Education for Sustainability: Integrating Climate Change and Energy into Lifelong Learning Initiatives for Small Island Developing States

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Abstract Human resources resemble a crucial bottleneck in certain parts of the world, as a lack of qualified human resources can hinder the introduction of renewable and energy efficient technologies, as well as the wider application of appropriate technology and, even more importantly, maintenance of those technologies. Concerning capacity building, for example in the field of sustainable energy, recommendations include the use of lifelong learning measures such as dedicated capacity building and continuous professional development programmes, or the extension of curricula to better prepare learners for employment in green economic sectors. These short and longer-term measures should focus on building interdisciplinary, multidisciplinary skills and knowledge as required in sustainability related jobs. This chapter addresses the challenges and opportunities which open online interventions, such as massive open online courses (MOOCs), combined with open educational resources (OER), can offer to provide wider and free access to interdisciplinary high quality knowledge provision. An area for which this is in high demand is energy access, energy security and energy efficiency (EASE) and its relation to climate change, for which there is a growing demand across professions and age levels, and a deficit especially in the developing world. This will be illustrated through the key online component of a dedicated lifelong learning model developed by the European funded EDULINK project L3EAP (short for

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"Lifelong Learning for Energy Access, Security and Efficiency in African and Pacific Small island Developing States"). It is argued that approaches like the L3EAP mentored MOOC have the potential to play an important role in building and strengthening human capacities in less developed regions of the world, where awareness of and knowledge about sustainable energy technologies and climate change can be lacking. The authors conclude that embracing ICT solutions can be a valuable cross-cutting measure to address the lack of human capacity in distant, less developed and remote locations, such as Small Island Developing States (SIDS), which may constrain a quicker uptake of sustainable energy technologies.

Keywords Mentored MOOC · Sustainable energy · Open educational resources Small island states

Introduction

Human resources resemble a crucial bottleneck, preventing parts of the world from entering more sustainable development pathways. A lack of qualified human resources still constrains the introduction of renewable and energy efficient technologies as well as the wider application of appropriate technology in Small Island Developing States (Innis 2012). The lack of qualified local personnel for maintenance of those technologies may further threaten progress in achieving the Sustainable Development Goal #7 which aims to ensure access to affordable, reliable, modern and sustainable energy for all. This is even more crucial for developing nations. Small Island Developing States (SIDS), for example, are constrained by some inherent characteristics, e.g. remoteness, small population, size of land, institutional infrastructure e.g. higher education institutions (HEI), and access to finance. At the same time, however, SIDS are highly susceptible to impacts of climate change as they are often located in regions where sea-level rise and extreme events such as cyclones, flooding and droughts already severely impact national development today (UNEP 2014). Many SIDS are heavily dependent on oil to fuel their economies and, correspondingly, national development. As such, exploitation of renewable energies such as solar, wind, geothermal and other types for production, combined with increasing energy efficiency in production and consumption, promises a significant opportunity to reduce the economic burden and dependence on fossil fuels, increasing sustainable development while contributing to the provision of cleaner energy supplies.

For SIDS, the qualification of its island workforce, such as through formal education, can be costly both on institutional as well as on individual levels. Informal educational measures, openly accessible knowledge and free educational offers become more and more important, not only for younger generations who grew up with internet technology but, in fact, all age groups. The buzzword 'lifelong learning' refers to the range of educational formats—in classroom settings, outside the classroom or online—, comprising general education, vocational

education, vocational training, non-formal education as well as informal learning undertaken throughout life which ideally leads to new knowledge, improved skills and strengthened competencies.

First and foremost, online learning activities are often regarded as one possible way to reduce costs of instruction. Referring to higher education institutions (HEI), Yuan and Powell (2013:17) claim that "higher education is already experiencing a period of unprecedented change worldwide", and the cost of funding was a major driver of this change which appears to be valid for both the developed as well as developing world. Moreover, online learning activities may serve to attract new sources of funding, reach out to new and external learners and even improve the quality of teaching and learning through embedding innovative formats and types of media that address learner behavior and labor market needs. Wolf et al. (2018:1) add that "embracing ICT solutions, in the area of energy, can be a valuable crosscutting measure to promote education for sustainability and address the chronic human capacity problem that constrains the quicker uptake of sustainable energy technologies in SIDS". How HEI may support such development will be briefly elaborated in the following chapters.

Chances and Drivers of ICT-Based Capacity-Building for Higher Education

When assessing the potential for ICT to be used in capacity-building, it needs to be considered that such mediated online learning arrangements fundamentally differ from on-site trainings (Siemens et al. 2015; Muilenburg and Berge 2005). Those who are working in the dynamic fields of renewable energies (RE), be it practitioners implementing RE technologies or educators at HEI who are teaching tomorrow's RE professionals, face the need to continuously update their knowledge and skills to meet the demands of working and academic environments (Wolf et al. 2018). This underscores the relevance and growing demand for lifelong learning opportunities that enable individuals to continuously update their knowledge levels and skills throughout their working lives, i.e. build new and strengthen existing capacities.

Regarding formal and non-formal education, and fueled by the inception of the Internet, digital technology has, by now, been adopted by higher education institutions (HEI) and beyond, for teaching and learning on and off campus all over the world (Kirkwood and Price 2016:1). Digital media can be utilized for classroom teaching, in blended learning contexts where learners participate in both classroom and digital sessions, as well as fully online, such as in virtual classroom settings, which might have online lectures or modular courses. These are, increasingly, developed in the form of massive open online courses (MOOCs), and offered both by providers of formal education, i.e. HEI, as well as private actors. There are three main drivers especially for HEI to develop such openly accessible online courses:

They expand access to higher education to a broad(er) audience, they allow HEI to create a space for experimentation with online teaching and learning, and they serve to extend the HEI's brand, helping them to gain international reputation. Generally, private companies reach out to learner groups that may not resemble the 'core' target groups of universities, for example learners who lack resources, time or entry qualifications for formal education offers yet strive to strengthen existing or build new capacities, or improve existing skills and competencies (Yuan and Powell 2013:8).

From a learner's point of view, openly accessible online learning can resemble a cost-efficient, convenient measure to foster lifelong learning, and more and more HEI have started to embrace such online approaches for a number of reasons. Firstly, there has been an increase in the availability of appropriate technological infrastructure as well as in the acceptance of online learning. This is reflected in increased digital literacy of learners, who nowadays have fewer barriers to be able to master digital technologies and their related hardware, and in the growing number of educational offers of various kinds (DiMaggio and Hargittai 2001; Wolf et al. 2018). Online learning offers a range of degree courses, from fully free and open to paid. For example, the Massachusetts Institute of Technology (MIT) started offering open online courses already in 2002 (Yuan and Powell 2013), whereas the major universities in SIDS regions, for example, the University of the West Indies (UWI) in the Caribbean, offers over forty paid full-time online degree programmes in various disciplines, indicating popularity and acceptance of online learning in SIDS (http://open.uwi.edu/programmes). Relating to HEI and their online learning offers, Yuan and Powell (2013:17) suggest a "significant momentum behind the concept of free and open access to high quality university learning, and it is likely that content and courses will continue to be promoted resulting in more MOOCs and other types of open education approaches emerging."

Openness is another driver of educational innovation and is expected to lead to further transformation of higher education. According to Yuan and Powell (2013:6), the concept of openness in education- relating to the free sharing of knowledge through which demographic, economic, and geographical barriers to learning may be overcome—had already evolved in the early 20th century. Referring to small island populations, the growing openness in online learning can thus provide great opportunities to access the latest know-how and expertise, to support lifelong learning. OER are characterized as openly accessible resources, i.e. downloadable via the internet, for which the creator explicitly permits their use by third parties for teaching and learning as well as non-commercial or commercial usages. Creative Commons licenses are the means to clearly define the type of use, i.e. if the OER may only be used or if it could even be changed and used in further settings by others (Mruck et al. 2013). By now, there is an established open educational resources (OER) movement comprising a wide range of organisations, governments, institutions, educators and learners from all over the world who fund, support, develop and use OER (Yuan and Powell 2013:18). Also city governments have become interested in seizing opportunities of OER to increase the leverage of academic knowhow. One example of this is how the Hamburg Open Online

University (HOOU) bundles all OER material developed by the higher educational and research institutions of The Free and Hanseatic City of Hamburg in Germany, on an openly accessible platform for its citizens (see: www.hoou.de).

While academics, like in the case of the HOOU, explore and experiment with the development of OER material, such as small content used for teaching and learning, the literature suggests that open courses such as MOOCs have the power to influence existing teaching processes, It is argued that educators can take part in, and share their knowledge in, open courses facilitated by others, and through this, learn and explore the pros and cons of various online learning approaches in different learning contexts (Yuan and Powell 2013:18).

A number of motivations exist for the development and use of MOOCs, as well as the participation in MOOCs. For universities and educational institutes, this could include to increase reach and flexibility of offered coursework, as well as for cost drivers as technology assisted learning can do (Kirkwood and Price 2016) or to strengthen, support or supplement parts of curriculum of a program. Zheng et al. (2015) examined the motivations for learners to do MOOCS and found that they cover reasons such as complementing their studies or work, to assist in improving their employability, and for curiosity, amongst other things.

Complementing this, a study conducted by the Duke university singled out four categories of learner motivations: (i) Tapping into new areas of knowledge; (ii) Personal challenge combined with social network aspect; (iii) Simplicity and convenience; and (iv) Curiousness to explore online education (Belanger et al. 2013).

Opportunities and Challenges of Massive Open Online Courses

Technological advances have facilitated the development of online learning environments, which can enable learning across distances. Online resources can be used to support traditional learning methods to improve learning outcomes and can be utilized in a fully online or blended online and classroom manner (Nguyen 2015), in groups or by individuals (Keegan 1998). A study by Nguyen (2015) surprisingly revealed null findings for the difference of online learning to traditional face to face learning.

Massive Open Online Courses (MOOCs)

While MOOCs are a form of online learning, there are some significant differences between virtual learning environments and MOOCs. This can include things such as the accessibility and openness that MOOCs can have, which can differ from

virtual learning environments, as well as the scales generally operated on, for example (Zheng et al. 2015).

MOOCs, as their name may suggest, are courses that are massive in scale, open and online, however there is still some contention around having a clear definition (Kay et al. 2013). Massive in scale refers to the number of participants (Waks 2016) (Hood and Littlejohn 2016), and there can be significant variation in these such numbers while still having the course fall under the MOOC banner. The 'openness' of a course, according to Hood and Littlejohn (2016) can have a number of meanings such as such as access, cost, that the knowledge is open or that it is open to be reused and developed further and as can the 'online' nature of MOOCs, which could be fully online or blended. As such and in general, a MOOC is an online course that is theoretically accessible to large groups of people.

Classification Schemes

The two main ways that MOOCs have been traditionally characterised as are either 'xMOOCs' or 'cMOOCs'. xMOOCs typically have a more traditional course and lecture format, but are extended and online; these have been known as the most commonly represented, and the most common types of MOOCs (Kay et al. 2013). cMOOCs, also known as connectivist MOOCs are ones which rely upon the generation of knowledge through participation of learners, and creation of course content through interaction and communication with each other (Kaplan and Haenlein 2016). As such cMOOCs might rely upon use of social media, and discussion forums as a central part. Although this classification system as xMOOCs or cMOOCs has been commonly used and referred to, some sources suggest that this system is insufficient to capture the diverse natures of these types of courses and their unique attributes (Conole 2014), and there are other ways that they have been described.

There are diverse characteristics and attributes that MOOCs can have, which can be used to classify them in different ways. Considering time, courses can be synchronous or asynchronous, meaning that learners are carried through the course at the same time, or can access it in their own time, respectively. As such these courses have sometimes be labelled as SMOCs, synchronous massive online courses or SSOCs synchronous small online courses (Kaplan and Haenlein 2016). The degree of 'openness' of a course can give rise to variation of MOOC look-alikes, such as SPOCs, small private online courses (Hood and Littlejohn 2016; Hashmi 2013).

Some MOOCs are labelled based on their purpose, such as the use of MOOCs4D, MOOCs for development (Castillo et al. 2015), which can serve to increase reach and information flows and build capacity for sustainable development outcomes, for example. Clarke (2013) proposed a list of 8 different types of MOOCs that take into account some of the main characteristics, such as origin, time and size. These

included: transferMOOCs, madeMOOCs, synchMOOCs, asynchMOOCs, adaptiveMOOCs, groupMOOCs, connectivistMOOCs and miniMOOCs.

Finally, Conole (2014) proposed 12 dimensions that could be used to classify MOOCs which were: the degree of openness, the scale of participation, the amount of use of multimedia, the amount of communication, the extent to which collaboration is included, the type of learner pathway, the level of quality assurance, the extent to which reflection is encouraged, the level of assessment, how informal or formal it is, autonomy, and diversity. These dimensions and different named classifications confirms that there is huge diversity in types and broadness in the definition of what a MOOC is.

Challenges and Opportunities

One of the major challenges facing MOOCs is that there is no agreed upon and robust way, or set of metrics, to measure quality and impact of MOOCs and to compare between different MOOCs (Hood and Littlejohn 2016; Onah et al. 2014). A very common metric used is drop-out rates, which can be contributed to by factors such as; student intent to complete or not, lack of time, difficulty and lack of support, amongst other things (Onah et al. 2014). Measurement of MOOC quality by drop-out rates alone has been heavily criticised, and it is recommended that contributing factors need to be taken such as participant motivations (Daradoumis et al. 2013). A metric related to drop-out, but looked at across the duration of the MOOC is persistence, as explored by Breslow et al. (2013). This can capture how far through a course students move before dropping out, and might imply how much benefit a student received from the course prior to dropping out. In general it is recommended that caution is applied to understand any metrics used (Hood and Littlejohn 2016) when evaluating the quality of a MOOC or comparing between them. Context specific metrics that reflect the unique nature of participants and their motivations, as well as course outcomes might appropriate for assessing the quality and success of MOOCs.

Aided by their ‘open’ nature, the ability to attract diverse participants from around the world and with varying levels of education is a strength of MOOCs, however this is not always fully realised (Hood and Littlejohn 2016; de Waard et al. 2014). It has been noted that ‘access’ for people in developing countries can be quite complex with a number of barriers including infrastructure access, digital literacy and language barriers (Liyanagunawardena et al. 2013). In general, MOOCs have potential to be open and accessible, but on a case-by-case basis the limitations need to be understood, especially in the context of developing countries, and where the content is designed to help sustainable development.

An additional challenge relates to online learning characteristics: As this kind of learning takes place virtually, i.e. not in a physical classroom, and without direct face-to-face interaction with fellow learners, online learners need high self-discipline, intrinsic motivation, and personal commitment, aspects which are

required for reflection and self-organization of one's own learning process (Zawacki-Richter et al. 2009; Anderson 2008).

Comprehensive e-tutoring and a learning community have been identified as key ingredients that will enable learners to successfully work in a self-determined, self-paced manner that is a typical feature of open online arrangements—the literature suggest that less than 10% of online learners are able to do without such facilitation and motivating learning community (LI 2017).

A significant opportunity within MOOCs is their ability to be tailor made to different contexts and suit different specific needs, and this is aided by their open access and online nature. A clear example is the use of MOOCs for capacity building and specific local needs of developing contexts, and specific purposes and demographics (Castillo et al. 2015). In terms of their structure, it has also been suggested by Zheng et al. (2015) that MOOCs can be tailored to meet motivations of participants including a "learning-driven" or a "certificate-driven" approach. If such courses are then designed in a modular way, and if learners are awarded by ideally bankable credits, this can increase learners' motivations (Yuan and Powell 2013). The collection of large amounts of data also presents an opportunity to learn (Breslow et al. 2013) and even to tailor make and improve courses. Other opportunities include the use of automated tools to streamline MOOC processes (Daradoumis et al. 2013), and creativity in the interactivity to increase engagement (Gené et al. 2014).

A significant strength of MOOCs also include their ability to facilitate social interaction and engagement between participants, both formally and informally, internally and external to the course (Zheng et al. 2015). This can lead to increased networks extending beyond the course and for continued collaboration supporting further learning.

Finally, through their flexibility and openness, MOOCs can support lifelong learning by principle as they "may also contribute to balancing work, family and social life (…) encourage more mature students to participate in higher education and gain qualifications to further their careers (Yuan and Powell 2013:18)." An example of an open online course that addressed the various opportunities and constraints by means of a unique mentored approach will be presented in the following chapter.

The L3EAP Online Learning Course "Sustainable Energy for SIDS"

In the frame of the Europe Aid project L3EAP (www.project-l3eap.eu), a mentored modular open online course has been developed, targeting distinctive audiences located on Small Island Developing States and which takes a constructivist approach to teaching, i.e. providing learners with hand-on knowledge and actionable outcomes.

Based on a survey of training needs that explored the learning preferences and characteristics of energy practitioners and academics in Fiji, Mauritius and Germany, a lack of formal educational programmes and non-formal training schemes focusing on EASE topics was identified (L3EAP 2017). In their analysis of the online course, Wolf et al. (2018) describe three crucial requirements for the design of such programmes that would need to be considered to meet the distinctive learning needs of practitioners and academics:

- Convenience—modular segments of short duration, ideally with close tutorial facilitation;
- 24/7, on demand availability—allowing to match individual work schedules and different times zones in which learning would take place; and
- High level of interaction with fellow SIDS learners and SIDS experts—fostering the transfer of contextualized knowledge, appropriate technologies and applicable skills.

This resulted in a two-stream lifelong learning model applied by the EU project, with one stream offering specific training courses on EASE topics to build local capacity in SIDS and the other stream resembling a generic online course on EASE (L3EAP 2017). How this second stream integrates the aforementioned considerations is further elaborated on below.

Profile

In 2016, the L3EAP partner consortium, in close collaboration with the Hamburg Open Online University, developed and implemented a six week long open online course on "Sustainable Energy for SIDS" with more than 1000 learners, hereof 54% from SIDS and 46% from the rest of the world, with a completion rate of about 13%. The e-course aimed at introducing an international community of heterogeneous learners to theoretical concepts, methods and distinctive real-life cases from two SIDS regions, the Pacific and the Indian Ocean. The pilot course comprised a range of learning material (videos, training booklets, quizzes, assignments, case studies). An iteration of the course with a slightly adapted, improved design took place in early 2017, reaching out to 750 learners this time.

With this concept, the L3EAP partners intended to provide an open learning opportunity that met distinctive needs of SIDS regarding sustainability topics, included transnational knowledge transfer, was grounded in real-life cases, and allowed for international networking. The design as a fully virtual course enabled implementation and facilitation without geographical or time zone related restrictions. Due to open access, a heterogenous learner group of university students, academics, members of public authorities and practitioners of various ages and from 29 out of 38 small island states (plus further countries) took part.

In anticipation of reaching out to a heterogenous learner group located on islands all over the world, Wolf et al. (2018) stated that the course was developed as a

MOOC from the very beginning. The course designers considered a set of specific conditions for course development:

- Access to state-of-the-art knowledge, expertise and a high diversity learning community;
- Collaborative learning arrangement driven by topical interest that supports peer-to-peer interaction;
- Use of open educational resources to support the dissemination of rights-free learning material to stakeholders outside the course, e.g. other universities; and
- Consideration of future iterations after pilot course evaluation and closing of the EU project.

The didactic design of the online course can be labelled as learner-centric and competencies-based. As Bretschneider and Pflaum (2016:112) found little scientific grounding or even an agreed upon definition of learner-centrism in the German-speaking literature, they suggested that learner-centric design resembles a fusion of two different perspectives, one being the learner-oriented approach known from education, the other being learner-centrism applied in user-centred software development (Pflaum and Wolf 2018).

Methodologically, the online course developers determined their key target groups according to a user-centered design approach which focuses on the development of computer-based products for and with the potential users (Abras et al. 2004). This approach puts the potential users, their existing knowledge and skills, their motivation and capacities, or learning requirements, at the heart of interactive systems development.

Over six weeks, the online course followed a certain modular structure that allowed learners each new week to access new content. The concluding week seven comprised of reflection, the evaluation of the final assessment and the official farewell. The final assessments served as means to evaluate if the overall learning objectives had been achieved, i.e. gaining new knowledge and skills. Consequently, the content, methods and tasks were designed in a way that learners were enabled to write an empirically grounded energy project proposal. Every week, the complexity and/or difficulty of tasks increased, guiding the learners successively towards the knowledge and skill level they needed to complete the final assignment. The following table illustrates the course weeks and the respective subtopics as well as the related tasks and learning goals (Table 1).

The overall structure, broken down into weekly modules, implied already a certain pathway to interact with the learning content. Every week, the complexity and difficulty of tasks increased, guiding the learners successively towards the knowledge and skill level they needed to complete the final assignment.

However, learners could pursue a range of learning paths, depending on their motivation as well as on their own capacities in terms of learning time. In practice, this meant that some learners chose the path that led to the certificate of completion in the end whereas others only picked what they needed, or what they were

Table 1 Overall structure of online course "Sustainable Energy for SIDS"

Week	Topic	Assignment/*Learning goals*
1	Overview	Analyzing energy in SIDS with an interdisciplinary framework *Sketch key issues, disciplinary aspects of the overall topic*
2	Challenges	Sustainable energy production in SIDS *Explain why sustainable energy essential for SIDS,* *Describe concrete examples from concrete SIDS settings*
3	Development	Energy access and energy security *Analyze theoretical foundations, concepts;* *Critically examine concrete examples from SIDS settings*
4	Strategies	Energy efficiency and energy management in SIDS *Explore theoretical foundations, concepts;* *Critically examine concrete examples from SIDS settings*
5	Technologies	Sustainable solutions for SIDS: the promise of renewable energies (RE) *Analyze theoretical foundations, concepts and RE technologies;* *critically examine concrete examples from SIDS settings*
6	Regimes	Policies, initiatives, programs *Identify suitable political frameworks for proposal* *Critically examine concrete examples from SIDS settings*
7	Reflection	Evaluation of project proposals and feedback to learners *Critical reflection of learning outcomes*
Learning goal at course completion: Create an evidence-based proposal for an energy project in a specific SIDS context		

Source L3EAP (2017)

Table 2 Learners personal learning goals (L3EAP online course survey)

Learner's personal goals for the course	%
To keep up to date with all course content, and complete all submission items on time (quizzes, case studies, assignments)	65.08
To watch/read most of the course content, and complete most of the submission items on time	20.63
To look at content in my own time, and maybe not complete the assessment items	5.56
I am teaching this subject and interested in the OER course material	4.76
To look through some of the course content, and complete some submission items	2.38
I'm just having a look around at this stage	0.79
No answer given	0.79
Total	100.00

Source L3EAP (2017)

interested in, without completing mandatory tasks that would have resulted in a certificate at the end (see Table 2).

Comprehensive e-facilitation resembled a key to motivate and inspire learners: A set of experienced e-facilitators and e-tutors guided, motivated and challenged the

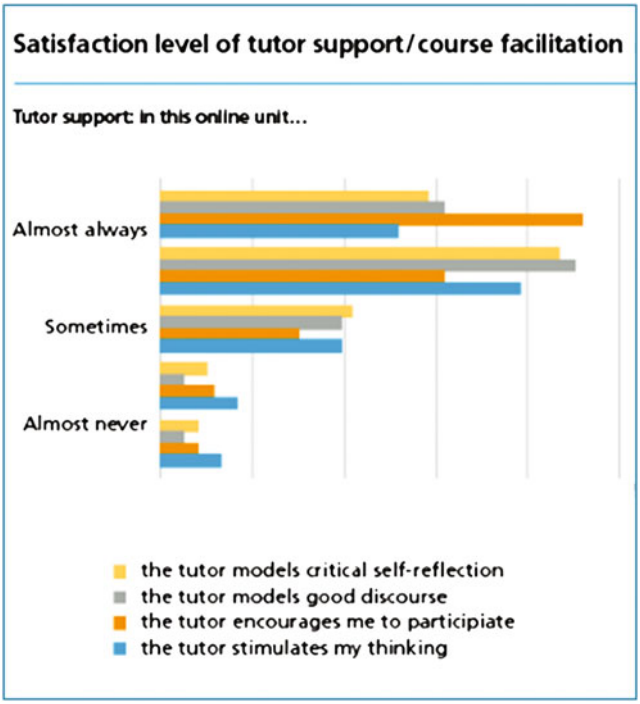

Fig. 1 Outcome of learning survey/pilot run of online course. *Source* L3EAP (2017)

learners sparking interaction and collaboration among the learners as well as between learners and e-tutors who were also experts in the topics of the course. During the online phase, these online facilitators and online tutors played important roles and positively influenced the learning experience in the virtual settings to a large extent through the overall coordination of and motivation of learners (see Fig. 1).

As this 'mentored' approach may be unusual for learners, especially those who possess less experiences with online learning, it should be duly communicated upfront to raise the motivation of learners to successfully work themselves through the online phase (e-Trainer 2017).

E-Tools

In line with the user-centred approach, learning objectives for two distinctive use cases (energy practitioners, master students) have been developed in a first step. Even though the learning objectives differed to some extent they were by no means contradictory to each other. These learning objectives then guided the

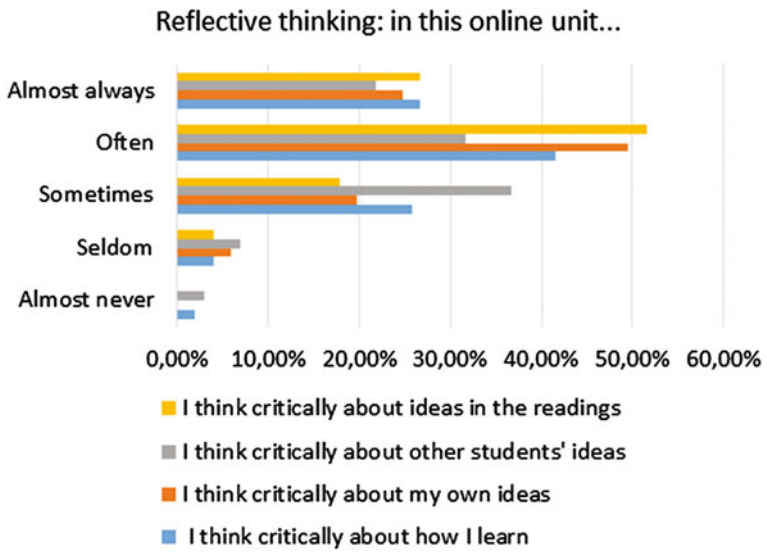

Fig. 2 Learners' perceptions/reflective thinking. *Source* L3EAP (2017)

development course content, and appropriate e-tools were chosen to suit these different user needs, their distinctive learning characteristics and the determined learning objectives (see Fig. 2). In the frame of the online course "Sustainable Energy for SIDS", learners were provided with a range of e-tools which are briefly described in the following:

Videos: Short videos (no longer than 5 min each) present technologies, policies and socio-economic aspects in SIDS, illustrated by real-life examples. Corresponding audio files and transcription were also provided to learners;

Slides: For those learners who needed more background information, training booklets were provided in which learners could read up on theoretical concepts and further background information related to the weekly topic. This content could also be downloaded by the learners;

Further resources: Comprehensive material for further reading, enabling learners to explore original energy policies and frameworks, national energy statistics, scientific papers and relevant best practice reports;

Interactive quizzes: Quizzes are included as a fun means to self-test learning progress. For this, the built-in feature of Moodle was used, where learners receive instant feedback on their answers;

Case studies/discussions: Case studies were introduced as a means of reflection, interaction and joint discussion which were facilitated by the online moderators and e-tutors. For this, distinctive weekly discussion forums were opened up and facilitated.

Deliverables: Weekly assignments which were shared within the learning community served to spread learnings and best practices throughout the community, enabling them to learn from each other.

All in all, the learning environment preferably applied asynchronous e-tools to communicate with and guide the learners along their individual learning paths. Especially the last two interactive e-tools (case studies/facilitated discussions, deliverables including peer review) are valuable tools to create learning occasions and opportunities for learners to discuss and engage with the topic, two important indicators of learner-centrism as suggested by Pflaum and Wolf (2018).

Lessons Learned

The L3EAP online course has achieved its course objectives (see objectives Table 3). The positioning and framing matched reality in that the course reached the envisaged learner groups, and it attracted an even higher number of participants than envisaged. Concerning the audience, the first run saw more SIDS participants than the second run in which 2/3 came from 'rest of world' countries. However, this may be due to the different timing—the first course was conducted in late summer, the second course in early spring—and due to recommendations.

The course appeared to be valuable to learners' professional and academic practice, and participants trained to critically assess island energy regimes, sustainable technologies and identify appropriate solutions. The course designers supported the online learning motivation of the learning community through using a broad range of e-tools, with particular attention paid to those that support

Table 3 Course objectives, key indicators and performance measures, L3EAP online course

Positioning	Interdisciplinary adult education course making current research accessible for students in higher ed, practitioners in the field of energy, to broaden awareness of the topic's complexity and provide a research-driven intervention in development discourses
Framing	Non-curricular, stand-alone course format for heterogeneous audience of adult-learners with proficiency in English
Audience	At least 500 course participants in pilot phase – 60% of which based in SIDS or SIDS ex-pat community – 40% rest-of-world Main target groups: – Political stakeholders/decision-makers/NGO in SIDS energy sector – Higher-Ed students in technical or development studies programs – Researchers interested in interdisciplinary perspectives on energy topic – Private and public donors/investors in sustainable energy management
Evaluation	Active participation, completion rate, recommendations rate
Indicators	Overall demand and feedback as an indicator for future course iterations

Source L3EAP (2017)

interaction and collaboration. Due to an on-going demand, the course has been repeated again, and it is planned to reiterate the course a third time in fall 2017.

Through the comprehensive mentoring by the course facilitators in the frame of the weekly online discussions, interaction with learners through peer-review activities and interactive discussions alike reflective thinking was encouraged (see Fig. 2). The facilitation, guidance and constructive feedback provided by the online moderators was also well received by the learners (L3EAP 2017). The high level of interaction also supported learning from peers and reflecting on own learning styles. Participant feedback also suggests that the learners have practical use for the knowledge and skills they gained (see Fig. 3). This may be especially related to the training of proposal writing skills which directly meets the existing need of small island energy practitioners and academics.

Finally, the development of the online module required a substantial amount of resources in the design phase, the development phase, the production phase (content and especially the professional video production), as well as the implementation and evaluation phase. The additional support of the Hamburg Open Online University beyond the resources the EU project could provide was thus key for the timely and professional development and delivery of the online course. As such, the L3EAP approach reflects lessons learned from early online learning initiatives who were not as successful as thought: "Lessons learnt from failing early online learning initiatives in the UK: the fact that the approach took a supply-driven rather than demand-led approach. (…) UK Open University experiences indicate that a much greater up-front investment of resources, time and careful planning is needed when designing distance-learning courses" (Casey 2012 in Yuan and Powell 2013:14).

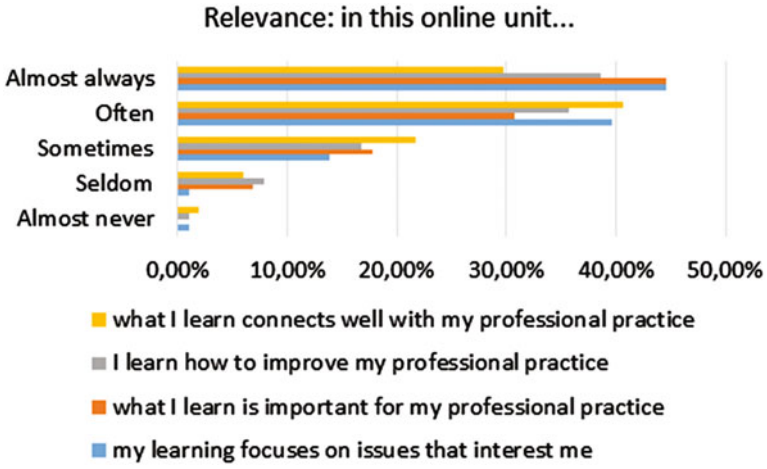

Fig. 3 Learners' perceptions/relevance of online course. *Source* L3EAP (2017)

Conclusions and Recommendations

From the experiences gained from the online course "Sustainable Energy for SIDS" it may be concluded that well designed open online courses can greatly assist in building and strengthening local capacities, especially in distant, remote islands. Online interventions such as the L3EAP online course can also be used for complementing existing capacity-building activities on the ground, and/or for increasing the outreach to further stakeholders. The creation of learning communities and enabling learning from peers are some other important factors that such online courses can support, and their relevance for lifelong learning opportunities should not be underestimated.

The L3EAP online course structure, its OER components and stand-alone course design allow easy replication and integration by others who want to extend their curricula with transdisciplinary topics, given that respective capacities and expertise for set-up of the platform, promotion and online facilitation exist.

Through its learner-centered design, the L3EAP course thus appears to have created an attractive learning experience that has been inspiring, motivating, and fun for learners worldwide. As these type of constructivist online learning approaches and related research is still rare in many parts of the world, educational actors are encouraged to experiment with developing and testing such formats to create a solid evidence base for online learning.

References

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-Centered Design. In W. Bainbridge (Ed.), *Encyclopedia of human-computer interaction*. Thousand Oaks: Sage Publications.

Anderson, T. (2008). *The theory and practice of online learning*. Canada: Athabasca University Press.

Belanger, Y., Thornton, J., & Barr, R. C. (2013). Bioelectricity: A quantitative approach-duke university's first MOOC. *EducationXPress, 2013*(2), 1.

Breslow, L., Pritchard, D. E., DeBoer, J., Stump, G. S., Ho, A. D., & Seaton, D. T. (2013). Studying learning in the worldwide classroom: Research into edX's first MOOC. *Research & Practice in Assessment*, *8*.

Bretschneider, M., & Pflaum, E. (2016). Lernendenzentrierung im Lehren und Lernen mit digitalen Medien. Teaching Trends 2016. Digitalisierung in der Hochschule: Mehr Vielfalt in der Lehre, pp. 111–120.

Castillo, N. M., Lee, J., Zahra, F. T., & Wagner, D. A. (2015). MOOCS for development: Trends, challenges, and opportunities. *Information Technologies & International Development, 11*(2), 35–42.

Conole, G. (2014). A new classification schema for MOOCs. *The international journal for Innovation and Quality in Learning, 2*(3), 65–77.

Clarke. (2013). *MOOCs: Taxonomy of 8 types of MOOC, blogpost*. Available online from: http://donaldclarkplanb.blogspot.com.au/2013/04/moocs-taxonomy-of-8-types-of-mooc.html.

Daradoumis, T., Bassi, R., Xhafa, F., & Caballé, S. (2013). A review on massive e-learning (MOOC) design, delivery and assessment. *2013 Eighth International Conference on paper presented at the P2P, Parallel, Grid, Cloud and Internet Computing (3PGCIC)*.

de Waard, I., Gallagher, M. S., Zelezny-Green, R., Czerniewicz, L., Downes, S., Kukulska-Hulme, A., et al. (2014). Challenges for conceptualising EU MOOC for vulnerable learner groups. *Proceedings of the European MOOC Stakeholder Summit, 2014,* 33–42.

DiMaggio, P., & Hargittai, E. (2001). *From the 'digital divide' to 'digital inequality': Studying Internet use as penetration increases*. Princeton University Center for Arts and Cultural Policy Studies, Working Paper Series 15. Retrieved April 20, 2017 from http://www.maximise-ict.co.uk/WP15_DiMaggioHargittai.pdf.

E-Trainer. (2017). Tipps zur Motivation. https://elearn.leading-interactive.de/mod/folder/view.php?id=1360.

Gené, O. B., Núñez, M. M., & Blanco, Á. F. (2014). *Gamification in MOOC: challenges, opportunities and proposals for advancing MOOC model*. Paper presented at the Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality.

Hashmi, A.H. (2013). *The Harvard Crimson, HarvardX Set to Launch Second SPOC*. September 17, 2013. http://www.thecrimson.com/article/2013/9/17/kennedy-school-spoc-edx/.

Hood, N., & Littlejohn, A. (2016). Quality in MOOCs: Surveying the terrain.

Innis, V. (2012). The implementation of low-carbon and green economy measures in small island developing states. Commonwealth Secretariat (2012). Small States Economic Review and Basic Statistics, Volume 16, doi:10.14217/smalst-2012-en.

Kaplan, A. M., & Haenlein, M. (2016). Higher education and the digital revolution: About MOOCs, SPOCs, social media, and the cookie monster. *Business Horizons, 59*(4), 441–450. doi:10.1016/j.bushor.2016.03.008.

Kay, J., Reimann, P., Diebold, E., & Kummerfeld, B. (2013). MOOCs: So many learners so much potential. *IEEE Intelligent Systems, 28*(3), 70–77.

Keegan, D. (1998). The two modes of distance education. *Open Learning: The Journal of Open, Distance and e-Learning, 13*(3), 43–47. doi:10.1080/0268051980130306.

Kirkwood, A., Price, L. (2016). Technology-enabled learning implementation handbook: Commonwealth of learning (COL). Retrieved from http://hdl.handle.net/11599/2363.

Leading Interactive (LI) (2017), Lerntypen, Qualifikation e-Trainer, internal learning material, https://elearn.leading-interactive.de/mod/folder/view.php?id=1360.

Liyanagunawardena, T. R., Adams, A. A., & Williams, S. A. (2013). MOOCs: A systematic study of the published literature 2008–2012. *The International Review of Research in Open and Distributed Learning, 14*(3), 202–227.

L3EAP (2017). Strengthening human capacity for the development of energy access, security and efficiency in sids, recommendation report. http://project-l3eap.eu/downloads/viewcategory/10-results.html.

Muilenburg, L. Y., & Berge, Z. L. (2005). Student barriers to online learning: A factor analytic study. *Distance Education, 26*(1), 29–48. doi:10.1080/01587910500081269.

Mruck, K., Mey, G., Schön, S., Idensen, H., & Purgathofer, P. (2013). Offene Lehr- und Forschungsressourcen, in: L3T Lehrbuch für Lernen und Lehren mit Technologien. http://l3t.eu/homepage/das-buch/ebook-2013/kapitel/o/id/112/name/offene-lehr-und-forschungsressourcen.

Nguyen, T. (2015). The effectiveness of online learning: Beyond no significant difference and future horizons. *MERLOT Journal of Online Learning and Teaching, 11*(2), 309–319.

Onah, D. F., Sinclair, J., & Boyatt, R. (2014). Dropout rates of massive open online courses: behavioural patterns. *EDULEARN14 Proceedings*, 5825–5834.

Pflaum, E., Wolf, F. (2018). Lernendenzentrierung und Kompetenzorientierung im Online-Kurs "Sustainable Energy for SIDS". In Leal Filho, W. (Ed), *Innovation in der Nachhaltigkeitsforschung, Theorie und Praxis der Nachhaltigkeit*, Springer, (forthcoming).

Siemens, G., Dawson, S., & Gašević, D. (eds.) (2015). Preparing for the Digital University. Retrieved September 1, 2016 from http://linkresearchlab.org/PreparingDigitalUniversity.pdf.

UNEP. (2014). *GEO small island developing states outlook*. Nairobi, Kenya: United Nations Environment Programme.

Waks, L. J. (2016). *The evolution and evaluation of massive open online courses: MOOCs in motion*. Berlin: Springer.

Wolf, F., Seyfarth, F., & Pflaum, E. (2018). Scalable capacity-building. Scalable online capacity-building for heterogeneous, geographically dispersed learners. In U. C. Pandey & V. Inrakanti (Eds.), *Open and distance learning for sustainable growth in emerging nations.* IGI Global. doi:10.4018/978-1-5225-2621-6.

Wolf, F., Becker, D., Leal, W., Krink, J., Haselberger, & Kowald, M. (2016). Sustainable energy generation and use in SIDS and beyond—the L3EAP online learning approach, Brazilian Journal of Science and Technology, *3*(2).doi:10.1186/s40552-016-0021-8.

Yuan, L., Powell, S. (2013). MOOCs and open education: Implications for higher education. *A white paper*, http://publications.cetis.ac.uk/2013/667.

Zawacki-Richter, O., Baecker, E. M., & Vogt, S. (2009). Review of distance education research (2000 to 2008): Analysis of research areas, methods, and authorship patterns. *International Review of Research in Open and Distance Learning, 10*(6), 21–50.

Zheng, S., Rosson, M. B., Shih, P. C., & Carroll, J. M. (2015). *Understanding student motivation, behaviors and perceptions in MOOCs.* Paper presented at the Proceedings of the 18th ACM conference on computer supported cooperative work & social computing.