainability. It coordinates strategy as well as sustainable activities. At UWB, various sustainable activities are supported by individual projects, that miss systematic university cooperation and educating staff, what sustainability really means (Herzner and Hommerová 2022).

7 Limitations

The presented results are based on a methodological procedure, which is anchored in a broad analysis of the literature, however, it is necessary to perceive possible limitations of conclusions. Defining the roles of the university in building water

sensitive communities should be seen as general results only. It is possible to specify the roles of the university in more detail, for example with regard to their typology or their deeper involvement in regional innovation systems (Gunasekara 2006). The main task of universities is to build human capital. More detailed follow-up research should show what are the appropriate study programs, forms and methods of teaching. However, this requires research on a sufficient sample of different universities.

Our study presents only one case study, which to some extent evaluates the specific and unique environment of UWB. The conclusions of the empirical part can therefore be taken as the basis for further possible comparison with other universities in a different socio-cultural context. UWB's cooperation on the sustainable development of the city also reflects the degree of development of the city in the area of RWM. Therefore, we considered it important to evaluate this level of development in detail first. Potentially significant bias can cause authors to rate the level of their own university. Deep insight and knowledge of the environment are an advantage, but also a possible reason for a less objective view. This bias was partially reduced by the participation of OTH Amberg-Weiden collaborators in the UWB evaluation of sustainable development (Herzner and Hommerová 2022).

8 Conclusions

Addressing rainwater management and blue-green infrastructure as part of SDGs requires interdisciplinary approaches and the involvement of a broad coalition of partners at the city level. By comparing the goals of the WSC and the general roles of universities, we have identified six key roles that universities can use to strengthen building water-sensitive communities: (1) Professional education and training; (2) Urban planning support; (3) Expert activity; (4) Research and innovation; (5) Education and awareness raising; (6) Blue-green campus development. Educating the sustainability leaders for future includes not only training and research involving students, but also the promotion of lifelong learning and close cooperation on the sustainable development with local communities. A great opportunity is to create university campuses as hotspots of blue-green infrastructure, which positively motivate the development of neighborhoods, cities and regions on the principle of sustainability.

These roles were presented through the example of UWB's involvement in the partnership for building a water sensitive community of the city of Pilsen. The case study shows so far only a partial use of UWB's potential in this direction. The presented involvement of UWB with projects in the city and especially its own changes in the priorities of campus planning as places for the development of blue-green infrastructure allow an optimistic view of further development. Foreign inspiration for the development of RWM can help not only the planning for the city of Pilsen, but also in strengthening the role of UWB in building a water sensitive community. The university sphere is key to connecting national and international contacts and key regional stakeholders.

A case study evaluating UWB can be the starting point for further research comparing the level of universities from different socio-cultural backgrounds. Further deepening of the topic is important in the field of educational methods and organization of study programs. The case study shows that the university's potential for educating the sustainability leaders of the future is still underused.

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References

Dean AJ, Lindsay J, Fielding KS, Smith LDG (2016) Fostering water sensitive citizenship—community profiles of engagement in water-related issues. Environ Sci Policy 55(1):238–247

Depietri Y, McPhearson T (2017) Integrating the grey, green, and blue in cities: nature-based solutions for climate change adaptation and risk reduction. In: Kabisch N et al (eds) Nature-based solutions to climate change adaptation in urban areas. Linkages between science, policy and practice. Springer, Cham, pp 91–109

Endowment Fund "Zelený poklad" (2022) Voda—Wasser 2020. https://www.zelenypoklad.org/1-6114-vlastni-cinnost-voda-wasser-2020.aspx. Last Accessed 3 June 2022

EURE (2022) Effectiveness of environmental urban policies to improve resources efficiency. EURE Interreg Europe. https://projects2014-2020.interregeurope.eu/eure/. Last Accessed 1 June 2022

Ferguson BC, Fratzeskaki N, Brown R (2013) A strategic program for transitioning to a water sensitive city. Landsc Urban Plan 117(1):32–45

Fletcher TD, Shuster W, Hunt WF, Ashley R, Butler D, Arthur S, Trowsdale S, Barraud S, Semadeni-Davies A, Bertrand-Krajewski J-L, Mikkelsen PS, Rivard G, Uhl M, Dagenais D, Viklander M (2015) SUDS, LID, BMPs, WSUD and more—the evolution and application of terminology surrounding urban drainage. Urban Water J 12(7):525–542

Frajer J, Pavelková R, Létal AK (2021) Relics and transformation of former ponds in the urban environment of the historical region of Bohemia (Czech Republic). J Maps 17(4):151–161

Gulwadi GB, Scholl KG (2017) Campus infrastructure and sustainable resource management practices: mapping campus DNA for human resiliency. In: Leal Filho W, Brandli L, Castro P, Newman J (eds) Handbook of theory and practice of sustainable development in higher education. Springer, Cham, pp 103–118

Gunasekara C (2004) The third role of Australian universities in human capital formation. J High Educ Policy Manag 26(3):329–343

Gunasekara C (2006) Reframing the role of universities in the development of regional innovation systems. J Technol Transf 31(1):101–113

Herzner A, Hommerová D (2022) Multi-dimensional assessment of a Bavarian and Czech university: a case study of sustainability implementation. Eur J Sustain Dev 11(2):93–113

Hoang L, Fenner RA (2016) System interactions of stormwater management using sustainable urban drainage systems and green infrastructure. Urban Water J 13(7):739–758

Hoang L, Fenner RA, Skenderian M (2018) A conceptual approach for evaluating the multiple benefits of urban flood management practices. J Flood Risk Manag 11:S943–S959

Howe C, Mitchell C (eds) (2012) Water sensitive cities. IWA Publishing, London, p 278

Kestin T, van den Belt M, Denby L, Ross K, Thwaites J, Hawkes M (2017) Getting started with the SDGs in universities: a guide for universities, higher education institutions, and the academic sector. Sustainable Development Solutions Network, Australia/Pacific, Melbourne, p 52

Kopp J, Ježek J (2018) Experience of Czech cities with the implementation of ecohydrological management. In: Grazer Schriften der Geographie und Raumforschung, vol. 48. Institut für Geographie und Raumforschung, Graz, Austria, pp 53–60

Kopp J, Preis J (2019) The potential implementation of stormwater retention ponds into the blue-green infrastructure of the suburban landscape of Pilsen, Czechia. Appl Ecol Environ Res 17(6):15055–15072

Kopp J, Frajer J, Lehnert M, Kohout M, Ježek J (2021a) Integrating concepts of blue-green infrastructure to support multidisciplinary planning of sustainable cities. Problemy Ekorozwoju 16(2):137–146

Kopp J, Frajer J, Novotná M, Preis J, Dolejš M (2021b) Comparison of ecohydrological and climatological zoning of the cities: case study of the city of Pilsen. ISPRS Int J Geoinf 10(5):1–21

Kopp J, Raška P, Vysoudil M, Ježek J, Dolejš M, Veith T, Frajer J, Novotná M, Hašová E (2017) Ekohydrologický management mikrostruktur městské krajiny. Czech Republic, University of West Bohemia, Pilsen, p 166

Krajhanzl J, Chabada T, Svobodová R, Kácha O, Vintr J, Becková A et al (2021) České klima 2021. Mapa českého veřejného mínění v oblasti změny klimatu. Masaryk University, Brno, Czech Republic. https://webcentrum.muni.cz/media/3331473/czklima2021.pdf. Last Accessed 1 June 2022

Leal Filho W (2011) About the role of universities and their contributions to sustainable development. High Educ Policy 24:427–438

Lehnert M, Geletič J, Kopp J, Brabec M, Jurek M, Pánek J (2021a) Comparison between mental mapping and land surface temperature in two Czech cities: a new perspective on indication of locations prone to heat stress. Build Environ 203:108090

Lehnert M, Tokar V, Jurek M, Geletič J (2021b) Summer thermal comfort in Czech cities: measured effects of blue and green features in city centres. Int J Biometeorol 65(8):1277–1289

Lorencová EK, Slavíková L, Emmer A, Vejchodská E, Rybová K, Vačkářová D (2021) Stakeholder engagement and institutional context features of the ecosystem-based approaches in urban adaptation planning in the Czech Republic. Urban for Urban Green 58:126955

Macháč J, Louda J (2019) Urban wetlands restoration in floodplains: a case of the city of Pilsen, Czech Republic. In: Hartmann T, Slavíková L, McCarthy S (eds) Nature-based flood risk management on private land. Springer, Cham, pp 111–126

Morison PJ, Brown RR (2011) Understanding the nature of publics and local policy commitment to water sensitive urban design. Landsc Urban Plan 99(2):83–92

Novotny V, Brown AJ (2010) Water centric sustainable communities: planning, retrofitting, and building the next urban environment. Wiley, Hoboken, New Jersey, p 606

Pinheiro R, Stensaker B (2014) Designing the entrepreneurial university: the interpretation of a global idea. Public Organiz Rev 14(4):497–516

Ribeiro JMP, Barbosa SB, Casagrande JL, Sehnem S, Berchin II, Silva CGD, Silveira ACMD, Zimmer GAA, Faraco RA, Andrade Guerra JBSOD (2017) Promotion of sustainable development at universities: the adoption of green campus strategies at the University of Southern Santa Catarina, Brazil. In: Leal Filho W, Brandli L, Castro P, Newman J (eds) Handbook of theory and practice of sustainable development in higher education. Springer, Cham, pp 471–486

Rogers BC, Dunn G, Hammer K, Novalia W, de Haan FJ, Brown L, Brown RR, Lloyd S, Urich C, Wong THF, Chesterfield C (2020) Water sensitive cities index: a diagnostic tool to assess water sensitivity and guide management actions. Water Res 186:116411

Stránský D, Kabelková I (2015) Review of the implementation process of sustainable stormwater management in the Czech Republic. In: Hlavínek P, Zeleňáková M (eds) Storm water management, examples from Czech Republic, Slovakia and Poland. Springer, Cham, pp 13–26

Technology Agency of the Czech Republic (2021) Interdisciplinary approaches to efficient rainwater management on development sites of urban areas in the economic, social and environmental context. https://starfos.tacr.cz/en/project/SS03010080. Last Accessed 10 June 2022
Trippl M, Sinozic T, Smith HL (2015) The role of universities in regional development: conceptual models and policy institutions in the UK, Sweden and Austria. Eur Plan Stud 23(9):1722–1740
United Nations (2015) Transforming our world, the 2030 agenda for sustainable development, general assembly resolution A/RES/70/1. United Nations, New York, p 35
UPDICP (2020) Koncepce odtokových poměrů města Plzně. Urban Planning and Development Institute of the City of Pilsen, Pilsen, Czech Republic. https://ukr.plzen.eu/zivotni-prostredi/koncepce-odtokovych-pomeru-mesta-plzne/koncepce-odtokovych-pomeru-mesta-plzne.aspx. Last Accessed 3 June 2022
Urich C, Rogers B, Beck L, Lioyd S, Wong T, Chestrefield C (2017) A water sensitive cities—comparing the benchmark results of 9 cities in Asia—Pacific region. In: Conference proceedings 14th IWA/IAHR international conference on urban drainage. IWA/IAHR, Prague, pp 1948–1952
UWB (2022) Strategy 2021–2025. University of West Bohemia, Pilsen, Czech Republic. https://www.zcu.cz/en/University/About-us/strategy-2025.html. Last Accessed 10 June 2022
Webber H (2012) Building effective city-university partnerships: lessons from the Heartland. In: Policy briefs, April 2012. Boston Area Research Initiative, Boston, Massachusetts, pp 1–6
WEF (2014) Green infrastructure implementation: a special publication. WEF special publication, Water Environment Federation, Alexandria, Virginia, p 491
Withycombe Keeler L, Beaudoin F, Wiek A, John B, Lerner AM, Beecroft R, Tamm K, Seebacher A, Lang DJ, Kay B, Forrest N (2019) Building actor-centric transformative capacity through city-university partnerships. Ambio 48(5):529–538
Withycombe Keeler L, Beaudoin FD, Lerner AM, John B, Beecroft R, Tamm K, Wiek A, Lang DJ (2018) Transferring sustainability solutions across contexts through city-university partnerships. Sustainability 10:2966
Wong THF (ed) (2013) Stormwater management in a water sensitive city: blueprint 2013. Cooperative Research Centre for Water Sensitive Cities, Clayton, Australia, p 84
Wong TH, Brown RR (2009) The water sensitive city: principles for practice. Water Sci Technol 60(3):673–682
Wong TH, Rogers BC, Brown RR (2020) Transforming cities through water-sensitive principles and practices. One Earth 3(4):436–447
Woods-Ballard B et al (2015) The SUDS manual (C753). CIRIA, London, p 937
Yun JJ, Liu Z (2019) Micro- and macro-dynamics of open innovation with a quadruple-helix model. Sustainability 11(12):3301
Zalewski M (2015) Ecohydrology and hydrologic engineering: regulation of hydrology-biota interactions for sustainability. J Hydrol Eng 20:1–8

Participatory Action Research in the Implementation of a Green Office: The Experience of a Brazilian University

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1 Introduction

The process of embedding sustainability in higher education institutions is complex and involves a series of components and actors. Much has been discussed on implementing sustainability in teaching (Rey-Garcia and Mato-Santiso 2020), research (Salvia et al. 2018), community engagement (Shabalala and Ngcwangu 2021) and also about a combined or whole-system approach (Bauer et al. 2021; Bovill 2020). Although these most common strategies might have differences and complementarities, a similar challenge across these seems to be ensuring students are engaged, motivated and ready for action.

The international project Transforming Universities for a Changing Climate (https://www.climate-uni.com/) is led by the University College London and has among its aims to support local action on climate change in Brazil, Fiji, India, Jamaica, Kenya, Morocco, Mozambique and Tanzania—the project partner countries—through the use of participatory action research (PAR) and assess how climate

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change is covered in the curricula, research and community engagement activities in a selected group of universities in each one of those countries.

University of Passo Fundo (UPF) is one of the partner universities in Brazil. The community university is located in Southern Brazil and has around 12,000 students. Although UPF has been undertaking several sustainability initiatives (Salvia et al. 2018; Brandli et al. 2019; Rebelatto et al. 2019; Mazutti et al. 2020), it lacked a dedicated unit to focus on student engagement and support the initiatives across campus, faculties and units. As part of the PAR at UPF, the research team in partnership with the university management implemented a Green Office—a new institutional unit to promote sustainability and climate action on campus. This is the first sustainability office in South America following the Green Office Model (https://www.greenofficemovement.org/).

This paper presents the process of implementation of the Green Office UPF and the first cycle of the PAR, with challenges and lessons on the procedures of engaging university students and calling them for action, in matters related to sustainability and climate change.

This chapter is structured as follows: Sect. 2 presents approaches for action with subsections dedicated to presenting the project Climate-U, the PAR approach and the Green Office Model. Section 3 presents the method for this study—namely the combination of the PAR methodology and the Green Office Model, and the case study at UPF; and Sects. 4 and 5 are dedicated to presenting the processes at the Green Office UPF and the Concluding Remarks, respectively.

2 Approaches for Action

2.1 Climate-U Project

The university plays a key role in building the society of the future. Especially when it comes to climate action, the university offers opportunities for reflection on the climate crisis and a space to think about solutions for this scenario (McCowan 2020, 2021). Considering this, the project Climate-U "*Transforming Universities for a Changing Climate*" (https://www.climate-uni.com/) aims to strengthen the contribution of the universities to enhance climate action in their territories and receives the support from UK Economic and Social Research Council, as part of the Global Challenges Research Fund.

The project works with four work packages: (1) Systems of Higher Education, encompassing analysis regarding the national contexts of the participating countries with national literature reviews (Brandli et al. 2021; Nyerere et al. 2021), policy analysis and a survey of Higher Education Institutions (Salvia et al. 2022); (2) Universities as change-makers, when the Participatory Action Research Methodology is applied to the interventions and evaluations (Climate-U 2021; Brandli et al. 2022); (3) Building a theory of university impact, with a global systematic review; and

(4) Global knowledge sharing, planned to disseminate the knowledge generated in the project and provide opportunities for national and global networks (Climate-U 2022). The central investigation relies on the PAR, and this specific methodology is presented in the following section.

2.2 PAR Approach

The Participatory Action Research approach brings the vision that research should be done together with people, involving community members, as stakeholders, in the planning and conduction of actions (Climate-U 2021). The influence of a PAR goes beyond the promotion of transformative and emancipatory opportunities and, as mentioned by Youssoufa-Bele et al. (2013, p. 186), is a "research oriented toward problem solving". In this sense, a PAR process encourages stakeholders to identify obstacles to climate adaptation and facilitates the collective work to meet the needs of the community. This dynamic research process enables different stakeholders to promote social and climate justice (Trott et al. 2018; Youssoufa Bele et al. 2013).

Youssoufa Bele et al. (2013) emphasize the PAR potential to reach vulnerable groups and promote sustained learning in which behavioral changes are aimed while enhancing partnerships among different stakeholders. The authors also present the role of PAR in promoting the fruitful integration of scientific knowledge on climate change with the local knowledge on climate, historical changes and the pathways to adaptation. Also, for Barton et al. (2014), the combination of different areas of knowledge, integrating 'soft science' with 'hard science', can bring to the process different and essential nuances in important aspects. Those might be strong synergies that make the PAR process even more impactful (Nussey et al. 2022).

The Climate-U project researchers have collaboratively developed a guidance document that serves as a Protocol for conducting a PAR focused on climate justice. The PAR Protocol (Climate-U 2021) explores five steps to implement a PAR:

(a) Identifying Site of Impact: includes the process of defining the 'area of action' and the primary focus in which the PAR groups will work;
(b) Identifying Group Participants & Defining Roles: following the principles of co-production and diversity, the complex process of defining who will be involved is key to ensuring it follows a participatory method;
(c) Convening the Group: as groups are formed, the PAR should ensure it generates opportunities for collective and ethical immersions, where participants share expectations and experiences;
(d) Planning Activities: in a collaborative process, the participants can discuss possibilities and design activities to be implemented as part of the PAR process.
(e) Strategy for documentation: as with any other research, the PAR also demands a robust documentation strategy; the project defined a MEL—Monitoring, Evaluation and Learning—process to support this step.

These steps can be seen in depth in the document "*A protocol for Participatory Action Research into Universities' Role in Climate Justice: Principles and tools*" (Climate-U 2021). The methodology chapter will explore how these five steps were adapted for the implementation of the Green Office UPF.

2.3 GO Model

The Green Office Model was proposed by the Green Office Movement, an initiative developed by the rootAbility group and Leuphana University in 2010. This academic office model differs from traditional sustainability office initiatives by proposing that students be the leading team in planning and conducting sustainability-related projects at the university (Leal Filho et al. 2019; Adomßent et al. 2019). This movement currently has 65 offices worldwide. As a movement that emerged in the Netherlands, today it concentrates most of its offices in Europe, but it already has representatives in other regions of the world, with the Green Office UPF being the first initiative of this format in Brazil and South America.

As a model that seeks to be global, the Green Office Movement develops many materials to guide the implementation of new Green Offices around the world. The document "*Green Office Model Guide*" prepared by rootAbility and Leuphana University (2019) is the main reference to understand the process of establishing an office following four fundamental steps: Mapping, Designing, Pitching and Lobbying. The integration of these four steps with the Participatory Action Research of the project Climate-U at UPF will be presented in the following chapter.

3 Method: Combining the PAR Methodology and the Green Office Model

This paper reports the experience of the University of Passo Fundo (UPF) as a case study of the implementation of its Green Office UPF, following the Green Office Model and a Participatory Action Research methodology.

UPF is located in the city of Passo Fundo, in the northwest region of the state of Rio Grande do Sul, south of Brazil. The main Campus, located in Passo Fundo, has the highest concentration of public, with around 12,000 students enrolled in undergraduate, graduate, high school, technical education and outreach courses, 716 professors and 879 employees (UPF 2022). UPF plays a fundamental role in the development of the city, as it is an important institution and of great regional reference. As a community university,[1] it promotes several actions in the city and region, always

[1] The community model encompasses universities that despite being private, are non-profit institutions and revert possible profits to the local and regional communities.

seeking to improve infrastructure, care for the environment, and promote social well-being of the local and regional population.

3.1 Methodological Steps

The method adopted for the implementation of the Green Office at the UPF followed two guiding references: (a) the PAR Protocol, prepared by the researchers of the international project Climate-U (Climate-U 2021); and (b) the Guide to the Green Office Model, prepared by the Green Office Movement (rootAbility and Leuphana University 2019). The steps of the PAR Protocol can be merged with the steps of the Green Office Model in the five moments presented in Fig. 1.

3.1.1 Map the Context

The first moment of the implementation of the GO at UPF was "Mapping the context" and may be described as a combination of the first steps of both the PAR protocol ('Identify site of impact') and the Green Office Model ('Map'). In the first moment of the process of implementing a Green Office, an important aspect may be to identify the "site of impact" as the Climate-U Protocol recommends. This is related to describing the area of action where the intervention will be implemented and identifying motivational aspects for carrying out this initiative. As a tool to help in the

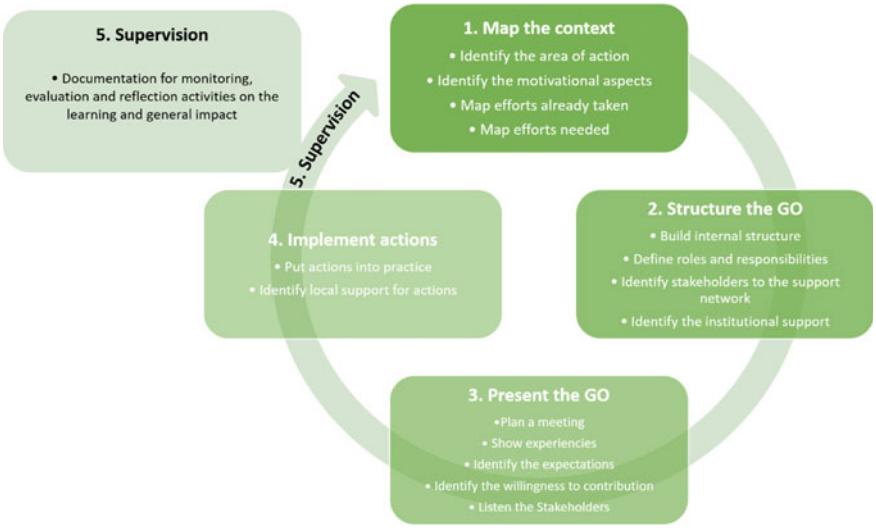

Fig. 1 The methodological steps to implement the Green Office UPF. *Source* Prepared by the authors based on Climate-U (2021) and rootAbility and Leuphana University (2019)

first step, we can have the so-called "Theory of Change" (Climate-U 2021) which leads to reflection on human resources, institutional structure and the socio-political context. Correspondingly, the Green Office Model recommends the development of an overview of existing sustainability efforts and initiatives (in terms of Education, Research, Student community, and Operations and Policy) and analyse their situation (i.e., Strengths and Challenges) (rootAbility and Leuphana University 2019) to understand what additional efforts are needed.

3.1.2 Structure the Green Office

The second moment of the GO implementation is "Structure the Green Office". In the PAR protocol, this stage is presented as "Identify group participants and define roles" and in the Green Office Model this is the "Design" step. At this moment, the GO internal structure is built as the researchers/participants define their functions and roles and the group identifies important stakeholders to contact and build a support network. This is also the moment when the institutional support needed is investigated. A suggested tool for this moment is the Stakeholders Matrix (Climate-U 2021) for mapping important groups that should be included in the GO activities. Coupled with this, an analysis of the influence and impact of local actors may also be performed, as well as an analysis of the stakeholders' trajectory and previous network.

3.1.3 Present the Green Office

Based on the step "Convening the group" and "Pitching" from the PAR Protocol and the Green Office Model, respectively, the third moment of the implementation of the Green Office UPF was defined as "Presenting the Green Office", when the proposal was officially presented to the university rectory and the stakeholders group. This is a very powerful moment since it represents an opportunity for the higher management and the stakeholders to express their expectations and willingness to contribute to the Green Office implementation and planned activities. The recommendation is to carefully prepare and plan the meeting, promote discussions to share experiences, and value and report the stakeholders' views. In most cases, this moment might also include a discussion regarding the financial support needed to implement the Green Office (which can include funding for projects and a space for the GO on campus).

3.1.4 Implement Actions

The fourth moment is "Implement actions" which is a combination of "Planning activities" from the PAR protocol and "Lobby" from the Green Office Model. In this step, the actions are put into practice but most importantly, the local support to implement the actions is provided. The suggestion to better plan the actions and

the PAR cycles is to clearly define the aim of each action and how and by whom the action would be implemented. These actions might be implemented and monitored by the GO or financially supported and monitored by the office. For example, the Green Office UPF launched a call for mini-projects to encourage the entire academic community to submit their proposals on sustainability or climate action. This approach promotes a Win–Win situation and can be beneficial to a GO since it may allow more time for the office to plan other projects while sharing opportunities across the university, engaging other actors, and empowering students.

3.1.5 Supervision

Finally, the arrow in Fig. 1 indicates that after the implementation of the actions, the process will start over, with reflections on the actions and impacts obtained being promoted. A new PAR cycle will be planned, building upon the progress and challenges observed in the previous cycle. This aspect is identified as "Supervision" and follows the recommendations from the "Strategy for documentation" in the PAR Protocol which includes monitoring, evaluation and reflection activities on the learning and general impact during the entire cycle.

4 The Processes at the Green Office UPF

4.1 Mapping the Context

As a result of the process of mapping the context, it was possible to identify the area of action that the Green Office UPF plans to impact as well as to define its main goal. The office at UPF aims to promote student agency regarding climate action, knowledge exchange between researchers and social connections inside and outside the campus. In this context, social resources have been built with opportunities for both the Green Office members and the community that will benefit from its actions.

Following the recommendations of the PAR Protocol (Climate-U 2021), the results of this mapping process made it possible to list important points regarding the expected impact of the Green Office, as shown in Fig. 2.

The motivational aspects that lead the Green Office to action are especially related to the promotion of climate agency in the university community. Two main supporting arguments were identified in the mapping moment: lack of student involvement and awareness regarding institutional sustainability and climate action practices, leading to the need to facilitate a student movement; and lack of connection among the projects already developed by the university—as UPF has been developing several small and isolated actions, with increased potential if collaboratively merged.

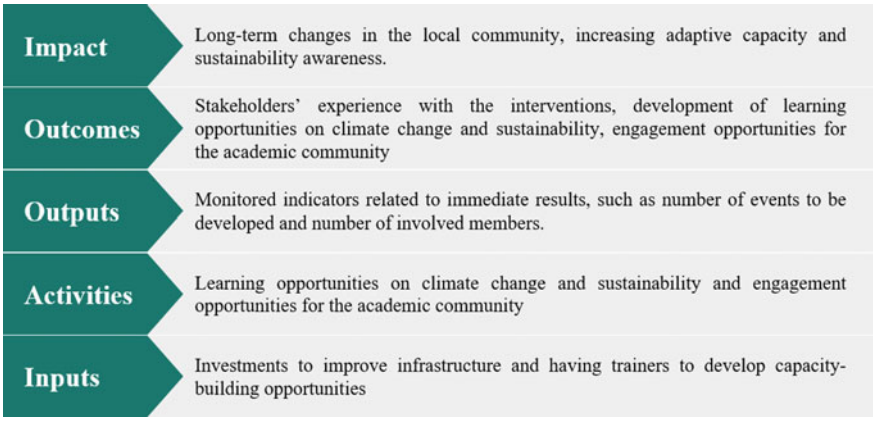

Fig. 2 Synthesis of the mapping process. *Source* Prepared by the authors

4.2 Structuring the GO

4.2.1 Internal Structure and Team

The Green Office UPF followed the model variation in which the team is led by students, having the supervision of professors and a staff contact with the rectory. Considering the importance of involving different areas of knowledge and students from different backgrounds and academic moments, the group prioritizes the multidisciplinary and plurality of the GO Team. Thus, the members of the Green Office include teaching staff and graduate and undergraduate students, all from different areas of knowledge, namely: Civil Engineering, Environmental Engineering, Biology, Architecture and Urbanism, Law, and Advertising and Marketing. The office also offers a set of research scholarships and supports the training and development of human resources.

4.2.2 Stakeholders to Support the Network

The stakeholders of the Green Office UPF are individuals from inside and outside the university who participate as partners and advisors. These stakeholders are involved with initiatives or sectors that are somehow related to the site of impact the office is trying to address. The group of partners is diverse and includes individuals from different segments and social groups: the university is represented by four different sectors: Rectory, Infrastructure and Logistic Division, Environmental Sanitation Sector, and Environment Technology Center; the local government participates with three units: Secretary of Education, Secretary of the Environment and Secretary of Urban Planning; students' organizations are included by means of the Junior Company of the Environmental Engineering course (ETAMB), the School Office of

the Civil Engineering course (ESEEC) and the Central Directory of Students (DCE); two local companies, one Environment Consultancy and one Energy Consultancy; and finally, two local non-governmental organizations, one from waste collectors and one focusing on decent housing. In addition to the variety of areas represented in the office, gender balance was also ensured when the group was formed.

The practical involvement of these stakeholders in the actions proposed by the Green Office consists of periodic meetings in which the plans are presented, and they can engage in the process of both planning and implementation. The meetings also include opportunities to learn about and discuss climate change impacts in the region and sustainability challenges within the university and in the local community.

4.2.3 Institutional Support

The support of the university's top management is listed as one of the most important aspects of a Green Office, according to rootAbility and Leuphana University (2019). At UPF, the support of the rectory is very positive and made it possible for the Green Office to have its own space on campus. All other resources needed for the GO initiatives come from the project Climate-U. Figure 3 presents the space of the Green Office at the university. The intention was to create a colourful and interactive environment where all community members could feel welcome.

Fig. 3 Green Office space at UPF. *Source* Authors

4.3 Presenting the GO

After a presentation meeting for the university's rectory, where the Green Office UPF proposal was approved, the team had a moment to be formally presented to the university community. This moment is important to build awareness of the expectations and needs of the context, as well as to share the willingness of the new unit to contribute to local challenges.

As a way of promoting knowledge about climate action and also engaging stakeholders in the decision-making process on the Green Office actions, regular meetings are proposed with the group. Some tools that can be used include brainstorming sessions, focus group meetings and the formation of model groups.

The Green Office team and the stakeholders meet monthly, and these PAR meetings are conducted to expand the understanding of issues surrounding climate change. In this sense, a new overarching topic was proposed for each meeting. During the first PAR cycle, 5 meetings with stakeholders were promoted. The meetings were conducted mainly as focus group discussions and included tools such as Mentimeter questions and the use of the Google Jamboard to engage the stakeholders in the discussions. For the final meeting, it was proposed an open space for dialogue and reflection on the semester. Table 1 presents a summary of the topics and main outcomes from these meetings.

Table 1 Summary of PAR meetings at UPF

Meeting	Topic discussed	Main outcomes
1	Introductory meeting to present the GO proposal at UPF and contextualize the Climate-U Project	Interactions of all stakeholders and identification of expectations and expressions of interest for possible contributions
2	Impacts observed in the city and region due to climate change	Need for awareness as a first step in all actions; identification of synergies and the GO seen as a facilitator of more partnerships; importance of interdisciplinary actions
3	The challenges for strengthening sustainability and climate action at the university	Partnerships between courses, academic units, professors/researchers; need to monitor and share what is done across areas
4	Student involvement, challenges and opportunities	Understanding that the profile of the university student is changing; activities must be promoted during class time; engaging students from the 1st semester
5	Reflection on the milestones achieved by the group so far	Need more media coverage on the Green Office; need to enhance students engagement

4.4 Implementing Actions

The implementation of actions by the Green Office UPF is divided into two main areas: facilitating educational activities and funding mini-projects within the university and in the local community. While the former was expected since the beginning of the PAR, the latter was not initially planned as an action of the Green Office. However, as stakeholders were mentioning the need for actions in the community and hands-on experience for students, this support was then offered.

4.4.1 Funded Projects

The idea for the Green Office Call for proposals was to promote agency among the academic community, including professors, students and staff and the strategy was adopted as a way to involve more people and courses in the Green Office actions. Each proposal was awarded R$3,000.00 (approximately USD 550.00) to be used in the preparation of activities within one semester. The stakeholders were invited to submit proposals for this call as well as the whole academic community. All projects were developed with the participation of university students and/or groups of stakeholders (local schools, government, and farmers). The first call funded 4 projects, covering the areas of rainwater harvesting, sustainable farming, sustainable architecture and medical gardening, as presented in the following sections:

Green Box—capturing rainwater

The project Green Box aimed at promoting actions on rainwater harvesting and the four pillars of basic sanitation: water supply; sanitary sewage; urban cleaning and solid waste management; and urban stormwater drainage and management. The actions were planned to be implemented in public elementary and high schools in Passo Fundo/RS.

The project can be characterized as a pilot in terms of simplicity of execution but of extreme importance. This first activity at the Fredolino Chimango School (Fig. 4) made it possible to assess the infrastructure and logistical difficulties involved in implementing the complete project in all schools. This initiative also facilitated and expanded the discussion about the SDGs, sustainability, and climate change being applied in the classroom and the role of teachers in this process. Currently, there is a generalized difficulty in the availability of human and financial resources to carry out and maintain projects like this, but there is a lot of demand, especially from the local government. Thus, it is understood that there are spaces for the creation of possible agreements to carry out the expansion of the Green Box[2] to cover all schools in the municipality.

[2] The material prepared for the Green Box project can be accessed at https://drive.google.com/file/d/1GWh7cj53hO-oYDgpGXHgWDYOPF9hRTci/view.

Fig. 4 Professor from the Green Box project presenting the rainwater collector at the school and the rainwater collector installed at the school. *Source* Authors

Climate Change 2050: Building future scenarios by architecture and urbanism students

The project Climate Change 2050 was developed using a methodological approach used in the discipline of the Architecture and Urbanism course at UPF, whose objective is to instigate critical thinking and induce the process of reflection. The coordinator professor which carried out the project brings reflections using the year 2050 as a future scenario, a numerical landmark in the middle of the twenty-first century and object of scientific projections; topics such as current patterns of consumption, transport, housing and work, the urgent demands of climate change, productive capacity and quality of life were part of the activities developed.

It is noteworthy that the outcome of this project includes works of students from different academic levels, organized in groups, bringing a variety of analyses and predictions, referring to the use of conventional or advanced technologies for the speculative design of the future. Above all, the final publication represents a tool to reflect on what steps projects should take nowadays and in the future. The publication of the student's proposals through the project e-book (Fig. 5) allows for expanding the discussion on how to design resilient buildings, infrastructures and cities in the face of climate change. Furthermore, approaches like this are considered proactive, as responses are designed before extreme events occur.

Medicinal Human Body Clock

The project consists of a Human Body Garden (Fig. 6) that enables the implementation of a garden as a tool to help maintain and care for health through medicinal plants, offered to the UPF community, professors and students. It provides the academic and

Fig. 5 Content from the E-book prepared. *Source* Project members

local community with the rescue of sustainability through the generation of home remedies, and sustainability was also promoted as the project team used recyclable materials in the execution of the garden. Through the project, it was also possible to promote the discussion of environmental awareness, since the medicinal plants are planted with organic fertilizer, without the use of pesticides, and used to combat various health diseases.

The project was carried out by a group of master's students in a course discipline called "Theory and Practice of Sustainable Development" in the Graduate Program in Civil and Environmental Engineering under the supervision of a professor from the Agronomy course. This multidisciplinarity was a central point that favoured learning among the members and allowed this action to be carried out, combining the individual knowledge of each member to deliver the final result.

Fig. 6 Human Body Garden at UPF. *Source* Authors

Fig. 7 Initiatives at the farmers market at Passo Fundo/RS, Brazil. *Source* Project members

Environmental Education and Sustainability in Farmers' Market

This project developed a series of initiatives aiming at encouraging and supporting sustainability connected to the 17 Sustainable Development Goals in organic farmers' markets held in the municipality of Passo Fundo/RS. The main results included an e-book on sustainable agriculture and connection with the SDGs (https://drive.google.com/file/d/1oF2c6augJ_CJGB8ohT2GDkGOBApM-M1K/view), the preparation of a domestic composting bin and development of a video with instructions about its use (to be disseminated in the farmers' markets) (as shown in Fig. 7), and an educational video with farmers about the process of organic farming.

The project was carried out by an Environmental Consultancy and had support from the Junior Company from the Environmental Engineering course (ETAMB) and a professor of this course as well.

The four projects funded by the Green Office at UPF were able to meet the local demands brought by the stakeholder group at the beginning of the formation of the PAR. These projects could reach a wide audience and benefit diverse actors including local schools, the UPF academic community (students, professors and staff), public managers, the private sector, local farmers and the local community in general. Also, the actions delivered both practical and theoretical results and could be connected to three different dimensions of the university: Campus, Curriculum and Outreach.

For future activities, the Green Office is planning to maintain and expand the opportunities provided by the calls to fund mini-projects, continuing to support actions in different areas of impact and on campus and in the local community. There will be five projects carried out in the second semester of 2022, on the themes of the UN Sustainable Development Goals (SDGs), aimed at creating a website and educational materials; Carbon sequestration on campus, with the study and planting of strategic native trees; Raising awareness about recycling and the correct destination of plastic bottles, with the promotion of educational games and construction

of a structure to store bottles in residential and commercial buildings; and Mapping sustainability actions at the university, informing the SDGs contributions at strategic points on the Campus.

4.4.2 Educational Activities

Besides funding the projects, the Green Office activities include participation in events, promotion of lectures for university courses, and production of content on climate action and sustainability for social media.

Within this area of activity, the GO was responsible for conducting a workshop at the university's "*Knowledge Week*", an academic event that takes place every year and aims to promote, disseminate and exchange knowledge from all areas. The workshop focused on how to promote sustainability in day-to-day activities and was titled "*Be the Change: Incorporating the Sustainable Development Goals SDGs in your daily life*" (available at https://www.youtube.com/watch?v=zzB-TiszpYQ&t=346s).

Also, as a way of informing the academic and local community on climate action and on the content of the SDGs, the Green Office team recorded short messages to be broadcasted on the university radio. For this activity, GO students were challenged to produce the content of the messages, review them and then record the messages on the university radio.

In social media, GO also seeks to produce informative and interactive content. Weekly, the team prepares, edits and shares content on the Green Office UPF social media (https://www.instagram.com/greenofficeupf/), always aiming to promote educational content on the theme of climate action and a sustainable lifestyle, in addition to informing about important dates for the environmental agenda, recommendations for movies or documentaries on the theme of climate change and participating in campaigns such as "Be the Change" and "Plastic Free July".

For the next cycle of action, new activities for the academic community are being planned, such as the Climate Week—dedicated to promoting lectures and workshops on climate-related topics—and the Sustainability Games, developed as a "scavenger hunt" to promote student engagement through a series of initiatives covering the SDGs.

5 Concluding Remarks

The Green Office UPF, as a connection between institutional and academic efforts, establishes an unprecedented point of action and several other institutional efforts can be channelled through this PAR initiative, which leads to transformative changes inside and outside the university. The promotion of the climate agency may be one of PAR's most significant results in the form of a Green Office, since all members involved in the activities (including students, stakeholders, local community and

institutional managers) are invited to take a new look at our ways of life, emphasizing the perspective of climate action. Once this process is done, students, on their own, can disseminate this knowledge in their communities and support long-lasting change.

As the most remarkable transformation for the university, it can be highlighted that the institution can and should value more the initiatives coordinated by students. The practical activities, such as the Human Body Clock and the ones focused on generating educational content, such as the Scenarios 2050, proved this. Additionally, the initiatives focused on the local community (Green Box and Environmental Education and Sustainability in Farmers' Market) supported the importance of connecting learning opportunities with community engagement and outreach. For all actions to be more successful, the need of transforming the university in the so-called "outreach curricularization" (curricularização da extensão, in Portuguese) has been discussed, allowing for extension/outreach activities to be included in the curricula of the courses and therefore enable students to have training that values the social function of their professions.

While this chapter focused on presenting the process of implementing the Green Office UPF and all steps are valuable and represent important outcomes of the project Climate-U, these were not without associated challenges and lessons learnt. First, there is the challenge considered since the first stage: engaging students. With the PAR process, the research team understood that the lack of engagement is not necessarily linked with a lack of interest or motivation, but it is primarily connected with the format available for action to take place—supporting the need of time for that in the curricula. Second, there is the challenge of keeping stakeholders active in the PAR and allowing them to feel empowered in the process. The partners of the Green Office should be seen as part of the team, and not part of the research performed by the project members. And third, the challenge of balancing the views and priorities of each group participating in the PAR process—as while internal groups (such as university sectors) tend to bring operational topics for discussion, the external groups (such as NGOs, companies and the local government) tend to prioritise community engagement and impacts.

The limitations of this study refer to the focus on a national case and specific methodologies for analysis. Future studies will dive into the learning processes associated with the PAR and the transformations fostered (and which are still needed) by the Green Office at UPF in the following cycles of action. Although this chapter presented a case study in the Brazilian context, the authors hope it can be useful for researchers and university teams working with Participatory Action Research, particularly on the topic of climate justice, and especially to those interested in or already implementing sustainability offices or Green Offices—as the participatory component of these units is complex but certainly needed.

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References

Adomßent M, Grahl A, Spira F (2019) Putting sustainable campuses into force: empowering students, staff and academics by the self-efficacy Green Office Model. Int J Sustain High Educ 20(3):470–481

Barton J, Harris J, Krellenberg K (2014) Developing climate change adaptation measures in a participatory process: roundtable meetings. In: Krellenberg K, Hansjürgens B (eds) Climate adaptation Santiago. Springer, Berlin, Heidelberg, pp 157–173

Bauer M, Rieckmann M, Niedlich S, Bormann I (2021) Sustainability governance at higher education institutions: equipped to transform? Front Sustain 2:24

Bovill C (2020) Co-creation in learning and teaching: the case for a whole-class approach in higher education. High Educ 79(6):1023–1037

Brandli LL, Savia AL, Moro LD, da Rocha VT, Mazutti J, Reginatto G (2019) How can ecological fairs increase sustainability in a university campus? Int J Sustain High Educ 20(3):515–529. https://doi.org/10.1108/IJSHE-02-2019-0055

Brandli LL, Savia AL, Mazutti J, Reginatto G (2021) Higher education institutions facing climate change: the Brazilian scenario. Transforming universities for a changing climate, Working paper series no. 5. ISSN 2754-0308

Brandli LL, Savia AL, Mazutti J, Reginatto G, Ambrizzi T, Hage S, McCowan T (2022) Strategies advancing climate change education in three Brazilian universities. NORRAG special issue 07: Education in times of climate change (in press)

Climate-U (2021) A protocol for participatory action research into climate justice: principles and tools. Transforming universities for a changing climate working paper series, no. 3. ISSN 2754-0308

Climate-U (2022) Transforming universities for a changing climate. Work packages. https://www.climate-uni.com/work-packages. Last accessed 30 June 2022

Leal Filho W, Will M, Salvia AL, Adomssent M, Grahl A, Spira F (2019) The role of green and sustainability offices in fostering sustainability efforts at higher education institutions. J Clean Prod 232:1394–1401

Mazutti J, Brandli LL, Savia AL, Gomes BMF, Damke LI, da Rocha VT, dos Santos Rabello R (2020) Smart and learning campus as living lab to foster education for sustainable development: an experience with air quality monitoring. Int J Sustain High Educ 21(7):1311–1330. https://doi.org/10.1108/IJSHE-01-2020-0016

McCowan T (2020) The impact of universities on climate change: a theoretical framework. Transforming universities for a changing climate, working paper series no. 1. ISSN 2754-0308

McCowan T (2021) Climate change in higher education: a curriculum topography approach. Transforming universities for a changing climate, working paper series no. 6. ISSN 2754-0308

Nussey C, Frediani AA, Lagi R, Mazutti J, Nyerere J (2022) Building university capabilities to respond to climate change through participatory action research: towards a comparative analytical framework. J Human Dev Capab 23(1):95–115

Nyerere J, Gatwiri W, Okinyi R (2021) Kenya's climate change policy actions and the response of higher education. Transforming universities for a changing climate, Working paper series no. 4. ISSN 2754-0308

Rebelatto BG, Salvia AL, Reginatto G, Daneli RC, Brandli LL (2019) Energy efficiency actions at a Brazilian university and their contribution to sustainable development Goal 7. Int J Sustain High Educ 20(5):842–855. https://doi.org/10.1108/IJSHE-01-2019-0023

Rey-Garcia M, Mato-Santiso V (2020) Enhancing the effects of university education for sustainable development on social sustainability: the role of social capital and real-world learning. Int J Sustain High Educ 21(7):1451–1476

rootAbility and Leuphana University (2019) Green office model guide. https://www.greenofficemovement.org/download/2486/. Last accessed 30 June 2022

Salvia et al (2018) Analysis of energy consumption and efficiency at University of Passo Fundo—Brazil

Salvia AL, Rolleston C, Nussey C, Veisa F, Okinyi R, Mananze R, McCowan T (2022) Technical note: the design and implementation of the Climate-U survey 'Climate change—practices, experiences and attitudes'. Transforming universities for a changing climate, Working paper series no. 7. ISSN 2754-0308

Shabalala LP, Ngcwangu S (2021) Accelerating the implementation of SDG 4: stakeholder perceptions towards initiation of sustainable community engagement projects by higher education institutions. Int J Sustain High Educ 22(7):1573–1591

Trott CD, Weinberg AE, Sample McMeeking LB (2018) Prefiguring sustainability through participatory action research experiences for undergraduates: reflections and recommendations for student development. Sustainability 10(9):3332

University of Passo Fundo (2022) Apresentação. https://www.upf.br/a-universidade/a-universidade. Last accessed 30 June 2022

Youssoufa Bele M, Sonwa DJ, Tiani AM (2013) Supporting local adaptive capacity to climate change in the Congo basin forest of Cameroon. Int J Clim Change Strateg Manag 5(2):181

Sustainability Leaders' Perspectives on the Potential of Innovation Labs: Toward Collective Regional Leadership

Tobias Klös and Marc-André Heidelmann

Introduction

The 17 Sustainable Development Goals (SDGs), which are "the blueprint to achieve a better and more sustainable future for all by 2030" (United Nations 2018), require cooperative, coordinated action by a wide range of heterogeneous actors (Kuenkel 2016, p. 41), which is also underlined within "Goal 17: Partnerships for the Goals." Such multi-stakeholder collaborations not only have catalytic effects (Eweje et al. 2020) on sustainable development, they are also crucial for regional circular economies (Geissdoerfer et al. 2017, p. 767). Circular economies are relevant for sustainability because they support local value creation and production, contribute to alternatives to linear-oriented economies, and depend on the fact that heterogeneous actors from various parts of the economy work together. Additionally, they depend on collective leadership, which is the "capacity of a group of leaders to deliver their contribution to a more sustainable future through assuming joint and flexible leadership in service of the common good" (Kuenkel 2016, p. 21). The problem is that many stakeholders are not prepared (ibid., p. 17) for collective leadership.

How can collective leadership be supported, especially by a university? Contrary to classical positions of institutional separation of science and society, of the context of creation and use of knowledge (Fricke 2017, p. 250), transdisciplinary models—such as the sociological model of knowledge and the science of "Mode 3" (Nowotny et al. 2001)—suggests networking and interlocking forms of work and encounters such as innovation labs (Schneidewind and Singer-Brodowski 2014, p. 124). A Mode

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3 Science stands for plurality, heterodox and engagement of the civil society (ibid., p. 122). In such spaces as Innovation labs, scholars and practitioners work together on real, socially relevant problems and issues, developing and implementing concrete interventions (Schneidewind 2018, p. 447). By initiating change processes together, scientists and practitioners can learn the "possibilities and patterns of successful change processes" (ibid.) in the various fields of action in sustainable development.

Against this background, this article asks what potential innovation labs can have in supporting collective leadership from the perspective of being a regional Practitioner. First, Part 1 introduces the theoretical foundations of leadership from a strategy-as-practice (SAP) perspective. From this perspective, strategy is viewed as something that is done rather than something that an organization has. As will be demonstrated, old ideas regarding strategy and leadership are not suitable for the challenges that accompany sustainable development, and new ideas like Sustainability Leadership are needed. While the SAP perspective (mostly) focuses on the strategy itself, organizational education may be the missing link between the strategy and the development of a supportive environment for strategic practices and the development of strategies toward a sustainable future. Based on this theoretical foundation, the article presents a concrete one-year organizational education program to support regional collective leadership within Part 3. In this program, regional stakeholders work together with students in the dialogic, participatory framework of three innovation labs on strategies for sustainable development in the region. The program is the context for an empirical case study (Part 4), which aims to reconstruct the perspectives on the innovation labs of the participating stakeholders. A qualitative longitudinal approach was chosen for this study, which used image-based interviews to ask regional stakeholders about their perspectives during the process. A metaphor-oriented approach was used to analyze the narrations and images to reconstruct the perspective of regional stakeholders about the potential of innovation labs. Based on the findings of the case analysis of the regional actor Heinz Rüdiger, which are presented in Part 5, the potential for establishing alternative practices in self-organizing for collective leadership is discussed in Part 6.

Limitations

The paper discusses only one case out of a total of thirty-two stakeholders. While the case shows interesting insights into the potential of the program, it is not possible to say whether and what potential other stakeholders see in the program for strategy building. Consideration of further cases, which was discarded here in favor of a more in-depth discussion of a specific case, would possibly be able to reveal interesting insights regarding the respective situatedness of the actors in the field and related perspectives on the potentials of the innovation labs.

1 Theoretical Foundations of Leadership: Strategy-as-a-Practice Perspective

> In order to find solutions to the complex problems that we face as a global society, we need active citizen leaders who can collaboratively restore our sense of community and actively engage in transforming our current social, political, economic and ecological realities. (Burns et al. 2015, p. 88)

Burns et al. (ibid.) not only emphasize the already mentioned need for cooperation, but also address the need for leadership. The question is, what kind of leaders? Burns et al. refer to the concept of sustainability leadership (SL), which is a new leadership idea that challenges traditional notions rooted in a scientific, technical, Newtonian paradigm of modernity. A paradigm assumes that the world is predictable through observation and thereby can be controlled. Not only does this paradigm fail if more than two variables are watched, but it also seems unsuitable concerning a so-called VUCA world characterized not by predictability but by volatility, uncertainty, complexity, and ambiguity (Mack et al. 2015). SL is rooted in a "living-process" paradigm, which sees the world as constantly changing, uncertain, evolving, and interconnected. However, who is a sustainable leader? While traditional notions of leadership associated this characteristic with particular formal position, physiological or psychological characteristics, or behaviors (Burns et al. 2015, p 91), SL emphasizes taking responsibility and acting for sustainability. According to Ferdig (2007, p. 25), "anyone who takes responsibility for understanding and acting on sustainability challenges" is a sustainable leader, "whether or not they hold formal leadership positions." SL identifies and addresses "the leader that inherently exists in each person and forges strong, healthy, sustainable, and just change through collaborative and creative means" (ibid., 2007).

Regarding the emphasis on collaborative actions and the need for cooperation regarding sustainability, it can be said that SL, at its core, is collective leadership. Concerning the importance of collective action, the essential leadership task is not to provide instructions but to create a participatory, dialogical space. However, not as much is known about what real sustainability leaders actually "do in practice" or what perspectives they have. Thakhathi et al. (2019, p. 246), for example, address what sustainability leader do "to create a readiness for and reinforcing the institutionalization of relatively large-scale organizational change towards corporate sustainability."

The gap between theoretical assumptions of "what people do" and what they actually do gave rise to the practice turn (Jarzabkowski 2004, p. 2), which is more interested in the actual day-to-day actions of practitioners than in abstract theories. SAP is not only part of the practice turn but also an essential approach in the context of SL regarding the strategic development of sustainability and the involvement of SL. Also, Sustainable development can also be seen as a strategy (Ioannou and Serafeim 2019) to survive within the Anthropocene age (Thakhathi et al. 2019, p. 248). Representatives of a classical understanding of strategy define strategy as a planned set of measures taken by the organization to achieve its long-term goals

(Weber 2018, p. 597). Failures in strategic change programs and recent research have highlighted that the assumptions of the traditional strategy perspective do not match the complex reality (Nini 2016, p. 6).

SAP starts at this point of a dynamic world. Instead of thinking of strategy as something which an organization *has*, SAP thinks of strategy as something *done* by people. Instead of relying on objectivism and positivism, SAP views strategy from the ontological viewpoint of social constructivism and subjectivism. From this viewpoint, strategy is not only an outcome of rational thinking but also something connected to the specific area where it becomes relevant. SAP, therefore, immerses itself in the discourse that reshapes and establishes a strategy.

If one takes into account both perspectives, SAP and SL, they can offer important insights into the "lived experience" of sustainability leaders (Iszatt-White 2010, p. 422). However, SAP focuses merely on the *strategic practice* and *practices.* The important difference between practice and practices is, that practice is the "actual activity" (Jarzabkowski 2004, p. 20) and then there a "practices", which are "those tools and artefacts that people use in doing strategy work" (Jarzabkowski 2021, p. 321), which can take many forms. We are interested in the form of practices that "create opportunities for and organize the interaction between practitioners in doing strategy" (ibid.), such as innovation labs. Organizational education could be the missing link between SAP research and the actual support of strategic practices.

2 Missing Link: Organizational Education Potential for a Strategic Practice of Collective Leadership

Organizational education is a relatively young sub-discipline of educational science that has existed for almost two decades. The discipline supports a scientific discourse, a common body of specific knowledge and methods, and the anchoring of the approaches of organizational education in the scientific systems (Weber et al. 2018, p. 832). Organizational education is concerned with organizational learning, which refers to the learning in, by, and between organizations (Göhlich et al. 2018, p. 207). Therefore, organizational education could be the missing link between a SAP approach and the strategic practice of collective leadership because it also asks methodological questions about how strategic practices can be designed (Weber 2018, p. 600). An answer could be innovation labs, a methodized form of the rationality of organizational education. These labs pursue the idea of bringing the entire system into one room (Weisbord and Janoff 2001) to enable collective strategic action in the search for desirable futures by heterogeneous but equal stakeholders across institutional boundaries (Weber 2018, p. 601). Innovation labs provide a participative space for the "social process of problem-solving" that lead to "new practice" (Jarzabkowski 2004, p. 10). Within innovation labs, organizational education network consulting can support the necessary network development process for a regional and

collective strategy (ibid.). Therefore, organizational education perspectives, knowledge, methods, and consulting can potentially be a strategic practice of collective leadership. The next part presents a concrete organizational program that uses three innovation labs to support strategic development and networking among regional stakeholders to promote collective leadership.

3 The Potential of Innovation Labs for Collective Learning Toward Partnerships

The program 'Greening the University Canteen' (Weber and Heidelmann 2019, p. 419) supported the goal of developing and establishing a regional economic cycle (Geissdoerfer et al. 2017) through three innovation labs. This transdisciplinary arrangement initiated by the department of Education at the Philipps-University of Marburg was realized by students together with regional cooperation partners. Addressed here were heterogeneous stakeholders from the regional field, such as producers, traders, buyers, consumers, and recyclers. Additionally, actors from politics, administration, science, and civil society were involved.

3.1 Arrangement of the Organizational Education Learning Program

The program works with an organizational education for sustainable development (OESD) approach, which extends the education for sustainable development (ESD) approach from the perspective of organizational education, which is as already mentioned interested in learning from, in, and between organizations (Göhlich et al. 2018, p. 207). While education for sustainable development initially addresses only the micro-level of the subjects, OESD also looks at the meso-level of organizations. Specifically, experiential, problem-based, networked, and design-oriented "innovation learning" is promoted within the innovation labs. Here, innovation learning (Weber, et al. 2019) refers to the learning setting of the innovation lab. Instead of a static one-on-one approach, a network approach was adopted, directly involving students and all relevant stakeholders, linking the professionalization of students and the learning of stakeholders in a complex Mode 3 (Nowotny et al. 2001) collective learning arrangement. The participating students learned in university courses and in the course of the practical situation of the innovation labs to support this reflexive transformation process (Schäffter 2014, p. 115) with an organizational educational network consulting approach (Heidelmann et al. 2023/ in this volume.). Concerning the stakeholders, the program aimed to support the development of strategy and collective leadership for sustainable regional development, based on de Haans' (2008) designability approach (Gestaltungskompetenz). Experiences and

problems of regional stakeholders become the starting point for the identification of joint solutions and the development of strategy (Heidelmann et al. 2023/ in this volume.).

The program does not remain at the individual practice level but addresses the practices by questioning and deconstructed unquestioned normalities, as places where discourses anchor. That means "those traditions, norms, rules, and routines through which the work of strategy is constructed" (Jarzabkowski 2004, p. 20) were questioned. Professionals and organizations are also seen as agents of discourse within the program, as they can discursively co-produce an alternative organizational logic. Through the discourse intervention of the program, not only can explicitly articulated strategies be addressed but also the "discourse, through which a strategy is constructed" (ibid., p. 21).

3.2 The Trans-epistemic Design Approach of the Three Innovation Labs

The analytically based organizational pedagogical approach (Weber and Wieners 2018) places design research as a multidimensional model (Weber and Keller 2022). Following Weber (2014), different knowledge of cultures of design (Mareis 2011) are imagined into an iterative trans-epistemic sequential process of boundary crossing (Weber and Heidelmann 2021) within three innovation labs:

The first innovation lab addressed the product and process level following a business rationale and supported the generation of product and process prototypes using the "design thinking" method (Plattner et al. 2009). Following a sociological rationality, the social system building level was targeted in the second innovation lab and methodically addressed through systemic questions. The "more dramatic the changes in our environment, the less we can rely on past patterns" (Scharmer and Kaeufer 2013, p. 3) and strategies based on past experiences. Therefore, changing the "inner place from which we operate" (ibid.) is necessary. A third innovation lab focused on a deep innovation in educational rationality, in other words, the transformation of inner attitudes (Weber and Heidelmann 2021), which was worked on with the Theory U approach (Scharmer 2007) and image-based dialogical approaches. Theory U mainly focuses on shifting the inner place from which people operate and on leading from the emerging future (ibid., pp 18–19) Scharmer and Kaeufer (2013) indicate that shifting attention from fighting the old ways to noticing emerging possibilities is at the core of deeper leadership work today. Rather than reacting to past patterns and solidifying them, it is about following a vision. Images-based aesthetic approaches can help "liquefy" collective imaginaries, supporting the emergence of new collective visions (Weber and Heidelmann 2022) and strategies that stem from the emerging future.

Fig. 1 Research design (*Source* Own illustration)

4 Strategy as Practice: Experiencing Organizational Education Innovation Labs for Collective Leadership

A SAP perspective from the viewpoint of organizational education would then mean focusing on the potential of innovation labs from the viewpoint of regional practitioners. From the perspective of SAP, practitioners are "obvious units of analysis" (Jarzabkowski et al. 2007, p. 8), since they are actively involved in practicing strategy and the ones who are *strategizing*. They shape strategies by "how they are, how they act, and what practices they draw on to do so" (ibid.). What perspectives do they have of the innovation lab, and what potential do they see regarding supporting collective leadership? To answer this question, a research project was undertaken during the project period in addition to the professionalization and consulting process.

For this purpose, a qualitative approach in the form of image-based guided interviews is appropriate, within which regional actors are asked about their expectations and experiences with the innovation labs. Such an approach, triangulating images and narratives (Brake 2018), was realized through a longitudinal research project during the entire project period (Fig. 1).

Based on impulse questions, stakeholders were asked to spontaneously select images that they believed were most fitting for their answers. Later in the interviews, they were asked to justify and interpret their choices. The images here not only have an elicitive function (Harper 2002), in other words, to stimulate narratives, but are also open to meaning beyond that and, therefore, require interpretation and are a gateway for metaphors.[1] Thus, in the course of image-based narratives, experiences with the professionalization program are expressed in metaphorical ways (Weber and Heidelmann 2021, p. 87). By analyzing the individual metaphors and elaborating on the conceptual metaphors behind them, it is possible to reconstruct what potential regional stakeholders see in the innovation labs. This follows the idea of Lakoff and Johnsson (2003, p. 11), who assume, in contrast to a representational model of language, that "our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature." Forceville (2008) points out that Lakoff and Johnson's concept of metaphor is by no means limited to linguistic metaphors but refers to all modalities of human experience. Junge (2019, p. 12) underlines that

[1] We would like to point out that the interviews were conducted in German and the analysis was undertaken based on the original material, before the translation into English. Therefore the passages quoted here as well as the metaphors they contain represent translations that were selected based on the logic of meaning that was apparent to the interviewee.

an image, regardless of whether material or imagined, is a statement, but it is not clear which statement has been made. This unclear meaning of the image is a gateway for metaphor, and in this sense, images are well suited to convey subjective meaning. Schmitt et al. (2017) draws attention to the fact that the analysis of metaphorical shifts makes it possible to use the method of metaphor analysis to describe dynamic processes. Therefore, it is also possible to reconstruct a shift within the perspective of the regional stakeholders.

If one asks about the potential of organizational education for a strategic practice for collective leadership, it is essential to consider that the actors themselves must not label a practice "strategic" (Jarzabkowski et al. 2007, p. 8). We follow the idea of Jarazabkowski (ibid.) that a practice can be called strategic, if its "consequential" for the "strategic outcomes, directions, survival, and competitive advantage" of an organization, even if "these consequences are not part of an intended and formally articulated strategy." However, the question is not about *what* is labeled as strategic, or *what* strategy is developed within the innovation labs, but *how* the innovation labs support offer potential as strategic practices for collective leadership. Regarding the question of potential, we will reconstruct the perspective of the regional stakeholders and their experience with the innovation lab as strategic practices for collective leadership. In the following, the case of Heinz Rüdiger is presented, and the findings of the metaphor-oriented analysis are presented and discussed.

5 "An Enriching Experience, in Any Case"—The Case of Heinz Rüdiger

The case analysis of Heinz Rüdiger (H.R.) deals with reconstructing a regional actor's perspective of the innovation labs' potential regarding a process toward collective leadership. H.R. is an interesting case for this topic, not only because he participated in the program, but also because he was involved in project groups between the innovation labs. For these reasons, he demonstrated significant interaction with the project, and he is already a sustainability leader in the sense of Ferdig (2007). H.R. does not have any classical formal leadership role but has been successfully involved in sustainable development in agriculture in the region for several decades through his role as a farmer and with the community of his farm. He is also an interesting case because, despite his interest in cooperating with others, he addresses this as an ongoing problem (Fig. 2).

Fig. 2 Images chosen by H.R. from a set of 70 images throughout the four interviews regarding his experiences and perspectives and the potentials of the Innovation labs (*Source* Own illustration)

5.1 Perspective on the University: "Bringing People Together," a Task "That Neither the Region nor the Farmers Can Fulfill"

In the course of the one-year research project, H.R. addressed the need for the university to take responsibility for networking among local actors with the goal of establishing regional partnerships. He alleged that the actors are incapable of doing so themselves, and any attempts thus far have failed. In T1, before the one-year-long research and consultation process, H.R. refers to the challenges he perceives in matching economic conditions with ecological goals. Even when pursuing "great idealistic goals," it is essential to generate some profit. Therefore, the "idealistic goal" must "pay off economically." Otherwise, his business would have to close. H.R. sees the solution to match economic demands with environmental goals as "bringing people together" who already know the importance of local, sustainable goods and are eager to act for sustainability. Therefore, the "producers and the traders, processors, and buyers" should be brought together.

"Taking Responsibility" in a "Pioneer's Role" and "A Little More Watering"—Leadership of the University

In T1, H.R. already imagines the university in a leadership role. The image (T1.1) depicting someone "leading the way," "taking new paths," and "crossing a bridge alone" symbolizes the "pioneer role" that the university should take on. The university could provide impetus by seeking new ways and promoting them. As a result, the discussions and the cooperation between the actors would then work. He believes only the university can take on such a role because the institution's knowledge,

intelligence, and momentum are combined. He also contrasts himself with the people at the university, whom he describes as "a whole bunch of young, eager-to-learn people who are dedicated to research and teaching." These people would "think outside the box" and "try really wild new things," ideas he said he wouldn't think about when working every day "as a normal farmer."

The ability to organize meetings and to work together represented to H.R. in T4, in retrospect, tasks in which farmers were often unsuccessful because they would often work alone or at cross purposes. Farmers are "bad" at establishing relationships, H.R. said, adding that they "would not have been able to organize such an event." In contrast to the "completely different format" of the innovation labs, which were "a bit more alive," meetings in agriculture are "stodgy" and "not a lot happens." Therefore, it was good to approach the process "free of thoughts about agriculture" and to "see this simply as groups of people who can be brought together," as the university had done.

In T3, the nutrition cycle is imagined as a fragile plant that is already growing on its own but is "still in its infancy" and requires support. Within the sense of this metaphor, the support of the innovation labs for the regional nutrition cycle is imagined as the entity that is "watering the plant," (T3.1), which supports the process of the plant's growth. By networking regional stakeholders, this process would "certainly speed up"; therefore, it needs "a little more watering" to accelerate the pace.

On this basis it can be assumed, that the conceptual metaphor is: The university should be a pioneer for regional networking. Thus, the potential to traverse borders by means of crossing bridges is conveyed, and in T3 the focus is on a support metaphor as the process. This is because the innovation labs, as H.R. states in T3, have started by means of an "initial spark," which is now imagined in T4 as a fragile plant that grows by itself but still needs some support, as it is still in its infancy. The innovation lab provides this support by assisting the growth process, but "a little more casting" is needed to ensure a quicker process.

In T4 he summarizes his perspective, when he stated that the collaboration was "enriching in any case." It opened his eyes and revealed "completely different perspectives. And it was also a completely different way of working" than what he was used to as a farmer.

5.2 Leadership of the University and Strategic Practice for Collective Leadership

With a view here to the condensed narration, H.R. first reveals that the economic preconditions or general conditions ("pay off economically") through projects to implement the SDGs. Likewise, he describes the existential risk and consequence of going out of business if sustainability projects fail to meet these financial requirements. H.R. imagines the solution for this problem within networking processes

("bringing people together") and extends this networking perspective to further cooperation partners ("the producers and the traders, processors, and buyers"). Concerning the problem, this is not a task that the practitioners or the region cannot do, he marks the difference between regional farmers, which includes himself, and the university as the leader, taking the pioneer role in supporting stakeholder collaborations.

The metaphors ("leading the way," "taking new paths," and "crossing a bridge alone") are related to this leading figure of the pioneer. The first image he chose (T1.1) depicts the pioneer who takes leadership or responsibility) for networking processes (bringing them together). This task, in his view, cannot be done by regional stakeholders, especially not by farmers, because they lack specific characteristics ("knowledge, intelligence, and momentum"), and they are too involved in day-to-day work. Conversely, the university is imagined as a place of people who have these characteristics and are already involved in innovative activities. In this sense, in H.R.'s vision in T1, the university takes the lead for networking processes among regional stakeholders.

Tying such an imagination of leadership back to leadership theory is reminiscent of the trait approach (Kopp 2013, p. 126), which assumes that leadership ability and successful leadership depend on physical and psychological characteristics (Heidelmann et al. 2023/ in this volume.) What remains open in this approach is the extent to which leadership characteristics can be generalized or whether a leader's capabilities should not always be contextualized, as leadership is always context-dependent. Another concept of leadership that could be summarized based on the metaphors is the gardener watering the plant. Here, we find metaphors that refer to an organic notion of a living and developing ("growing") volatile ("fragile") organic ("plant") process. In this respect, such an idea of leadership is more rooted in the paradigm of living processes (Burns et al. 2015). At the same time, the leadership imagination presented here already refers to the need for pedagogical support, because the metaphor for establishing a regional nutrition circle imagines the process as a child who is still in its infancy and needs some support. Therefore, "growing" in this context, which initially referred to a plant's growth process, can also be understood as the process of growing up. In this sense, a gardener's imagination refers to classical ideas of educational leadership. Furthermore, the leading figures of the pioneer and the gardener can also be understood as expressions of a leadership practice that is seen in the professional–pedagogical tradition as an indissoluble dialectical relationship between leading and letting grow (Schröer 2018, p. 480).

5.3 Perspective on Students: From "a Bit Skeptical at First" to "Some People Could Take a Leaf out of Their Book"

Throughout the project, H.R.'s opinion about working with students within the innovation labs changes from a somewhat skeptical, critical perspective to an appreciative one.

"There's Not Much He Can Do for Me"—A Practitioner's Perspective on Students

In T1, H.R.'s perspective about future encounters with students in the innovation labs is critical, because he believes "there's not much" that a student can do for him. Instead, he believes practitioners will "sacrifice a part of their free time and energy" to give students some input from which they can profit. Nevertheless, he said he is hoping for a long-term impact, in other words, that students will gain "a bunch of knowledge and information" and form their opinions based on that free knowledge. Later, he said he hopes that when they are leaders they will "use *that* information." This imagination of the encounter between students and practitioners is also symbolized by the chosen image (T1.2), where he described himself as an "old bum" (left) from whom students (right) expect to gain experience.

From "What Do They Actually Want Here Now?" to "Pleasantly Surprised"—A Shift in Perspective on Students

In T2, the critical perspective of H.R. changed from a "bit skeptical at first" to "pleasantly surprised." Initially, he asked himself, "What do they actually want here now?" and "Why are *they* doing this for us?" He then said he was pleasantly surprised when he realized that the students' goal was to support the networking process among regional stakeholders, to "bring farmers together with producers from the region." This first encounter with the students was also described as "refreshing in several ways," which is symbolized by an image in T2 (T2.1) that depicts someone with a surfboard in "very cold water." In T4, he explained that the "very important refreshing newness" of the students is that they "approach things in a very clueless way." However, clueless does not mean they know nothing; it means that they would not concern themselves with how things have been done in the past but would "go down completely new paths" and break the "old, outdated habits of acting." As he stated in T2, "usual thought patterns were also disrupted." Therefore, he wished in T2 that the students would continue to be "ready with fresh energy" to think "*completely* differently; to think outside the box." In the accompanying image (T2.1), they are "younger ones" (right) who "should take the older ones" (left) by the hand and "pull them along." In T3, he added regarding his experience with the students that it felt like they were "working together on a big thing" and that they were "rowing together in the same boat" (T3.2) to "move the whole thing forward." Furthermore, he contrasted this image with the first picture chosen in T1 (T1.1.), in which the "senior expert gives wise advice, and the young people listen enthusiastically." Nor was it that one person "lectured and the others all listened." Instead, it was "working together for a goal." He also said he imagines the students in T3 as catalysts who bring people together and, sometimes, "make people think."

"Some People Could Take a Leaf out of Their Book"—Contrasting the Perspectives of Organizational Education Students With the Perspective of Practitioners

At the end of the process, there is no trace left of H.R.'s initial skepticism and critical view of the students, because he believes people from his organization could learn something from the students, saying they "could take a leaf out of their book." This is necessary, from his point of view, because farmers know their subject but have not been trained for situations where they must lead a group or organize discussions. H.R. said he thinks "organizational education […] needs to be incorporated into significantly more professions."

5.4 The Leadership and Strategic Practice of Students Within Innovation Labs

With regard to HR's chosen metaphors and images for the students, it can be seen that his view of the students changes throughout the process. At the outset, they are viewed critically against the background of a functional perspective ("what a student can do for me") and in the present as not relevant to practice ("not much he can do for me"). Furthermore, a unidirectional transfer of knowledge from practitioners to students is imagined. Although the metaphor of sacrificing refers to an initially selfless act for a higher purpose, the remainder of the metaphors relate to economic logic ("profit from it," "for free"). This indicates that the economic gain in the form of educational capital ("heaps of knowledge and information") is initially located on the side of the students. The gain of the stakeholders is present within the long-term impact that will influence the decisions of the students who have become leaders. This leads to the reconstruction of a conceptual metaphor such as: The contact with students is an investment in the future. This can also be viewed as a strategic practice because the strategy is to influence the decision-making of future leaders in the present. H.R.'s initial skeptical perspective about the students' intentions and role as moderator changes, because he realizes the students are supporting his goal of a networking process involving regional actors ("bringing together farmers from the region with producers").

H.R. uses metaphors of freshness ("fresh energy", "refreshing newness") for the images, which symbolize the encounters with the students (T2.2 and T4.2). In this regard, the conceptual metaphor can be reconstructed here, with "refreshing" encounters with students positively connected to the experience of difference. Other metaphors point to a process of reflecting on outdated ways of acting and thinking ("breaking old, outdated habits"). In this respect, refreshing refers to the energetic aspect of a moment of trans-epistemic boundary crossing, which is perceived as overcoming the limitations of internalized normalities and traditional ways of acting. While the metaphor of refreshing refers to the effect of the encounter, the metaphor of "catalyst" is more about describing the trigger, in other words, the students

themselves. The metaphor of the catalyst, which is traced back to chemistry, refers primarily to its application in a target area (networking), triggering or energetically accelerating the process of bringing people together. In this respect, an energetic process is described here and refers to the energetic dimension of strategizing, which is not only a rational but also energetic, emotional process. While only a few studies exist in the SAP field that address the role of emotions (Brundin and Liu 2015, p. 632) within organizations, even fewer focus on the role that emotions play between organizations. However, it can be said that positive "affective traits and states, such as being interested [and] enthusiastic affect the ability to think outside the box strategically" (Brundin et al. 2022, p. 10). This is not only explicitly articulated about the students but is also an implicit part of the catalyst metaphor, which refers to the epistemic dimension as well ("sometimes it is making people think"). Thus, it can be said that students are addressed not only in terms of their organizational training but also as those who are able to support new ways of thinking because they are unfamiliar with the previous methods. Tying this back to strategy theory, this is reminiscent of the way new members of an organization question existing strategies because of their low socialization to the community. The difference here is that the students are not part of one of the local organizations (Jarzabkowski 2004, p. 11).

5.5 Perspective on Collective Leadership "Everyone Must Be Committed to Sustainability"

The need for actions formulated by H.R. to bring together the stakeholders to form regional collaborations has already been presented. Subsequently, the students' support of this process was highlighted. The following section now refers to how H.R. perceives this network-building process for collective leadership.

Already in T1, H.R. called for a collective commitment of regional actors, stating that "*everyone* must be committed to sustainability." In T1, he wished for mutual cooperation on "eyesight," symbolized through the image of a rowing boat (T1.3). In T3, he also added that "a willingness on all sides" is needed, which he symbolized again with the rowboat (T3.2) that stands for "working together for a goal." For this to succeed, he said it is crucial to have a vision in mind. The vision of the regional food cycle, here symbolized by a "richly prepared table" (T3.3), is described by H.R. as "happy people, good food, of course, ecological and from the region."

"A Richly Prepared Table for All" Has Not Been Realized Yet, "but Something Like It Has"—Perspectives on the Networking Processes of Regional Actors

The vision of the regional nutrition circle as a "richly prepared table" reappeared in T4 narratively and figuratively (T4.3). H.R. said this vision has not "been realized yet," and a "network hasn't emerged," but something like it has: "contacts, understanding for each other" and also "for the problems of the others." During the process, the interaction with the other actors became "more relaxed or friendly" within the

atmosphere of the "safeness" of the innovation labs. H.R. was also able to establish contact with other farmers, an action he otherwise would not have taken. Within the dialogical group settings, he can recognize that other farmers "had similar problems," which is why they "immediately made contact." H.R. has now reached out to the key players in the region and knows who he can contact if he needs help or cooperation. The innovation labs have strengthened the contacts to the extent that the regional stakeholders no longer introduce themselves and only shake hands because they know each other so well. The innovation labs, therefore, supported the emergence of a position working situation among regional stakeholders.

"In the Group, You Realize Once Again That This Is What It's Worth Working for"—Individual and Collective Leadership

At the end of the one-year process, it became clear to H.R. that the path that the regional actors have started "with the sustainable food cycle is not characterized by quick, short-term successes" and will not "go forward in big steps, only in very small steps." That is why those involved must "constantly keep working on it" and "not be demotivated by setbacks" but "stubbornly keep going."

Through the innovation labs, H.R. said he was "being shown once again that what [I am] doing is actually *right*." This is not something that he said he "noticed in daily life," but within the group he "realized once again that this is what it's worth working for" and that he should "keep going." This dimension of individual long-term commitment within a group of people working toward a common goal can also be seen in the long-distance runner (T4.3), which he associates with a "certain perseverance."

5.6 The Leadership and Strategic Practice of Regional Stakeholders

H.R. addressed the collective dimension across the process in each case with group images that express, on the one hand, a collective effort (rowing, long-distance running) and, on the other hand, focus on a common goal ("a richly prepared table for all"). H.R. first describes the necessity of such a vision ("richly prepared table") and regional actors who follow this vision together. Concerning the collaborative process toward this goal, there is also a process of realization, as H.R. recognizes in the innovation labs that a long-term commitment is needed to achieve the goal. Likewise, he sees the actors actively on the path toward a regional food cycle, and the image of the long-distance runner can be interpreted here as a leading figure in this collective leadership, which is imagined as both a long-term, continuous individual and a collective commitment to a common goal. The difference to traditional ideas is, that the leading figure is not one person, but multiple regional stakeholders. Also, tied back to the idea of *leading from the emerging future*, that was explained before, the vision of a richly prepared table can be viewed as such an emerging future.

In this conception, the successful development of a regional food cycle also requires that stakeholders take over the SL, do not allow setbacks to impede their commitment, and continue to engage stoically ("stubbornly keep going") and continuously ("constantly keep working on it"). In this respect, H.R. also addresses the ability to deal with dynamic, changing, volatile situations and to consider the long term. If one ties this back to the debate about SAP, then this can be understood as a perspective that sees the process, and thus Strategy, as an 'perennially unfinished project' (Knights and Mueller 2004, p. 55) that has a target, but remains open for change within a dynamic world and focuses more on the process than the goal. SL becomes therefore an ongoing, processual activity (Iszatt-White 2010, p. 409).

Against this background, the innovation labs become of particular importance. While H.R. initially addressed the necessary ideal characteristics of perseverance, goal orientation, and continuity, he subsequently described the positive effect of the innovation labs on his perseverance ("encouraged not to let up"), goal-setting ("aspiration"), and continuity ("don't give up, don't give up, just keep going"). This reinforcing effect of the innovation labs is marked as an experience of difference from one's everyday life and is described as a process of recognition ("you realize once again"), which is possible only based on interaction with other actors. In this respect, the encounter with other practitioners is also eventful for H.R., since it shifts his perspective and allows him to understand that his problems are not unique. This led to a networking process, and the contact with other stakeholders allowed him to understand and see his problems as collective. He also assured himself of his commitment through encounters with other stakeholders and their perspectives. In this sense, he was being reassured about his strategic practice ("being shown once again that what you are doing is actually *right*"). These reassuring interactions can be seen as part of strategizing, because this process also includes the interactions of multiple actors in accomplishing strategy (Jarzabkowski et al. 2007, pp. 7–8). The practices and support of the innovation is the setting for regional stakeholders coming together in one place.

From H.R.'s perspective, however, a regional food cycle as part of a circular economy had not yet been established at the end of the program. Although a true network was lacking, something similar had been created, which can be seen in the relaxed and friendly way in which regional practitioners interact with each other.

5.7 The Learning Process Within the Innovation Labs as 'Eventful Knowledge Encounters'

The focus of organizational education is not individual learning. However, individual learning processes are coming into focus at the moment when organizations become relevant as conceptual conditions and influence (Feld and Seitter 2018, p. 86). In this sense, it is interesting how the innovation labs also support a learning process.

The idea of an "eventful knowledge encounter" (Dewe et al. 1992) can be a valuable perspective for analyzing H.R.'s learning process. Dewe et al. (ibid.) have demonstrated in their study about various epistemological of theory–practice and their change over time, that transfer- and transformation-concepts are not suitable to describe what happens within learning processes between theory and practice. This is because theoretical- and practical knowledge are two different structured kinds of knowledge or perspective at the world, and therefore inconsumable. As an alternative, they suggest "eventful knowledge encounters" between theory and practice as an independent, third form of knowledge (ibid., p. 87). Within this encounter, differentiated constructions of reality would remain and would not merge into a common perspective. Instead, encounters of different types of knowledge would take place in the mode of reciprocal labeling, relating, and contrasting as well as pushing perspectives over each other (ibid.).

Regarding the university—more precisely, the innovation labs—it can be seen in the material that the generalized description of the experience with the organizational and network consulting process as enrichment ("definitely enriching") points to a dynamization of H.R.'s perspective and an eventful knowledge encounter. Furthermore, he contrasts this enriching experience with his own history as a farmer ("as what I am so used to in agriculture"). In this sense, the encounter with the university management becomes an eventful experience for H.R. in the sense that he encounters the university's perspective, which in this concrete situation does not look at the process from an agricultural-practical perspective, but from the perspective of organizational education. What H.R. describes can also be interpreted as different worlds of thought and perspectives. On the one hand, the perspective of the producers is seen as one that is biased by thoughts about agriculture while the perspective of the university is "free thoughts about agriculture."

Furthermore, H.R. becomes able to see networking opportunities. As is already quite clear in T1, the people at the university were imagined as unburdened by action in contrast to practice ("when you work like this every day"), so they can dedicate themselves to teaching, learning, and thinking. It is more or less imagined as an institution where the crossing of boundaries is a possible thought and carried out.

The contact with the students also becomes an eventful knowledge encounter for H.R., who sees a perspective different from his own. Through this contact it also becomes possible for H.R. to contrast the training and skills of the leaders within his organization with the organizational pedagogical training of the students. He then concludes that knowledge of the organization is relevant for practice. Contrasted here are practice-relevant knowledge from the field of agriculture ("knows about soil, plants, machine, and animals") and organizational pedagogical knowledge that essentially focuses on SL ("leading people," "organizing discussion groups"). In this sense, he identified the problem that most practitioners are not well trained for such tasks (Kuenkel 2016). Through the encounter with students who apply practice-relevant methodology within the innovation labs, a relationship of similarity between theory and practice becomes possible. This means that what is to be done in the situation in question within the practice and science is related to each other (Dewe 2001, p. 245). The organizational educational knowledge contained in the trans-epistemic

process of the innovation labs can be understood as found or used knowledge and facts (Dewe et al. 1992, p. 79), which H.R. identifies as independent "organizational pedagogical" knowledge. This knowledge is marked as being scientific, as he sees its origin in the department of educational science. Transgenerational learning becomes possible during encounters with the students, which here are perceived as a vitalizing experience. The contrast of age refers to the perceived potential of intergenerational innovation arrangements and the benefit of leadership by the students ("taking them by the hand").

These contacts with the program and the students, can be viewed as an eventful knowledge encounter that led to a shift in H.R.'s perspective, which H.R. addressed in T4. The participatory-dialogic-creative setting of the innovation labs between theory and practice thus successfully supports eventful knowledge encounters. These can become relevant in terms of new strategy development, as new perspectives can be the starting point of collective transformation, a transformational practice, and leadership (Heidelmann 2020, p. 270).

6 Conclusion: Experiencing New Methodological Strategies—Potential for Establishing Alternative Practices in Self-organizing for Collective Leadership

At the beginning of this article, we underlined that Multi-Stakeholder-Partnerships are important for reaching the SDGs and for establishing circular economies. We have also indicated that sustainability leadership or collective leadership can be supported by the university through university-society interlocking formats such as innovation labs. Coming from the Idea of Strategy as Practice, which thinks of Strategy as something which people do, and from the question of how to support the actual practice of 'strategizing' From a SAP perspective, the viewpoint of a regional practitioner and sustainable leader on a concrete organizational, educational project that seeks to create collective leadership was gathered using a longitudinal image-based interview approach and reconstructed by means of a metaphor-oriented analysis approach. The case analysis indicated that the new methodological strategy of innovation labs, facilitated by students, offers a participatory, dialogical space for the participating regional stakeholders. The encounters within the program, with the students, and other stakeholders offers the potential of a learning process in the mode of an eventful knowledge encounter.

With the Innovation labs, the university brought a new methodological setting for developing strategies and collective leadership into the regional field. The program offers new methodological strategies for establishing an alternative practice of self-organization for collective leadership within innovation labs, by using a transepistemic design, which addresses processes and prototypes, strategy development for network-building and the consciousness of regional stakeholders.

Through this, the program initiated a process toward collective leadership. Since this program is only a pilot project and therefore a temporary and not permanent offer, there is a need to integrate such projects within regular training programs in the field of organizational pedagogy and sustainability-related curricula and to anchor them as a continuing education format in order to develop its impact on a permanent basis (Heidelmann et al. 2023/in this volume). However, this does not only require an internal consolidation within the university, but also an external consolidation, i.e. the regional actors must continue the network development and strategy process induced by the university by means of network consultation. The successful establishment of a Food Policy Council (Ernährungsrat Marburg 2020) for the region of Marburg—that was an idea within the innovation lab—can be seen as such an establishment of Collective Leadership as a strategy towards sustainability.

References

Brake A (2018) Prozessorientierung und Längsschnittdesign als Forschungsstrategie der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 307–318

Brundin E, Liu F (2015) The role of emotions in strategizing. In: Golsorki D, Rouleau L, Seidl D, Vaara E (eds) Cambridge handbook of strategy as practice. Cambridge University Press, Cambridge, pp 632–646

Brundin E, Liu F, Cyron T (2022) Emotion in strategic management. Long Range Plan 55(4)

Burns H, Diamond-Vaught H, Bauman C (2015) Leadership for sustainability: theoretical foundations and pedagogical practices that foster change. J Leadersh Stud 9(1):89–100

de Haan G (2008) Gestaltungskompetenz als Kompetenzkonzept für Bildung für nachhaltige Entwicklung. In: Bormann I, de Haan G (eds) Kompetenzen der Bildung für nachhaltige Entwicklung. Springer, Wiesbaden, pp 23–44

Dewe B (2001) Wissenschaftliche Beratung für professionelle Praktiker. Zeitschrift Für Qualitative Bildungs-, Beratungs- Und Sozialforschung 2(2):241–263

Dewe B, Ferchhoff W, Radtke FO (1992) Das "Professionswissen" von Pädagogen. In: Dewe B, Ferchhoff W, Radtke FO (eds) Erziehen als Profession. Springer, Wiesbaden, pp 70–91

Eweje G, Aymen S, Shobod DN, Kazunori K (2020) Multi-stakeholder partnerships. J Mark Intell Plan 39(2):186–212

Ernährungsrat Marburg (2020) Gründung. https://ernaehrungsrat-marburg.de/gruendung/. Last accessed 15 Aug 2022

Feld TC, Seitter W (2018) Weiterbildung/Erwachsenenbildung und Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 83–93

Ferdig MA (2007) Sustainability leadership: co-creating a sustainable future. J Change Manag 7(1):25–35

Forceville C (2008) Metaphor in pictures and multimodal representations. In: Gibbs RW (ed) The Cambridge handbook of metaphor and thought. Cambridge University Press, Cambridge, pp 462–482

Fricke W (2017) Probleme wissenschaftlicher Begleitung von Modellversuchen – vermeidbar durch Aktionsforschung. In: Schemme D, Novak H (eds) Gestaltungsorientierte Forschung. Bielefeld, Bertelsmann, pp 235–267

Geissdoerfer M, Savaget P, Bocken N, Hultink E (2017) The circular economy. J Clean Prod 143(1):757–768

Göhlich M, Novotný P, Revsbæk L, Schröer A, Weber SM, Yi BJ (2018) Research memorandum organizational education. Stud Paedagog 23(2):205–215
Harper D (2002) Talking about pictures. Vis Stud 17(1):13–26
Heidelmann MA (2020) Verantwortung (in) der Organisationsberatung – Organisationspädagogisches Proprium im Plural theoretischer Perspektiven. In: Fahrendwald C, Engel N, Schröer A (eds) Organisation und Verantwortung. Springer, Wiesbaden, pp 259–273
Heidelmann MA, Weber SM, Klös T (2023/in this volume) Collective leadership toward sustainability innovations. In: Leal Filho W, Salvia AL, Beth C, Pallant E, Pearce K (eds) Educating the sustainability leaders of the future. Springer Nature, Berlin
Ioannou I, Serafeim G (2019) Corporate sustainability. Harvard Business School Accounting & Management Unit Working Paper No 19
Iszatt-White M (2010) Strategic leadership. Leadership 6(4):409–424
Jarzabkowski P (2004) Strategy as practice. Org Stud (25)
Jarzabkowski P (2021) Strategy as practice. Sage, London
Jarzabkowski P, Balogun J, Seidl D (2007) Strategizing. Human Relat 60(1):5–27
Junge M (2019) Das Bild in der Metapher. Springer, Wiesbaden
Knights D, Mueller F (2004) Strategy as a "project." Eur Manag Rev 1:55–61
Kuenkel P (2016) The art of leading collectively. Chelsea Green, Vermont
Lakoff G, Johnsson M (2003) Metaphors we live by. Carl-Auer, Heidelberg
Mack O, Khare A, Krämer A, Burgartz T (2015) Managing in a VUCA world. Springer, Heidelberg
Mareis C (2011) Design als Wissenskultur. Transcript, Stuttgart
Nini M (2016) Strategy as practice. Occasional Report 2. https://www.ckju.net/sites/default/files/research/16_02_strategy_as_pratice_uselfway_for_startegic_management.pdf. Last accessed 27 July 2022
Nowotny H, Scott PB, Gibbons MT (2001) Re-thinking science. Polity, Cambridge
Plattner H, Meinel C, Weinberg U (2009) Design-thinking. Moderne Industrie, München
Schäffter O (2014) Relationstheoretische Forschung in der Transformationsgesellschaft. https://gr80.files.wordpress.com/2014/09/relationstheoretische-forschung-in-der-transformationsgesellschaft.pdf. Last accessed 24 Juli 2022
Scharmer O (2007) Theory U. Berrett-Koehler, San Francisco
Scharmer O, Kaeufer K (2013) Leading from the emerging future. Berrett-Koehler, San Francisco
Schmitt R, Schröder J, Pfaller L (2017) Identifikation von Metaphern, Bildung von Konzepten. In: Schmitt R, Schröder J, Pfaller L (eds) Systematische Metaphernanalyse. Springer, Wiesbaden, pp 69–80
Schneidewind U (2018) Die Große Transformation. Fischer, Berlin
Schneidewind U, Singer-Brodowski M (2014) Transformative Wissenschaft. Metropolis, Marburg
Schröer A (2018) Führung als Gegenstand der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 479–490
Thakhathi A, le Roux C, Davis A (2019) Sustainability leaders' influencing strategies for institutionalising organisational change toward corporate sustainability. J Change Manag 19(4):246–265
United Nations (2018) Sustainable development goals. About the sustainable development goals. https://www.un.org/sustainabledevelopment/sustainable-development-goals/. Last accessed 29 June 2022
Weber SM (2014) Change by design!? In: Weber SM, Göhlich M, Schröer A, Schwarz J (eds) Organisation und das Neue. Springer, Wiesbaden, pp 27–38
Weber SM (2018) Strategieentwicklung als Gegenstand der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 595–606
Weber SM, Heidelmann MA (2019) Towards regional circular economies. 'Greening the university canteen' by sustainability innovation labs. In: Leal Filho W, Bardi U (eds) Sustainability in university campuses: learning, skills building and best practice. Springer, Cham, pp 415–435

Weber SM, Heidelmann MA (2021) Im Dispositiv ‚Diskursiver Gestaltung' In: Schröer A, Köngeter S, Manhart S, Schröder C, Wendt T (eds) Organisation über Grenzen. Springer, Wiesbaden, pp 77–91
Weber SM, Heidelmann MA (2022) Images—Imagination—Imaginaries: Epistemic Organizing and Epistemologies of the Visual. In: Cambre C, Barromi-Perlman E, David H (Eds.) Visual Pedagogies. Brill, Boston, pp 37–57
Weber SM, Keller A (2022/forthcoming) Doing knowledge. In: Mensching A, Engel N, Fahrenwald C, Hunold M, Weber SM (eds) Organisation zwischen Theorie und Praxis. Springer, Wiesbaden
Weber SM, Wieners S (2018) Diskurstheoretische Grundlagen der Organisationspädagogik. In: Göhlich M, Weber SM, Schröer A (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 635–647
Weber SM, Heidelmann MA, Adler A (2019) Mit der Engagementwerkstatt Studierende und Freiwilligenorganisationen vereinen. In: Möller C, Rundnagel H (eds) Freiwilliges Engagement von Studierenden. Springer, Wiesbaden, pp 131–152
Weber SM, Göhlich M, Schröer A (2018) Institutionalisierung und Professionalisierung der Organisationspädagogik. In: Göhlich M, Schröer A, Weber SM (eds) Handbuch Organisationspädagogik. Springer, Wiesbaden, pp 831–838
Weisbord MR, Janoff S (2001) Future research. Berrett-Koehler, San Francisco

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Towards a Greater Engagement of Students in Sustainability Efforts

Walter Leal Filho

1 Introduction: Sustainability and the Engagement of Students

For many decades, much has been written about involving university students in sustainability efforts. Since the launching of the UN Sustainable Development Goals in 2015, a new impulse has been provided: more and more higher education institutions have been making a concerted effort to incorporate sustainability into their practices, and engage students in the process.

This process has been supported through a variety of measures such as:

(a) the signature of declarations,
(b) the design of a new curriculum,
(c) the pursuit of sustainable campus practices,
(d) the development of capacity among statt.

Also, the formation of partnerships at a regional and global level (Findler et al. 2019; Lozano et al. 2015) has been supporting the process. However, one of the most powerful means to catalyse developments at higher education institutions is by engaging the students that annually enroll. Both university teaching staff and researchers are constantly testing and developing ways to adequately prepare students to learn about sustainability (Junghanns and Beery 2020). Unfortunately, not all pay attention to the need to actively engage their students.

Yet, students form one of the largest groups of stakeholders at higher education institutions, and can significantly contribute to sustainability if they are provided

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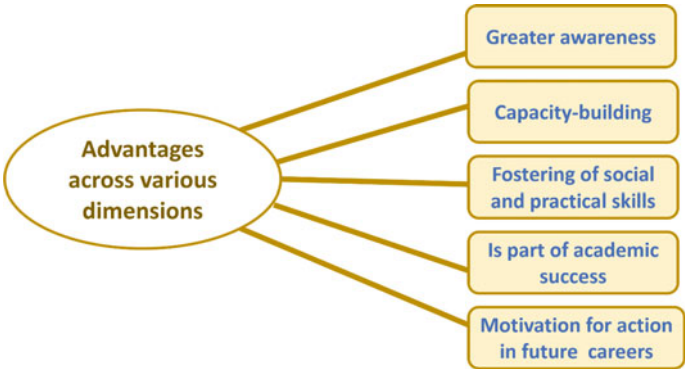

Fig. 1 Some of the advantages of students´ engagement in sustainability. *Source* The author

with the necessary skills and tools (Dagiliūtė et al. 2018) which may enable them to engage. Higher education institutions have the possibility not only to educate and train but also to open the minds of students towards sustainability. Students can develop valuable competencies during training and learning activities. This means they can integrate knowledge from specific themes such as transport, energy, water or wastes towards a broader topic such as sustainability. But there is more to it: practical work may foster skills and attitudes towards a greater engagement in sustainability affairs.

Furthermore, the engagement of students means that they can develop traversal competencies that can be applied in scenarios outside of the professional world. This caters for active and critical citizenship that ultimately benefits the planet and people (Zamora-Polo et al. 2019). Figure 1 presents some of the advantages of the engagement of students on sustainability.

Many researchers have often stressed the fact that higher education institutions can do more as part of their attempts to raise awareness about environmental problems among students. This allows for students to be more conscious of actions on campus on the one hand, and thereafter translate the same consciousness when in the workplace, on the other. This is particularly beneficial as some students will take up work in management, science, legislation, and governance in the future, and thus can promote sustainability at a local, national, and global level (Fissi et al. 2021).

Some studies have shown that a systematic involvement of students in sustainability initiatives may also support institutional efforts such as becoming green higher education institutions. Students are more likely to partake in sustainable initiatives on campus if they are shown the key role they can play in the process of understanding and solving problems (Dagiliūtė et al. 2018).

Students are vastly considered as agents of change in various fields. They have the power to develop into leaders and ambassadors for sustainability, based on the foundations and knowledge acquired during their time at universities. This being said, many higher education institutions have over the years actively involved students in green or sustainability initiatives. In countries as varied as the UK, United States,

Spain, Netherlands, or Brazil, some institutions have set up Green Campus Initiatives (or Green Offices) with the aim of systematically engaging students as part of efforts to pursue a more sustainable campus, and/or a greener campus environment. Such works ensure the dissemination of sustainable development concepts at campuses and improve students' knowledge and proactivity in terms of sustainability. There is evidence that this has significantly led to increased sustainability outputs (Ribeiro et al. 2019).

Furthermore, higher education institutions face many financial constraints while implementing sustainability and in going green. Considering students form a large percentage of the campus community, their purchase power may considerably assist with greening activities. Students are likely to contribute financially to sustainability initiatives, provided that are aware of the problems and responsibility and active citizenship are raised. Studies indicate that students' willingness to pay for sustainability-related initiatives ranges from US$10,00 to US$ 18 (González-Ramírez et al. 2021). Collectively these sums can significantly assist in support of sustainability programmes, allow students to have a voice in sustainability, shape the agenda of higher education institutions, and work closely to create a green campus and community (González-Ramírez et al. 2021).

In many instances, students are the key players in campus-community initiatives. This is the case in many of the students-led Green Offices such as those at the University of Maastricht, in the Netherlands. On such occasions, they can bridge the gap between the university administration and the academic community, i.e. working with the support of senior management. They can catalyse processes occurring between the university and the surrounding communities. Furthermore, they have the ability to develop stronger community-university partnerships and advance sustainability transitions, especially if most students are from these communities (Budowle et al. 2021).

Students at higher education institutions can also promote sustainability through the transformation of their campus operations. This includes greening initiatives to ensure an environmentally friendly campus (Gui et al. 2021). This can be significantly enhanced by student engagement in areas as varied as clean transportation, recycling, waste management, water usage, and food wastage (Bennett and Alexandridis 2021; Hidalgo-González et al. 2022; Li et al. 2021).

2 Barriers to Involving University Students in Sustainable Development

Higher education institutions bear a great responsibility for transforming societies and contributing to a more sustainable society (Barth and Rieckmann 2012). They can create and implement sustainability concepts in a variety of fields, such as curricula and education, research, and institutional structure (Lozano et al. 2015; UNESCO 2012). However, despite the progress achieved to date, there are still several barriers

to sustainability, and which inhibit efforts to include it in the operation of universities (Leal Filho et al. 2017). According to Dahle and Neumayer (2001) and Brandli et al. (2015), the main barrier to sustainability in higher education is a lack of budget and financial resources for sustainability projects. In addition, whereas much research on matters related to sustainable development has been undertaken in recent times, only a few studies have taken into account students' opinions on sustainability (Elliott and Wright 2013).

Barth and Rieckmann (2012), suggested that many higher education institutions have faced great challenges in changing their already existing curricula to incorporate sustainability. In most higher education institutions, activities in areas such as research, teaching, and management have left no room to implement sustainability efforts (Brandli et al. 2015). According to a study to determine the barriers and challenges of applying sustainability in Brazilian higher education institutions, most Brazilian universities have lacked strategies in their institutional programmes, that motivate their academic staff and students to involve in sustainability (Brandli et al. 2015). The study mentioned other challenges like lack of sustainability knowledge, lack of resources to fund sustainability projects, and lack of cooperation between higher education institutions to be among the barriers to involving students in sustainable development. According to Brandli et al. (2015), most higher education institutions also do not have senior and experienced staff to oversee the implementation of sustainable development initiatives among students.

A study by Elliott and Wright (2013) showed that students realize that they are part of the change. Motivated students are one of the resources to develop sustainable and pioneering solutions Veiga Ávila et al. (2019). A study conducted by Mawonde and Togo (2021), revealed that barriers to students of the University of South Africa (Unisa) being involved in SDG projects are the great distance between the university management and the students, financial shortage, time deficit, misconceptions, and lack of interest in SDGs.

Another study undertaken to determine the barriers to the implementation of sustainable development in higher education institutions in Namibia reported dispositional barriers as the major obstacles to integrating sustainable development at universities in the country (Kanyimba et al. 2014). According to the results of the study, most lecturers had a hard time incorporating sustainable development into their lectures because they lacked sufficient skills and the ability to incorporate sustainable development into subjects. The results of the study reported that 31% of the respondents admitted that they did not teach sustainable development concepts in their courses while 12% were not sure whether they did (Kanyimba et al. 2014). The study also highlighted institutional barriers like schedules, rules, and systems as some of the reasons which have hindered initiatives in this field.

A study by Weiss et al. (2021), identified a lack of interdisciplinary competence of university faculty as the main barrier to implementing sustainability in the curriculum in higher education. Other common barriers identified by Weiss et al. (2021) were:

(a) bureaucracies in the organizational structure of HEIs,
(b) lack of incentives to motivate the staff to infuse curricula development in their courses,
(c) a structure that does not encourage the introduction of sustainability topics,
(d) lack of collaboration to share knowledge and resources within the institution, and
(e) limited time and qualified personnel.

The results of the study also reported that a lack of strong leadership was linked to low levels of involvement of students in sustainable development practices.

Table 1 provides an overview of some of the items which have been leading to a limited success- or failures- in involving students in sustainability.

Moreover, the choice of pedagogies that use activating techniques, which can add value to the teaching, is not always favoured. In this case, good opportunities to deploy diversified teaching methods which may motivate and encourage the engagement of students, are missed.

Against this background, it is important that higher education institutions should consider fostering transformative changes, so as to successfully develop an institutional understanding of sustainable development, and include it in the educational curricula. Since much depends on those teaching, the right mindset of teaching staff is important in creating opportunities for better inclusion of sustainability in teaching practices.

Table 1 Some of the factors inhibiting the implementation of sustainability at higher education institutions

Item	Impact
Poor course design	Courses failing to properly tackle sustainability
Lack of links with regional and local issues	Missed opportunity to cater for a greater understanding of regional and local matters
Length of teaching programmes	Unsuitable workloads, insufficient to tackle all key issues
Inappropriate teaching methods	An unbalanced combination of classroom activities and fieldwork
Lack of coherence between courses	Duplication of contents
Inadequate teacher-student-ratio	Prevents a better interaction and supervision of students
Focus on contents	Lack of emphasis to competence-building
Limited quality control	Limited measures to monitor progress and quality of the work done
Disciplinary approach	Emphasis on one discipline, overlooking the contribution of others

Previous experiences have shown that higher education institutions that infused sustainability in their research and campus operations are more likely to fully implement sustainability in their curricula (Weiss et al. 2021). According to Kanyimba et al. (2014), strategies to involve students in sustainable development must address the information needs of individual lecturers, the individual characteristics of each higher education institution, and avail teaching resources to support staff.

3 Conclusions

Against the background here provided, a key question that may be posed is: how best to engage students in sustainability efforts at universities? Some of the measures which may be deployed to achieve this goal are:

(a) Selection of the contents that matter: Select and insert in the curriculum, in a participatory manner, what matters, leaving aside the contents that do not make sense, do not apply to the context, and therefore, for this very reason, are not applicable, that do not make sense, that does not apply to the context, and therefore do not generate significant learning.
(b) Use new technologies as a means of teaching: new technologies should be part of education today, just as the book and the pen are. This contemporary curriculum should also include content that encourages good levels of digital literacy, with the development of skills appropriate to the new technologies should also be included in this contemporary curriculum. Even more fundamental is the integrated use of new media to support the learning process.
(c) Foster collaboration among students: the world is increasingly complex, and because of this collaboration is a condition without which there will be no survival.
(d) Application of active methodologies, moving away from the idea that the student is a simple coadjuvant in the learning process and enforcing the notion that the student has an active role in this process.
(e) A greater orientation towards personalised learning: personalised education is the one that provides students with easy access to the contents they need, and at the same time, looks at the different characteristics of each student and how each one learns.

It is also important to bear in mind that curricular changes (progressive) and improvements need to be seen against a background of institutional changes (transformational), as seen in Fig. 2.

As support measures, adaptive teaching platforms may help in the processes of personalization of learning, as they use intelligent software that personalizes the teaching, adapting it to meet the specific needs of a given student.

Moreover, it is important to regard efforts to engage students as **long-term** ones, and not as one-off initiatives since they need a continuation to yield long-term benefits.

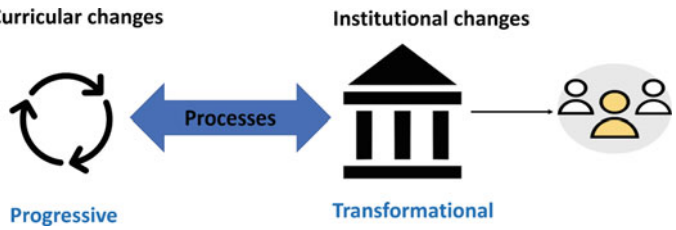

Fig. 2 Two main scenarios of inclusion of sustainability at universities. *Source* The author

Current research shows that, by the year 2030, around two billion jobs will disappear because they will be obsolete due to automation. This is an expected process, given the increasingly common technological innovations. Some examples of professions that, according to trend analysts, are in danger of decreasing and, in some cases, even disappearing due to the automation of work are travel agents, postmen, telemarketing operators, taxi drivers, file clerks, typists, supermarket cashiers, and even banking. This trend illustrates the need for updating and upgrading the skills of those working in these fields.

In all these areas, a sustainability dimension can be found. Therefore, professions that now seem in danger, may benefit from adding or tackling the sustainability dimensions of the work associated with them. This will not only offer them an opportunity to continue to be relevant, but also open the way for a new orientation of the work, and the jobs, making them, themselves, more sustainable in the long term.

References

Barth M, Rieckmann M (2012) Academic staff development as a catalyst for curriculum change towards education for sustainable development: an output perspective. J Clean Prod 26:28–36. https://doi.org/10.1016/j.jclepro.2011.12.011

Bennett EM, Alexandridis P (2021) Informing the public and educating students on plastic recycling. Recycling 6(4):69. https://doi.org/10.3390/recycling6040069

Brandli LL, Leal Filho W, Frandoloso MAL, Korf EP, Daris D (2015) The environmental sustainability of Brazilian universities: barriers and pre-conditions BT. In: Leal Filho W, Azeiteiro UM, Caeiro S, Alves F (eds) Integrating sustainability thinking in science and engineering curricula: innovative approaches, methods, and tools. Springer, Cham, pp 63–74. https://doi.org/10.1007/978-3-319-09474-8_5

Budowle R, Krszjzaniek E, Taylor C (2021) Students as change agents for community-university sustainability transition partnerships. Sustainability 13(11):6036. https://doi.org/10.3390/su13116036

Dagiliūtė R, Liobikienė G, Minelgaitė A (2018) Sustainability at universities: students' perceptions from Green and Non-Green universities. J Clean Prod 181:473–482. https://doi.org/10.1016/j.jclepro.2018.01.213

Dahle M, Neumayer E (2001) Institutions in London, UK overcoming barriers to campus greening. Int J Sustain High Educ 2(2):139–160

Elliott H, Wright T (2013) Barriers to sustainable universities and ways forward: a Canadian students' perspective. The 3rd world sustainability forum. https://doi.org/10.3390/wsf3-f006

Findler F, Schönherr N, Lozano R, Reider D, Martinuzzi A (2019) The impacts of higher education institutions on sustainable development: a review and conceptualization. Int J Sustain High Educ 20(1):23–38. https://doi.org/10.1108/IJSHE-07-2017-0114

Fissi S, Romolini A, Gori E, Contri M (2021) The path toward a sustainable green university: the case of the University of Florence. J Clean Prod 279:123655. https://doi.org/10.1016/j.jclepro.2020.123655

González-Ramírez J, Cheng H, Arral S (2021) Funding campus sustainability through a green fee—estimating students' willingness to pay. Sustainability 13(5):2528. https://doi.org/10.3390/su13052528

Gui X, Gou Z, Lu Y (2021) Reducing university energy use beyond energy retrofitting: the academic calendar impacts. Energy Build 231:110647. https://doi.org/10.1016/j.enbuild.2020.110647

Hidalgo-González C, Rodríguez-Fernández MP, Pérez-Neira D (2022) Energy consumption in university commuting: barriers, policies and reduction scenarios in León (Spain). Transp Policy 116:48–57. https://doi.org/10.1016/j.tranpol.2021.10.016

Junghanns J, Beery T (2020) Ecological sanitation and sustainable nutrient recovery education: considering the three fixes for environmental problem-solving. Sustainability 12(9):3587. https://doi.org/10.3390/su12093587

Kanyimba A, Hamunyela M, Kasanda CD (2014) Barriers to the implementation of education for sustainable development in Namibia's higher education institutions. Creat Educ 5:242–252. https://doi.org/10.4236/ce.2014.54033

Leal Filho W, Wu Y-CJ, Brandli LL, Avila LV, Azeiteiro UM, Caeiro S, da Madruga LR (2017) Identifying and overcoming obstacles to the implementation of sustainable development at universities. J Integr Environ Sci 14(1):93–108. https://doi.org/10.1080/1943815X.2017.1362007

Li J, Li W, Wang L, Jin B (2021) Environmental and cost impacts of food waste in university canteen from a life cycle perspective. Energies 14(18):5907. https://doi.org/10.3390/en14185907

Lozano R, Ceulemans K, Alonso-Almeida M, Huisingh D, Lozano FJ, Waas T, Lambrechts W, Lukman R, Hugé J (2015) A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey. J Clean Prod 108:1–18. https://doi.org/10.1016/j.jclepro.2014.09.048

Mawonde A, Togo M (2021) Challenges of involving students in campus SDGs-related practices in an ODeL context: the case of the University of South Africa (Unisa). Int J Sustain High Educ 22(7):1487–1502. https://doi.org/10.1108/IJSHE-05-2020-0160

Ribeiro AG, Downward GS, de Freitas CU, Neto FC, Cardoso MRA, de Oliveira M, Hystad P, Vermeulen R, Nardocci AC (2019) Incidence and mortality for respiratory cancer and traffic-related air pollution in São Paulo, Brazil. Environ Res 170:243–251. https://doi.org/10.1016/j.envres.2018.12.034

UNESCO (2012) Shaping the education of tomorrow. United Nations Educational, Scientific and Cultural Organization, Paris. http://unesdoc.unesco.org/images/0021/002166/216606e.pdf102

Veiga Ávila L, Beuron TA, Brandli LL, Damke LI, Pereira RS, Klein LL (2019) Barriers to innovation and sustainability in universities: an international comparison. Int J Sustain High Educ 20(5):805–821. https://doi.org/10.1108/IJSHE-02-2019-0067

Weiss M, Barth M, Wiek A, von Wehrden H (2021) Drivers and barriers of implementing sustainability curricula in higher education—assumptions and evidence. High Educ Stud 11(2):42. https://doi.org/10.5539/HES.V11N2P42

Zamora-Polo F, Sánchez-Martín J, Corrales-Serrano M, Espejo-Antúnez L (2019) What do university students know about sustainable development goals? A realistic approach to the reception of this UN programme amongst the youth population. Sustainability 11(13):3533. https://doi.org/10.3390/su11133533