Theoretical Framework of Personal Learning Environments: SPET Model

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Abstract. The lack of a compelling educational theory underlying the advancement of Personal Learning Environments (PLEs) has an impact on PLE implementation in Higher Education (HE). The purpose of this article is to introduce the concepts and theoretical framework of PLEs in the context of higher education. Constructivism, Connectivism, and Cognitivism have all been used in previous studies to explain the principles and implementations of PLEs. However, in order to promote the development of PLEs in higher education, a comprehensive theoretical framework is required. We developed the Society, Policy, Education, and Technology (SPET) framework to explain the environmental factors involved in accelerating the promotion of PLEs, beginning with redefining the value of Higher Education. Furthermore, we created a PLE framework that incorporates four major perspectives in the educational field to explain the internal factors of PLEs. These are academic administrative, learner and learning, teacher and teaching, and information communication technology (ICT) perspectives. All stakeholders involved in promoting PLEs in higher education can benefit from the two PLE frameworks.

Keywords: personal learning environments · PLEs · theoretical framework · higher education

1 Introduction

Two decades have passed since the first recorded use of the term "Personal Learning Environment" in a session titled at the 2004 Joint Information Systems Committee/Center for Education Technology & Interoperability Standards Conference in the UK, while the implementation of PLEs was still in its early stages, slow, and fraught with challenges (Ricardo Torres-Kompen 2015). As Attwell (2021) pointed out, recent developments in the PLEs field have a tendency to drift into tech-centrism; that is, too much time has been spent on the new technology rather than looking at the pedagogy of how PLEs might be used.

The reasons for the slow progress in the PLEs field were complex and varied, involving a lack of consensus on PLEs among all stakeholders; conservative policy;

the rigid Higher Education (HE) system; the inherent attitudes of teachers, learners, and administrators; an overemphasis on the social development function of HE, and, most importantly, a lack of PLEs theory and a theoretical framework.

The purpose of this research is to create a wholistic theoretical framework for PLEs that includes the external Society, Policy, Education, and Technology (SPECT) framework as well as the internal framework that includes four perspectives: academic administration, learner and learning, teacher and teaching, and information communication technology (ICT).

We hope that the proposed framework will give all key stakeholders an in-depth and comprehensive understanding of the methods and theories that can be used to promote the implementation of PLEs in higher education.

2 The Concept of Personal Learning Environments (PLEs)

First, consider PLEs as platforms. PLEs appeared as "a new construct in the e-learning literature that finds its support on social media and steadily gains ground in the e-learning field as an effective platform for student learning" (Dabbagh & Kitsantas 2012). PLEs have been described as "a type of e-learning system that is structured on a model of e-learning itself rather than a model of the institution" (Kalz et al. 2011), as well as multidimensional spaces (van Harmelen 2006) or central nodes of a network (Downes 2010, p. 30).

Second, PLEs as source aggregation: such as Fiedler & Pata (2009), Amine (2009), Dolors Reig (el caparazón) 2009), or Henri et al. (2008) who define PLEs as a self-defined collection of resources, services, tools, and devices that can assist teachers and students in shaping their personal learning and knowledge networks.

Third, PLEs as an innovative educational methodology: PLEs were considered a means of understanding both how students learn and how educators teach (Attwell, 2007; Adell & Castañeda 2010; Cabero 2012). PLEs were essentially a social-pedagogical approach to teaching and learning with technology. (Attwell 2021). PLE "focuses on the students and the decisions they make to personalize and self-regulate their learning."

As can be seen from the above definitions of PLEs, the implementation of PLEs was not only about technology reform but also about a philosophy or a way of working, as asserted by Sebba et al. (2007). The essence of PLEs was a vision to empower learners to take more ownership of their learning as well as to foster learner autonomy and lifelong learning (Ballard & Butler 2011). More recently, the concept of PLEs has tended to drift into techno-centrism, usually including references to social media and the possibilities for the creation and sharing of knowledge that ultimately relate to the control of learning by the student (Rahimi et al. 2015).

Dabbagh & Castañeda (2020) claimed that PLEs could be characterized as a techno-social reality that embodies the socio-material entanglement with which people are able to learn, with an approach that enacts contemporary ideas about how people learn. The PLE's learning ecology and ability to connect formal, non-formal, and informal learning experiences within a framework that addresses the challenges of continuous learning and empowers learners to develop lifelong learning skills.

In the current study, PLEs are defined as new digital learning literacy, conceptual space, pedagogical processes, and social networks that enable and support learners in

achieving their lifelong learning objectives. PLEs are regarded as dynamic, interconnected environments with an ever-changing community of learners, instructors, tools, and content.

We envision the PLE as the heart of a diverse, personalized, social, adaptive, integrated, and transparent learning activity ecosystem, enabling the creation of a network of learning that supports students as peers, creators, entrepreneurs, and agents of their own learning.

3   The Features of Learning in PLEs

The PLEs paradigm occurs in a social context in which knowledge is shared globally and students act as problem solvers. Faculty members provide motivational and evaluative coaching, as well as the facilitation of relationships in ad hoc, peer-to-peer networks. The assumption is that students can self-actualize by utilizing the proposed educational system to fully realize their human potential. Learning in PLEs is self-education in which the learner, rather than the teacher, determines the learning program's goals, learning procedures, resources, and evaluation decisions (Moore 1984).

Our understanding of PLEs is comprised of five parts. First, it entails self-directed learning processes in which learners must set goals, make appropriate plans, and implement the plans. To do so, learners require the space, environment, and guided support to integrate their needs, life experiences, and culture into goal-setting and action plans.

Second, it entails a collaborative process via networked learning or support groups. It should include guiding principles to ensure that all key stakeholders involved in the collaborative process understand the importance of equity and access in order for all learners to develop a strong sense of belonging.

Third, it is a "knowledge construction" process in which learners simultaneously build knowledge through theoretical learning and real-world practice. This process improves skills, task mastery, confidence, and a sense of belonging, as well as preparing the mind and body for intellectual rigour in mindset and skills, which leads to purposeful and spontaneous learning.

Fourth, by integrating the curriculum with the practical application of knowledge and teamwork, these processes necessitate and strengthen human trust and reciprocity (Humphris 2007).

Finally, there is the changing value and status of Information and Communication Technologies (ICTs), which are no longer merely instruments or tools but are shaping sociocultural practices and human behavior at all levels (Adell 2018; Selwyn 2017; Veletsianos and Moe 2017).

To summarize, PLEs are processes of collaborative, cooperative, and collective inquiry; knowledge construction and transfer; trusting relationships and supportive settings; a sense of belonging and capacity realization; and convivial technologies. PLEs help people, learning sites, and actions, as well as ideas, resources, and solutions, connect across time, space, and media.

4   Why does Higher Education need Personal Learning Environments?

The growing demand for lifelong learning opportunities to keep up with social, economic, and technological changes drives the demand for more accessible alternatives to traditional real-time, campus-based instruction. Technology advancements are reshaping education by changing when, how, and where students learn, as well as empowering them at every stage of their journey.

Technology has the potential to tailor education to individual preferences and requirements. As a learner, he or she can establish formal or informal learning objectives. There are three options for achieving these personalized learning goals.

First, through formal higher education, which benefits from standardization, systematization, institutionalization, and specialization; second, through difficult and uncertain self-directed learning; and third, through enterprise-supported learning tools and platforms, which are distinguished by personalization, cutting-edge technology, adaptability, and flexibility, as shown in Fig. 1.
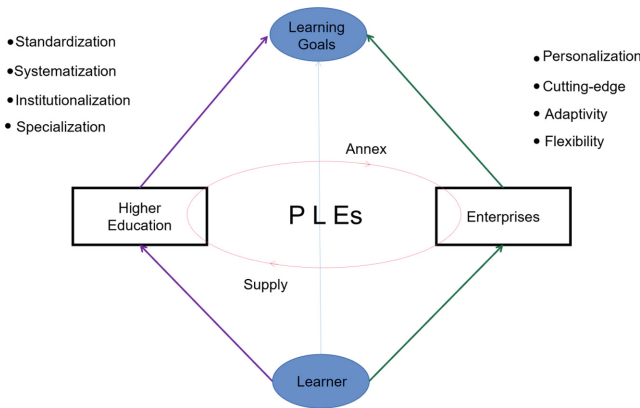

Fig. 1. Three ways to reach the educational ideal goal

With the advancement of Information and Communication Technology (ICT), higher education (HE) is no longer the sole source or path to achieving the educational ideal. Knowledge claims are no longer made solely by universities; knowledge production is increasingly being built in businesses, non-governmental organizations, and the so-called third sector, with local, inter, and supranational actors involved (Soysal & Baltaru 2021).

Learners can use third-party learning platforms like Zoom or Google Classroom, as well as apps like Duolingo, to make learning anywhere more efficient and enjoyable.

Meanwhile, enterprises create interactive online tools such as the Google Slides add-on "Pear Deck," course content sharing "Edmodo," and an advanced LMS tool "Blackboard," among others, to assist learners in making the best decisions about which applications best suit their various online subjects and learning needs.

For example, the pandemic has created an opportunity to assess the suitability of third-party education delivery systems. All of these learning tools, platforms, Open Educational Resources (OER), and technologies, such as data mining and learning analytics, enable personalized learning. Learners can create their own learning paths based on their preferred learning style, prior knowledge, and skills and interests.

With the trend toward more personalized learning, there is an urgent need for PLEs to be integrated into HE. For one thing, formal higher education lacks flexibility and responsiveness, which causes its pedagogy, curriculum design, and teaching methods to lag far behind in the rapidly changing digital information age. These decreases learning efficiency and increases the gap between learners' needs, expectations, and achievements. Self-paced, personalized learning, on the other hand, can aid in the development of learners' creativity, critical thinking, and problem-solving abilities. Furthermore, many students are unhappy with their current academic performance.

Many higher education institutions are attempting to improve their outputs and demonstrate their social and economic worth while ignoring potentially more worthwhile institutional missions and human pursuits. To meet these challenges, higher education must reform. Personal Learning Environments (PLEs), which represent a learning paradigm shift, have emerged as the reform path's top priority.

On the one hand, educational providers other than universities or colleges, as competitors, are devoted to developing their own commercial PLEs or similar personalized online learning platforms for learners or HE institutions, such as Symbaloo, Protopage, Dingding, Zoom, and so on.

To maintain a competitive advantage, HE must either annex the PLEs developed by other educational providers or purchase their service. Many higher education institutions are now creating their own PLEs with open-source social networks like Elgg (www.elgg.com), OSSN, DEMO, and others. Meanwhile, for some institutions that are not yet ready to develop their own PLEs, enterprises can provide a solution.

The sections that follow will focus on the external framework—the Society, Policy, Education, and Technology (SPET) framework—as well as the internal framework—Academic Administration, Teacher, Learner, and ICT (ATLI).

The external framework refers to environmental factors that, if not present, will prevent the paradigm shift toward PLEs from having a broad and long-term impact on HE. The internal framework refers to key stakeholders within HE who are driving the implementation of PLEs in HE.

5   The Society, Policy, Education, and Technology (SPET) Framework for PLEs

PLEs enable the development of learners' personal communicative and formative scenography to enhance learning that is halfway between formal and informal, encouraging them to organize and take responsibility for their own learning.

However, fully implementing PLEs in HE requires not only revolution, collaboration, and compromise among all key stakeholders as internal factors, but also the combined efforts of external environmental factors—Society, Policy, Education, and Technology (SPET), as shown in Fig. 2.
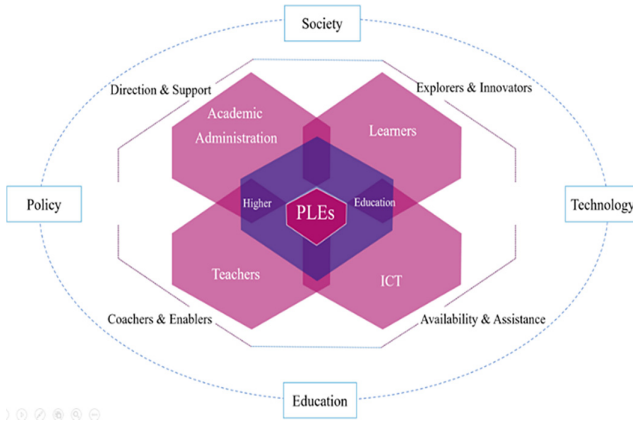
Fig. 2. The theoretical framework of PLEs

5.1 Society

The class system, cultural values, power structure, balance of individual freedom and social control, and degree of urbanization and industrialization all have a significant impact on any society's education system.

In retrospect, our society has come a long way, from the hunting society (Society 1.0), agricultural society (Society 2.0), industrial society (Society 3.0), and information society (Society 4.0), to the future super-smart society. Among them is the Society 5.0 vision, which is a human-centered imagination society in which humans, nature, and technology create a sustainable balance that is enhanced by super-smart AI data systems.

Economic growth in the current Society 4.0 or information society is knowledge-driven and innovation-driven, with the goal of achieving sustainable growth, more efficient resource use, and the formation of an "intelligent society" (Valentina 2017). Education is essential for social change.

For example, HE assists British society in transition from a colonial power to a welfare state and a globally oriented knowledge-based economy. To generate a new paradigm of social growth in the transition from Society 4.0 to Society 5.0, education should be transformed into smart education using smart technologies (technologies based on interaction and experience exchange). In terms of the paradigm shift from traditional HE to PLEs, society should indeed make changes to facilitate HE reform.

First, universities have long been regarded as a socioeconomic source of human capital and economic growth. Not only are knowledge, research, and degrees measured as the economic and societal value in the twenty-first century (Schofer et al. 2020), but academic sciences have become "economic engines" on which both the market and the state act.

However, the growing specialization of educational provision and the rapid expansion of universities are being discussed as the consumerization of higher education and the erosion of the university's public mission (Wright & Shore 2018).

The global race to excellence in higher education, for example, which is widely perceived and promoted as a driver of economic growth and competitiveness, has accelerated

(European Commission 2003; OECD 2008). To implement PLEs in higher education, the emphasis on HE's socioeconomic value must be reduced. For example, higher education should place a greater emphasis on its ability to foster desired states of being that allow individuals to pursue a meaningful future life course, to be proactive and societally engaged, and to carry the imprints of their historical legacies (Tomlinson 2021; Soysal and Baltaru 2021). Second, from a social-cultural standpoint, social structures, social norms, and social value systems should change.

Both formal and informal social structures influence individuals' thoughts, values, and behaviors. Individuals' opinions, beliefs, and behaviors can be shaped by formal organizations (Prell et al. 2010). According to organizational theory, shared values in formal organizations would evolve into organizational norms, which would then become concrete guidelines outlining the appropriate types of behavior for employees (Hill & Jones 2000).

The cultures of educational institutions can guide administrators', teachers', students', and parents' views, opinions, and subsequent actions regarding the implementation of PLEs in HE and the redefining of institutional logic and purpose, beliefs, approaches, and so on.

In terms of informal social structure, "social networks" refer to the similarity among individuals, including views, beliefs, and behavior (Lazarsfeld & Merton 1954), that would form a social attraction or a tie among individuals (McPherson et al. 2001), also known as the "homophily effect" in the social network literature. Individuals' views and behavior toward PLE implementation in HE would be guided or constrained by the heterogeneous population's understanding of PLEs.

According to Bicchieri (2006, p. ix), social norms are the "grammar" of social interactions. Norms are customary or typical behaviors that people engage in because they believe that is what others do or how you should behave (Reno et al. 1993). Changing social norms may be more important than changing behavior (Bicchieri & Xiao 2009; Krupka & Weber 2015).

Social values are idealistic criteria shared by the majority of a society that regulate and organize daily life. Sociological values are ideally unique to one group at a single point in time, according to sociology (Doan 2011). General and specific social values exist. General social values, for example, include universally accepted human values such as social equality, justice, and women's empowerment. Social values can be used to evaluate social norms both subjectively and objectively. Social norms are founded on social values that are justified by moral or aesthetic standards. Individuals' social values are built into their personalities and guide their thoughts and actions. Social norms can also have an impact on an individual's attitudes.

The development of PLEs in higher education necessitates a shift in social norms and social values regarding educational beliefs and values, particularly among parents, students, teachers, and administrators.

They should be aware of the PLEs paradigm from a macro-perspective, such as the acceptance of informal education and vocational education, the redefinition of talents, shifts in learning appraisal from score-oriented to competency-based or capability-realization, the prevalence of open education and open science, and credit recognition across universities or even countries.

Teachers, in particular, must arm themselves with new pedagogical concepts such as competency-based education, personalized learning, and so on; learn new teaching approaches such as teaching through enterprise projects and real work with local employers (Tyumaseva et al. 2020); form community partnerships; employ asset-based pedagogical approaches such as Culturally Responsive instruction, and so on; and shift their roles from instruction to mentoring, advising, and consulting; acquire new skills in the effective use of information technologies, mentoring, advising, and consulting; encourage self-motivation to unlock learners' potentials; build their academic confidence, sense of belonging; and ensure they can take ownership and responsibility for their own learning (Miliband 2006; Sun and Xu, forthcoming) to lead a life they believe is meaningful and valuable.

Administrators must support attainment- or mastery-based assessment, criteria-based, flexible, and continuous assessment of sub-competences, and the long-term use of e-portfolios for formative assessment to ensure assessment for learning and learning success.

To summarize, PLEs reform necessitates the acceptance of social norms. For example, if the social norm promotes educational equity by providing individuals with an environment conducive to their overall development, respecting education as a basic human right, and supporting open education and open data, more people will advocate for HE reforms toward PLEs.

5.2 Policy

To successfully implement PLEs in higher education, the policy must be redesigned from the education system to the HE organization infrastructure to reflect the value and goal of higher education.

First, full-time classroom-based education must be replaced by capacity-realization mode by integrating formal education, professional training, and entrepreneurship into PLEs and giving every single learner the opportunity to be the best they can be, regardless of talent or background (Miliband 2004). Learners can gain, improve, and retain the knowledge, competencies, skills, instincts, instruments, tools, and other resources needed to expand their capabilities. The underlying philosophy is that the social function of education has progressed through three stages, beginning with illiteracy eradication and ending with human development. With the rapid development of ICT, HE is entering a capacity-realization phase that corresponds to a higher level of human development. Learners are empowered to pursue alternative paths to self-actualization. Policymakers must now shift their attitude and mindset away from time-based education and toward competency-based and capacity-realization education. In other words, traditional programs require fixed units of time (semesters or terms) and a minimum number of courses or credits to complete the program. This single-model approach prevents many students from achieving their full potential. Time and space are much more flexible in competency-based or capacity-realization education for learners, who can learn through a variety of activities at their own pace and schedule.

Second, the infrastructure of the HE organization should be modified accordingly. For example, rankings have aided the current model of the university system and the organizational development that has surrounded it (Sauder & Espeland 2009; Baltaru &

Soysal 2018). To promote equity, diversity, distinctiveness, and uniqueness, we propose that universities be organized around disciplines and further subdivided by discipline attributes. We believe that grouping disciplines can optimize the layout of disciplines in higher education, promote diverse development, and avoid repetitive construction due to the pursuit of large and comprehensive disciplines. When rankings are made within disciplinary groups rather than university rankings, each discipline has access to resources based on its own characteristics rather than being sidelined by utilitarian factors in a university, which is especially true in the humanities. Students may also select a university or college based on discipline rankings rather than the university's overall ranking. Ranking universities, on the other hand, would increase inequity and utilitarianism.

For example, in China, the Double First-Class Initiative (China's largest education development scheme to date, aimed at increasing global recognition of China's university system by 2049) seeks to use the performance assessment approach to drive reform and strengthen the development of key disciplines. However, it will exacerbate the regional imbalance in higher education because the elected universities will receive more financial resources, human resources, material resources, and policy support (Liu et al. 2019).

In addition to the above-mentioned fields of policy, the following areas are also crucial to implementing PLEs in HE: first, structures to promote privacy and security standards, regulations, and legal protection should be established in HE since Artificial Intelligence applications will raise ethical issues and pose potential threats to the right to education; second, the method of evaluation and appraisal of HE should be more dynamic, focusing on HE's potential to enable individuals to pursue a meaningful future life (Tomlinson 2021); third, financial support is vital, which should invest more in digital learning through the development of online learning platforms; and a, tailored support and resources offered by instructional designers and technology coaches to faculty and staff in the form of consultation; training; and workshops (Archer-Kuhn et al. 2020; Morley & Clarke 2020).

5.3 Education

To fully implement PLEs in HE, we should redefine education's goals and values to get it back on track. As shown in Fig. 3, we believe that the value of education, from K–12 to higher education, is presented in three areas: social development, human development, and knowledge development.
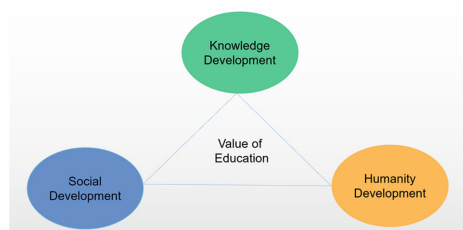

Fig. 3. The value of education

Aron (1965) defines social development as the "increasing moralization of human behavior and thought." This is linked to educational systems. For example, the system of the twentieth century was largely based on a "one size fits all" model, similar to factory models of the previous century. Since the turn of the century, there has been a government push to create social systems that prioritize citizens, challenging the "old" model and creating systems that are more responsive to individual needs. The educational trend is shifting away from the industrial economy and toward a knowledge economy, where citizens must be equipped with a diverse set of personal, social, thinking, and learning skills. Education is thought to be inextricably linked to processes such as social mobility, community development, national integration, urbanization, and population change.

Education is essential for the recovery of human and social capital. Learning declines have a long-term negative impact on productivity and economic growth (Global Partnership for Education 2020). Higher education planning must include a strategic plan to meet societal needs and create job opportunities. The pandemic, for example, changed the entire concept of education by emphasizing community well-being and engagement. As a result, the entrepreneurial university model emerges, adding a strong third mission to Higher Education Institutions (HEIs) (Stolze 2020).

Meanwhile, education has equitably become the focal point of the recovery, with an emphasis on strengthening educational systems (Global Partnership for Education 2020). Reducing inequities in education will be the norm, and reimagining our educational systems will have a positive societal impact (Garca & Weiss 2020a, b).

To summarize, higher education is critical for increasing youth employment opportunities, reducing societal disparities, ensuring the inclusion of vulnerable and marginalized groups, and conducting impact research that generates long-term socioeconomic returns.

Knowledge development is the accumulation and transfer of knowledge. For one thing, in terms of knowledge accumulation, HE is seen as the pinnacle of "powerful knowledge"—a concept that has recently gained traction (Wheelahan 2012; Young & Muller 2013). HE also allows students to reflect on and evaluate various bodies of knowledge, as well as their own relationships to dominant scientific and socio-political regimes of truth. Another benefit of higher education is that it motivates and inspires people to explore the unknown world in search of knowledge and truth. Knowledge transfer can be accomplished by involving innovation partners, delivering innovative products (Păunescu & McDonnell Naughton 2020), sharing knowledge, conducting interdisciplinary research, and collaborating with colleagues from other fields.

In terms of humanity development, the model uses the Merriam-Webster definition: "compassionate, sympathetic, or generous behavior or disposition: the quality or state of being humane." Higher education promotes both personal and social growth. Individually, higher education empowers students by increasing their agential freedom. Higher education provides a set of resources from which a person can make positive decisions about the course of their lives and how to cultivate this further. The dispositions or "qualities" identified by Barnett (2018) as central to the concept of contemporary university education—willingness to learn, engagement, openness to experience, and resilience— entail processes of ontological change that are now potentially as valuable as formal

knowledge acquisition. For the development of social humanity, higher education promotes, among other things, citizenship education, human rights, democracy, cultural diversity, sustainability, national history, security, and moral values.

According to Tomlinson (2021), current HE is valued in three ways: first, the continued movement toward systemic massification; second, the movement toward marketization and the entrepreneurial and transactional orientation of academics, students, and senior managers; and third, the graduate employment rate in a more flexible and uncertain labor market. All three methods of evaluation center on the monetary benefits of higher education, which drives institutions to be organized along market logic in order to meet market-related desires. The value-for-money metric tells us little about how HE's transformational potential manifests itself or how and in what ways HE affects our future lives. Educational research has also contested and critiqued these value framings (Crawford & van der Erve 2015; Downs 2017; Tomlinson 2018). The value of higher education is centered on its ability to foster desired states of being that allow individuals to pursue a meaningful future life course.

5.4 Technology

With increased digitalization, connectivity, and the use of Artificial Intelligence (AI), collective intelligence technologies, and knowledge management systems, it is recognized that the digital world is becoming smarter than Big Data technologies.

Meanwhile, the concepts of "knowledge society" and "smart society" persisted after the "information society," as evidenced by the number of FTTH network subscribers, download speed, broadband access quality, and so on.

When it comes to Society 5.0, technology is supposed to help build innovative mechanisms for a smart society where society can self-regulate through smart technologies and trained citizens.

To fully implement PLEs, the role, function, and value of technology in education must be altered.

First, technology's role must shift. Technology is no longer an afterthought in education; rather, it should be a key decision-making factor. Technology has the potential to improve data collection and analysis in order to facilitate educational decision-making and practices. For example, during COVID-19, some countries were able to respond quickly to the pandemic due to their prior stance on technology access for education (see, for example, the International Council of Education Advisers Report 2018–20, published by the Scottish Government in December 2020). For another, as technology becomes more prevalent in daily life, everyone will need to "access, manage, understand, integrate, communicate, evaluate, and create information" in order to participate in the working, social, and political spheres.

Second, the role of technology must evolve. In the digital age, technology and the internet will become a source of water and electricity, as well as a service for all as a human right. Technology has evolved into a powerful tool for overcoming inequalities, which could be realized by utilizing technology to serve disadvantaged populations while also ensuring its accessibility and affordability for all. Technology transforms the organization of HE institutions (e.g., the cross-fields institute, transcending disciplines,

etc.), curriculum design, and pedagogical mode in the HE field (e.g., virtual reality, augmented reality, personalized learning) at the micro level.

Third, the value of technology must change. Technology is currently transforming our perceptions and expectations of education, with concepts such as lifelong learning, mutual credit recognition, personalized learning, and so on taking root in our minds. In other words, sustainability has infiltrated higher education, necessitating seamless, agent-based, and technology-driven intelligent learning (Menon & Suresh 2020).

Technology helps to develop a lifelong learning system that extends beyond the boundaries of educational institutions and areas and organizes lifelong learning opportunities in a more flexible manner, especially at the local level (Mazzucato 2018). As a result, HE can take advantage of digitalized systems and technology-assisted processes, and strategies for demonstrating flexibility, sustainability orientation, and impact achievement are developed.

People, things, and systems will all be connected in cyberspace in the coming "Society 5.0," and the massive amount of data from sensors in physical space will be analyzed by artificial intelligence (AI) and fed back to humans in physical space. Self-actualization through education becomes possible when people have the freedom and technical support to fully express their talents and create values for society. The new value created by innovation will, in turn, eliminate regional, age, gender, and language gaps, allowing for the provision of products and services finely tailored to diverse individual needs and latent needs.

6 The Four Perspectives of PLEs Scales

Successfully implementing PLEs in higher education necessitates the collaboration of four major stakeholders or perspectives in the educational field, namely Academic Administration, teachers, students, and ICT. A set of PLE rubrics that ensure quality control and assurance for the use of PLEs in higher education is necessary. The four scales are known as the PLEs Teacher and Teaching Scale (PLEs-TTS), PLEs Learner and Learning Scale (PLEs-LLS), PLEs Academic Administration Scale (PLEs-AAS), and PLE Technology Scale (PLEs-TS).

We believe that the current slow adoption of PLEs in higher education is primarily due to a lack of consensus among various stakeholders, which has resulted in a demand and supply gap between users and developers. The following sections explain the roles and relationships of the four PLE perspectives. The roles of the four perspectives are shown in Fig. 4.

As shown in Fig. 4, the implementation of PLEs in higher education necessitates cooperation and collaboration among the four perspectives. Academic administration is defined as "the activities are undertaken by academic workers to achieve effective teaching, research, and community service in accordance with the institution's prescribed regulations" (KOKO 2011). Academic administration's primary role is to set clear expectations and criteria for the other three perspectives, which include, student recruitment and services, faculty development and assessment, policy and planning, financial and budgeting, and purchasing goods and equipment.

In the context of PLEs, instructors, among other things, serve as designers of learning experiences and facilitators of learning (Francom 2014; Reigeluth & Karnopp 2013).
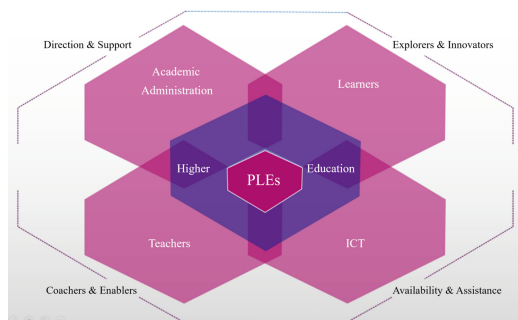
Fig. 4. The roles of the four perspectives in PLEs

Teachers, as designers, create sequences of learning tasks to provide an appropriate level of challenge for students and determine how to personalize and differentiate tasks based on students' prior knowledge. They must treat learners as explorers and innovators and use asset-based transformative pedagogical principles to ensure that students, especially those from historically and systemically underserved backgrounds, feel a part of the academic community and have the confidence and skills to successfully navigate PLEs and achieve their learning goals and potentials (Sun and Xu forthcoming). They must learn skills in designing and managing online collaborative strategies for appropriate online communication, as well as developing and/or reviewing current technologies integrated into their teaching area to enhance learning (Segrave et al. 2005).

More importantly, as facilitators, they must explain the learning task and demonstrate how different parts of the task should be completed; recommend appropriate resources; provide coaching and feedback to learners as they work on learning tasks; and assist students in learning on their own.

Learners in PLEs become masters of their own learning, transitioning from passive receivers of information to self-directed and collaborative learners, as well as active knowledge explorers (Reigeluth 2016; Reigeluth & Karnopp 2013). They investigate and direct their learning, solve problems, and conduct self-analysis, self-control, and self-evaluation of their learning process.

They develop into collaborative learners who teach and learn from one another through discussions, teamwork, presentations, peer critique, and other activities (Reigeluth & Karnopp 2013). PLEs may also aid in the development of higher-order thinking (Elfeky 2018).

In summary, learners gain the ability to plan their educational and self-educational activities, manage their time effectively, work productively with educational materials, and monitor the outcomes of their work.

In terms of ICT, the primary role is to provide access to and support for PLEs used by teachers, students, and administrators. In terms of accessibility, the growing use of data for Learning Analytics and the use of AI in education (e.g., automated feedback systems, recommender systems, and content creation systems) offer significant potential for the development of PLEs by providing feedback, opportunities for reflection, and recommendations based on learner data. In terms of assistance, studies and PLE

workshops and projects have repeatedly demonstrated that students lack confidence and competence in using technology to create their own PLEs.

In fact, most students' digital practice is informal, and they are more accustomed to using apps than applications (JISC 2009). Effective PLEs are complex applications, and many students and teachers require structured assistance in using, let alone developing, PLEs.

To sum up, as the Organization for Economic Co-operation and Development (OECD) suggested,

Education systems will need to adapt to the changes brought on by automation, teaching children and teenagers the skills necessary to fully benefit from the present wave of technological implementation. This involves both cognitive and social intelligence, as well as the abilities required to function effectively in a digital environment, both as specialists and as users of digital technology.

Academic Administration establishes rules, principles, and regulations, as well as supports and procedures to ensure that such policies, standards, and regulations are followed by learners and teachers via ICT-integrated assessment and appraisal. In turn, learners and teachers follow those regulations and requirements in order to fulfill their duties and accept administrative supervision. In PLEs, learners and teachers collaborate to achieve learning. Teachers can use technology to boost their productivity, implement useful digital tools to expand students' learning opportunities, and increase student support and engagement. It also enables teachers to improve their instructional methods and personalize learning. Learners use ICT to create their own learning environment, access and analyze information, interpret and transform that information into their own personal knowledge (Ertmer & Ottenbreit-Leftwich 2013), and develop their learning confidence and competence as lifelong learners. ICT provides support and access to academic administration, learners, and teachers.

From an educational standpoint, perhaps the most significant aspect is that the paradigm shift to PLEs must include more than just a change in the tools or resources used, but must also promote a change in attitude in which students have the opportunity to take an active role in the teaching and learning process, of which they are an essential part through self-regulated learning. The teacher, in turn, possesses the various skills and abilities required to modify the design and planning of instructional situations in the context of teaching. Meanwhile, academic administrators accept the competency-based
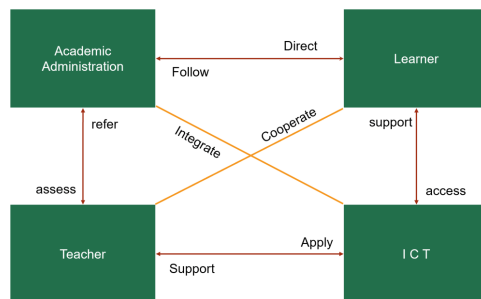

Fig. 5. The relationship between the four perspectives in PLEs

or capacity-realization mode of education in order to establish appropriate policies, principles, and standards. And the ICT department understands the principle of PLEs, makes sure ICT resources are accessible, and provides proper support for learners, teachers, and administrators. The relationship between the four perspectives is shown in Fig. 5.

7 Conclusion

The pandemic has fueled public debate about the importance of higher education in general, and specific models of higher education in particular. According to some researchers, the current higher education system is out of date in terms of cost-return and breadth (Psacharopoulos 1972; Bigliardi et al. 2005).

Meanwhile, higher education institutions are in flux, as are the expectations and practices of teachers, students, and parents. The one-size-fits-all approach is fading, and the idea of PLEs is gaining traction. The most recent advancements in information technology and digital content creation allow all students to benefit from the PLE approach.

In the context of Personalized Learning Environments, the purpose or value of higher education is to facilitate the realization of learners' capabilities through learner-driven and learner-designed education. However, the development of the PLEs agenda is not about quick fixes but about strengthening the educational system's capacity to meet the learning needs of all learners, regardless of age. Competency-based or capability-realization education necessitates learners understand their current capabilities through objective cloud-based assessment and then rationally gain knowledge, experience, and attitude in a self-driven paradigm to awaken or transcend their potential.

The evaluation of successful learners, as well as the productivity and effectiveness of education, is based on competency development and personal capability fulfillment rather than criterion-referenced measurement. Nonetheless, our Policy, Education, Society, and Technology (PEST) must all evolve in order to facilitate the implementation of PLEs in higher education. PLEs seek to re-establish the value of higher education in terms of social development, knowledge development, and human development.

References

Adell, J.: Más allá del instrumentalismo en tecnología educativa. Cambiar los contenidos, cambiar la educación. Madrid: Morata (2018)

Adell, J., Castañeda Quintero, L.J.: Los Entornos Personales de Aprendizaje (PLEs): una nueva manera de entender el aprendizaje (2010)

Almenara, J.C.: Tendencias para el aprendizaje digital: de los contenidos cerrados al diseño de materiales centrado en las actividades. El Proyecto Dipro 2.0. Revista de Educación a Distancia (RED), (32) (2012)

Amine, M.: Mohamed Amine Chatti's ongoing research on Knowledge and Learning (2009). http://mohamedaminechatti.blogspot.com/2009/04/ple-pkn.html

Archer-Kuhn, B., Ayala, J., Hewson, J., Letkemann, L.: Canadian reflections on the Covid-19 pandemic in social work education: from Tsunami to innovation. Soc. Work. Educ. **39**(8), 1010–1018 (2020)

Aron, B.: Le Developpement Social. Congress et Colloques (1965)

Attwell, G.: Personal learning environments-the future of eLearning. Elearning Papers **2**(1), 1–8 (2007)

Attwell, G.: Personal learning environments: looking back and looking forward. In: Ninth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'21), pp. 522–526 (2021)

Ballard, J., Butler, P.: Personalised learning: developing a vygotskian framework for e-learning. Int. J. Technol. Knowl. Soc. **7**(2), 21 (2011)

Baltaru, R.D., Soysal, Y.N.: Administrators in higher education: organizational expansion in a transforming institution. High. Educ. **76**(2), 213–229 (2018)

Barnett, R.: The Ecological University: A Feasible Utopia. Routledge (2017)

Bicchieri, C.: The Grammar of Society: The Nature and Dynamics of Social Norms. Cambridge University Press (2005)

Bicchieri, C., Xiao, E.: Do the right thing: but only if others do so. J. Behav. Decis. Mak. **22**(2), 191–208 (2009)

Bigliardi, B., Petroni, A., Dormio, A.I.: Organizational socialization, career aspirations and turnover intentions among design engineers. Leadersh. Org. Dev. J. **26**(6), 424–441 (2005)

Dabbagh, N., Castaneda, L.: The PLE as a framework for developing agency in lifelong learning. Educ. Tech. Res. Dev. **68**, 3041–3055 (2020)

Dabbagh, N., Kitsantas, A.: Personal learning environments, social media, and self-regulated learning: a natural formula for connecting formal and informal learning. Internet High. Educ. **15**(1), 3–8 (2012)

Dolors, R.: Entornos personalizados de aprendizaje (2009). http://www.slideshare.net/dreig/ple-1340811

Downes, S.: New technology supporting informal learning. J. Emerg. Technol. Web Intell. **2**(1), 27–33 (2010)

Downs, Y.: Furthering alternative cultures of valuation in higher education research. Camb. J. Educ. **47**(1), 37–51 (2017)

Elfeky, A.I.M.: The effect of personal learning environments on participants' higher order thinking skills and satisfaction. Innov. Educ. Teach. Int. (2018)

Ertmer, P.A., Ottenbreit-Leftwich, A.: Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. Comput. Educ. **64**, 175–182 (2013)

Fiedler, S., Pata, K.: Distributed learning environments and social software: in search for a framework of design. In: Social Computing: Concepts, Methodologies, Tools, and Applications, pp. 403–416. IGI Global (2010)

Francom, G.M.: Educational Technology Use among K-12 Teachers: What Technologies Are Available and What Barriers Are Present?. Online Submission (2016)

Henri, F., Charlier, B., Limpens, F.: Understanding ple as an essential component of the learning process. In: EdMedia+ Innovate Learning, pp. 3766–3770. Association for the Advancement of Computing in Education (AACE) (2008)

Hill, C.W., Jones, G.R.: Cases in Strategic Management (5th ed.). Houghton Mifflin Company (2000)

Humphris, D.: Multiprofessional working, interprofessional learning and primary care: a way forward? Contemp. Nurse **26**(1), 48–55 (2007)

Kalz, M., Schön, S., Lindner, M., Roth, D., Baumgartner, P.: Systeme im Einsatz-Lernmanagement, Kompetenzmanagement und PLE (2011)

Krupka, E.L., Weber, R.A.: Identifying social norms using coordination games: why does dictator game sharing vary? J. Eur. Econ. Assoc. **11**(3), 495–524 (2013)

Lazarsfeld, P.F., Merton, R.K.: Friendship as a social process: a substantive and methodological analysis. Freedom Control Mod. Soc. **18**(1), 18–66 (1954)

Liu, Q., Turner, D., Jing, X.: The double first-class initiative in China: background, implementation, and potential problems. Beijing Int. Rev. Educ. **1**(1), 92–108 (2019)

Mazzucato, M.: Mission-oriented research & innovation in the European: A problem-solving approach to fuel innovation-led growth (2018)

McPherson, M., Smith-Lovin, L., Cook, J.M.: Birds of a feather: homophily in social networks. Ann. Rev. Sociol. **27**(1), 415–444 (2001)

Menon, S., Suresh, M.: Synergizing education, research, campus operations, and community engagements towards sustainability in higher education: a literature review. Int. J. Sustain. High. Educ. **21**(5), 1015–1051 (2020)

Miliband, D.: Personalised Learning : Building a New Relationship with Schools (2004)

Miliband, D.: Choice and voice in personalised learning. School. Tom. Personalising Educ. 21–30 (2006)

Moore, M.: On a theory of independent study. In: Distance Education, pp. 68–94. Routledge (2020)

Morley, C., Clarke, J.: From crisis to opportunity? innovations in Australian social work field education during the COVID-19 global pandemic. Soc. Work. Educ. **39**(8), 1048–1057 (2020)

Prell, C., Reed, M., Racin, L., Hubacek, K.: Competing structure, competing views: the role of formal and informal social structures in shaping stakeholder perceptions. Ecol. Soc. **15**(4) (2010)

Psacharopoulos, G.: Rates of return to investment in education around the World. Comp. Educ. Rev. **16**(1), 54–67 (1972)

Rahimi, E., van den Berg, J., Veen, W.: Facilitating student-driven constructing of learning environments using Web 2.0 personal learning environments. Comput. Educ. **81**, 235–246 (2015)

Reigeluth, C.M.: Instructional theory and technology for the new paradigm of education. Revista de Educación a Distancia (RED), (50) (2016)

Reigeluth, C.M., Karnopp, J.R.: Reinventing schools: It's time to break the mold. R&L Education (2013)

Reno, R.R., Cialdini, R.B., Kallgren, C.A.: The transsituational influence of social norms. J. Pers. Soc. Psychol. **64**(1), 104 (1993)

Sauder, M., Espeland, W.N.: The discipline of rankings: tight coupling and organizational change. Am. Sociol. Rev. **74**(1), 63–82 (2009)

Schofer, E., Ramirez, F.O., Meyer, J.W.: The societal consequences of higher education. Sociol. Educ. **94**(1), 1–19 (2021)

Sebba, J., Brown, N., Steward, S., Galton, M., James, M.: An Investigation of Personalised Learning Approaches used by Schools. DfES Publications, Nottingham (2007)

Segrave, S., Holt, D., Farmer, J.: The power of the 6 three model for enhancing academic teachers' capacities for effective online teaching and learning: benefits, initiatives and future directions. Australas. J. Educ. Technol. **21**(1) (2005)

Selwyn, N.: Education and Technology: Critical Questions (2017)

Soysal, Y.N., Baltaru, R.D.: University as the producer of knowledge, and economic and societal value: the 20th and twenty-first century transformations of the UK higher education system. Europ. J. High. Educ. **11**(3), 312–328 (2021)

Stolze, A.: A meta-ethnography on HEIs' transformation into more entrepreneurial institutions: towards an action-framework proposition. Ind. High. Educ. **35**(1), 14–27 (2021)

Tomlinson, M.: Conceptions of the value of higher education in a measured market. High. Educ. **75**(4), 711–727 (2017). https://doi.org/10.1007/s10734-017-0165-6

Tomlinson, M.: Missing values: engaging the value of higher education and implications for future measurements. Oxf. Rev. Educ. **48**(1), 46–62 (2022)

Torres Kompen, R.: Personal Learning Environments Based on WEB 2.0 Services in Secondary and Higher Education (2016)

Tyumaseva, Z.I., et al.: Psychological and social aspects of innovations and standardization in education. Bull. Natl. Acad. Sci. Republic Kazakhstan **4**, 274–283 (2020)

van Harmelen, M.: Personal learning environments. In: Sixth IEEE International Conference on Advanced Learning Technologies (ICALT'06), pp. 815–816 (2006)

Van Harmelen, M.: Design trajectories: four experiments in PLE implementation. Interact. Learn. Environ. **16**(1), 35–46 (2008)

Veletsianos, G., Moe, R.: The rise of educational technology as a sociocultural and ideological phenomenon. Educause Rev. **4** (2017)

Voronkova, V., Kyvliuk, O.: Philosophical reflection smart-society as a new model of the information society and its impact on the education of the 21st century. Future Hum. Image **7**, 154–162 (2017)

Wheelahan, L.: Why Knowledge Matters in Curriculum: A Social Realist Argument. Routledge (2012)

Young, M., Muller, J.: On the powers of powerful knowledge. Rev. Educ. **1**(3), 229–250 (2013)