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Applying ChatGPT to Tackle the Side Effects of Personal Learning Environments in Higher Education: A Teacher and Teaching Perspective

Xiaoshu XU[a], Xibing WANG[b1], Yunfeng ZHANG[c],
Huanhuan ZHANG[d], Yunyang WU [a]
a School of Foreign Studies, Wenzhou University, Wenzhou, 325000, China
b Graduate School of Education, Stamford International University of Thailand, 10250, Thailand
c Faculty of Languages and Translation, Macao Polytechnic University, Macao,999078, China
d Faculty of Applied Sciences, Macau Polytechnic University, Macao, 999078, China

Abstract. This paper explores the way to apply ChatGPT to mitigate the side effects of Personal Learning Environments (PLEs) in higher education from the perspectives of teachers and teaching. An interview with six university professors and two Information and Communication Technology (ICT) experts was conducted. The thematic analysis reveals two main categories of side effects, including educational philosophy and teaching skills. The data analysis also contends that ChatGPT offers a valuable tool to aid educators in overcoming these challenges by improving the personalization of PLEs, aligning PLEs with formal education requirements, and designing innovative assessments and enhancing learning engagement in PLEs. This study provides insights beneficial to practitioners, researchers, and policymakers by elucidating the challenges and opportunities associated with integrating ChatGPT with PLEs in higher education.

Keywords. Personal Learning Environment, ChatGPT, higher education, teacher and teaching, side effects

1. Introduction

Personal Learning Environments (PLEs) have become increasingly prevalent in higher education, offering students flexible, personalized learning experiences [1][2]. With the rise and expansion of chatbots, specifically ChatGPT, in higher education, there is immense potential for personalizing learning within PLEs. ChatGPT, developed by OpenAI, is an advanced chatbot that can handle a range of text-based queries, from simple inquiries to more complex tasks like creating thank-you letters or guiding conversations on productivity concerns [3]. Yet, implementing PLEs faces significant

[1] Corresponding author, Xibing Wang, Graduate School of Education, Stamford International University of Thailand, 10250, Thailand; E-mail: 2105100003@students.stamford.edu.

hurdles, including inadequate Information and Communication Technology (ICT) literacy among teachers and students, insufficient self-directed learning skills among learners, and issues related to ICT and internet access.

This paper seeks to identify the primary challenges teachers face in implementing PLEs and explore ways to mitigate these side effects. Although much research has investigated the benefits of PLEs [4][5], studies on the challenges of implementation, especially from the perspective of teachers, are limited [4]. Barriers such as low ICT literacy [6], resistance to new technology [7], inadequate awareness of PLEs as a new educational philosophy [2], and deficient assessment and evaluation skills [8] all hinder the successful implementation of PLEs and warrant further exploration.

In an attempt to improve the integration of PLEs in higher education, this paper aims to identify and address teachers' challenges using Artificial Intelligence (AI), particularly ChatGPT. This led to two main research questions: 1) What are the main challenges teachers encounter when implementing ChatGPT in higher education? 2) How can ChatGPT help to solve these main challenges? Semi-structured interviews were conducted with six university professors and two ICT experts to answer these questions.

This study's significance lies in its potential to enhance PLE implementation, promoting personalized and flexible learning experiences for students. By exploring ChatGPT's potential, the research also aims to provide practical implications for educators to incorporate ChatGPT to improve the quality of teaching and learning in higher education.

2. Literature review

2.1. Development of Personal Learning Environments (PLEs) in higher education

Our knowledge-driven society necessitates a transformation in learning methods. Although technology-enhanced learning holds potential, it hasn't completely altered education. Presently, learning content is often delivered through closed systems, but this needs to be restructured towards a more open, learner-focused approach. Personal Learning Environments (PLEs) are a promising solution to address the limitations of traditional technology-assisted learning models, offering a learner-centric approach where individuals can tailor their learning resources to their needs [9]. While PLEs are adaptable ecosystems of tools, resources, and networks designed to help learners achieve their goals and develop lifelong learning skills. They provide learners with control over their learning processes and access to a diverse range of tools and resources that align with their personal needs and preferences.

However, implementing PLEs in higher education presents challenges including the design of the underlying technological infrastructure [10], accommodating diverse learning styles [11], fostering metacognitive awareness for effective PLE use [12], tracking PLE effectiveness [13], and preparing students with digital literacy and self-regulatory skills to use, develop, and manage their own PLEs [14]. Addressing these challenges is crucial for the successful implementation of PLEs in higher education. In addition, PLEs aim to meet the needs of online education by providing learners with the freedom to access and evaluate diverse resources outside of institutional boundaries, aligning with communities of practice [15].

2.2. Side effects of PLE in higher education from a teacher and teaching perspective

From the perspective of teachers, implementing Personal Learning Environments (PLEs) presents several challenges. Teachers must have adequate ICT literacy skills to effectively design and facilitate learning activities within PLEs [16]. They must also be adaptable and resilient to new technology, as PLEs require continuous exploration of emerging digital tools and resources [17]. PLEs represent a shift from teacher-centered to learner-centered education, and teachers need to be aware of this new educational philosophy [18]. Assessing and evaluating learning outcomes within PLEs, which are often diverse and informal, is another challenge that teachers face [17]. Lastly, the implementation of PLEs necessitates new pedagogical designs, requiring a reevaluation of traditional instructional models [17].

PLEs, which are characterized by their learner-centric approach, have gained attention in higher education due to their potential to promote personalized learning and student engagement. However, the impact of PLEs on the role of teachers and the practice of teaching is an area that needs further research. Identifying effective strategies to address these challenges is crucial for the successful implementation of PLEs in higher education.

2.3. PLE ecosystem

Personal Learning Environments (PLEs) acknowledge that learning takes place in various settings beyond the traditional classroom and recognize the learner's engagement with a broader educational ecosystem that includes organizational, institutional, recreational, and societal elements [19][20]. Successful personalized learning relies on a dynamic ecosystem of interactions between the learner and the external environment. According to Fake [21], a personalized learning approach consists of a diverse range of resources within an ecosystem, encompassing different instructional methods, activities, and interactions for learners.

The PLE ecosystem theoretical framework guides the development of the interview questionnaire and facilitates the thematic analysis of the interview data. By applying this framework, we can examine how the identified themes are influenced and shaped within the PLE ecosystem, enabling a comprehensive understanding of the dynamic relationship between PLEs and the different dimensions of teaching and learning in higher education.

3. Methods

To address the aforementioned ramifications of PLEs from the teacher and teaching standpoint, this study employed an expert interview methodology.

3.1. Context

Our research team has spent the past seven years developing and implementing Personal Learning Environments (PLEs) in higher education. This immersive experience has allowed us to explore the potential and challenges of PLEs, particularly regarding teachers and teaching practices. This extensive engagement with PLEs forms the

backdrop for our current research, which seeks to identify and address the side effects of PLEs using ChatGPT.

3.2. Participants

The experts and teachers from higher education who participated in the study were selected based on their expertise and experience in the field. The selection criteria were established beforehand to ensure that only participants with relevant knowledge and expertise were invited to participate. The following Table 1 described the criteria operatively:

Table 1. Selection criteria for experts and teachers from higher education.

Criterion	ICT Experts	Higher Education Teachers
Experience	Minimum of five years in developing platforms for higher education	Minimum of five years of higher education teaching
Skills	Experience in creating and implementing personalized online learning platforms	Experience in teaching using personalized online platforms, such as Blackboard
Knowledge of PLEs	Ability to develop ICT tools to address challenges in PLEs	Clear understanding of PLEs
Education	Hold a Master's or Ph.D. degree	Hold a Master's or Ph.D. degree
Gender	Include both male and female experts	Include both male and female professors
Age		Include both young teachers and experienced professors

The study consisted of a sample of eight participants, which included two ICT experts and six university teachers. The ICT experts had 10-15 years of experience in developing online platforms for higher education, with one holding a master's degree and the other holding a Ph.D. Both participants had a good understanding of PLEs and ChatGPT. The university teachers were aged between 30-50 and had teaching experience ranging from 5-20 years. Four of the participants held Ph.D. degrees and two held master's degrees. All participants used personalized platforms and had a good understanding of PLEs. Furthermore, all participants had used ChatGPT for 2-4 months and held both positive and conservative opinions on the application of ChatGPT in PLEs to improve personalized learning (see Table 2).

Despite the small sample size, participants were carefully chosen for their extensive field experience and expertise. Our rigorous selection criteria ensured we gathered rich and insightful data from highly knowledgeable experts, enhancing the reliability of our findings.

Table 2. Personal Information of Interviewees.

No.	Gender	Teaching Experience	Age	Degree	Position
Expert interviewee 1	Male	10	35	Ph.D.	ICT expert
Expert interviewee 2	Male	15	43	MA	ICT expert
Professor interviewee 1	Female	5	30	MA	Lecturer
Professor interviewee 2	Male	20	50	Ph.D.	Professor
Professor interviewee 3	Female	11	40	MA	Associate Professor
Professor interviewee 4	Male	6	37	Ph.D.	Lecturer
Professor interviewee 5	Female	19	53	Ph.D.	Professor
Professor interviewee 6	Female	17	48	Ph.D.	Associate Professor

3.3. Research Instrument

In this study, data was collected through an unstructured survey of nine questions, aimed at gathering expert insights on Personal Learning Environments (PLEs) and ChatGPT. The questions were designed to understand the experts' perspectives on integrating ChatGPT into PLEs, their experiences with the challenges of implementing PLEs in higher education, and their suggestions for utilizing ChatGPT to mitigate the negative impacts of PLEs from a teaching perspective.

The survey was divided into three sections. The first section (Questions 1-2) focused on the experts' understanding of PLE and ChatGPT. The second section (Questions 3-4) aimed to capture their thoughts on applying ChatGPT in PLEs. The third section (Questions 5-9) explored their experiences with PLE implementation challenges and asked for suggestions on how ChatGPT could aid in developing the necessary skills for successful PLE teaching. These skills, extracted from the literature review, included assessment and evaluation, pedagogical design, learner engagement, and digital literacy. The experts were asked to propose ways in which ChatGPT could be employed to foster these skills and support their teaching within PLEs.

3.4. Procedures

Participants in this study were involved in online semi-structured interviews, conducted using Tencent Conference, an online conference tool. These interviews, conducted in English, lasted between 20-30 minutes and centered around open-ended questions designed to explore the potential of ChatGPT in addressing the side effects of Personal Learning Environments (PLEs), with a particular focus on the teacher and teaching perspectives. The study spanned over two months, during which the interviews were audio-recorded and transcribed for analysis.

Thematic analysis was used to examine the interview data. Researchers read and re-read the transcriptions to identify key themes and patterns relevant to the research questions. These themes were subsequently categorized and sub-categorized to spot commonalities and differences among the responses.

The research team prioritized ethical considerations throughout the study. Before the interviews, participants gave informed consent, upholding their autonomy and freedom of choice. They were made aware that their involvement was voluntary and they could opt out at any time without any negative consequences. The researchers aimed to conduct a scientifically rigorous study while preserving the rights and dignity of the participants.

3.5. Data analysis

Interview responses were analyzed using thematic analysis, a technique well-suited for summarizing key features, generating unexpected insights, and aiding policy development [22]. The method involved six phases as proposed by Braun and Clarke [22]: familiarizing oneself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report.

The interviews aimed to gain insights from higher education specialists on the potential application of ChatGPT in enhancing teaching experiences and mitigating potential adverse effects of Personal Learning Environments (PLEs) for teachers. However, due to the limited sample size, there may be restrictions in comprehensively

understanding the research question. Also, the sole reliance on expert interviews may limit the scope and depth of the information obtained. Future research should consider incorporating additional data collection methods, such as questionnaires or observations, to gain a more holistic understanding of educators' experiences with PLEs and ChatGPT.

4. Results

The thematic analysis method was utilized to evaluate the data collected from the interviews in this study, following the methodology of Braun & Clarke [22] and Elo & Kyngäs [23]. This analysis started with the first author reviewing all text, creating an initial list of codes, and organizing these codes into themes. Both the first and second authors then reviewed and refined these themes and codes. Each researcher independently carried out their thematic analyses, referring to the initial list of themes and codes. Once all the codes and themes were independently identified, they were extensively compared and discussed. Definitions were then assigned to all the codes, and some themes were reclassified. A second round of coding took place, based on the revised themes. After further discussions, the researchers agreed on more than 85% of the themes, codes, and references (see Table 3). The final step involved identifying the main themes and subthemes concerning the challenges of PLE implementation and strategies to address them from the teacher and teaching perspective (Table 3).

Table 3. Themes and sub-themes extracted from the opinions of the interviewees.

Questions	Main themes	Subthemes
PLEs & ChatGPT understanding	Concepts Challenges Advantages	-learning approach -self-directed learning platform -individual needs and preferences learner control -technology support -an artificial intelligence-powered language model/ Chatbot
Experience with PLEs & familiarity with ChatGPT	Familiarity Usage	-familiar with a variety of PLE tools and technologies -used ChatGPT to support language learning -model development
potential benefits ChatGPT brings to PLEs	Learner-teacher relationship Teaching support Learning support	-facilitate communication between learners and educators -personalized support -facilitate formative assessment -real-time feedback -adapt to students' learning needs -enhance students' engagement -promote personalized learning
challenges of incorporating ChatGPT into PLEs	Curriculum design Learners' needs Technical issues Teachers' competence Learners' competence Ethics	-aligns with the learning objectives of PLEs -effectively supports learners' educational needs -user-friendly design -adapt to different learning styles and preferences -easily accessible -technical hurdles -avoid replacing human interaction -effective assessment -ethical considerations -interoperability teachers' roles

pedagogical adjustments to align with PLEs	Teaching content design Platform design Education Philosophy Leaners' shift of roles Evaluation Philosophy	-Incorporating more user-generated content -Using open educational resources -Encouraging self-reflection and self-assessment -Leveraging social media and other online communities -Personalizing the learning experience -Shift to leaner-centered -developing students' digital literacy -Promote lifelong learning -competence-based learning -promote self-actualization -learners take control of their learning -Foster a growth mindset -Promote diversity and inclusion
ChatGPT for assessment and evaluation methods	Evaluation design Evaluation literacy Assessment challenges	-Shift assessment to higher-order thinking skills -Competence-based assessment -redesign activities -develop appropriate metrics and methods for assessment -emotional intelligence and creativity -reflection competence and information literacy
ChatGPT enhances learner engagement	Active learning Learning design Teachers' support Learning network	-diversified learning experiences in PLEs -emphasize active learning Personalization gamification social learning -involve students in the design -needs and preferences of diverse learners scaffolding -learning community
obstacles of pedagogical design and solutions	Understand concept External support Learner readiness Teacher readiness	-lack of understanding of PLEs -integrate PLEs with Learning Management Systems (LMS) -lack of support and resources for teachers -lack of learner agency -limited scaffolding competence -align PLEs requirement with formal education -insufficient ICT literacy limited time
ChatGPT helps to cultivate digital literacy	Cooperation Application Lifelong learning	-use ChatGPT for research and learning -stay up to date with ICT -collaborate with ICT experts -professional development peer mentoring -technology integration in lessons -continuous learning

4.1. The first set of questions

The interviews revealed that the two ICT experts define PLEs as customizable learning environments that cater to individual learner preferences, and they understand ChatGPT as an AI-driven tool capable of supporting learners in various tasks by imitating human conversation. They are acquainted with numerous PLE tools such as Learning Management Systems, social media platforms, and collaborative tools, and have utilized ChatGPT for purposes such as language learning and question-answering in diverse educational scenarios.

From the six university teachers interviewed, the younger half perceive PLEs as platforms that support self-directed learning, offering learners control over their learning

content and resources. In contrast, the older participants view PLEs as a new pedagogical approach that utilizes technology to promote self-directed and lifelong learning, enabling learners to create personalized learning environments that align with their individual interests and goals. In terms of understanding ChatGPT, four teachers see it as a chatbot platform aimed at increasing learner engagement and interaction in online learning settings. The remaining two see it as an AI-powered chatbot capable of natural language conversations, providing information, and delivering personalized support to users. For instance, university teacher interviewee 5 said:

"In my experience, PLEs have become increasingly important in higher education as learners seek more flexible and personalized approaches to learning. And, for ChatGPT, I believe it has the potential to enhance the learning experience, through providing personalized support and facilitating communication between learners and educators."

Three university teachers interviewed identified various potential benefits of integrating ChatGPT into PLEs, including its role in facilitating formative, self, peer, and summative assessments. They emphasized the importance of aligning assessment and evaluation methods with learning goals and objectives. These teachers noted that the use of technology like ChatGPT could help implement these assessment methods by offering real-time feedback and personalized learning experiences.

For instance, teachers 3 and 5 proposed that innovative and adaptive assessment techniques, such as game-based assessments offering real-time feedback through chatbots or personalized assessments that adapt to students' learning needs, could be integrated into PLEs to enhance learning outcomes.

4.2. The second set of questions

Question 4: What challenges do you foresee in incorporating ChatGPT into PLEs?

ICT expert interviewee 1 pointed out that one of the foremost challenges is ensuring that the ChatGPT aligns with the learning objectives of the PLEs and effectively supports learners' educational needs. Besides, Designing the ChatGPT to be user-friendly and easily accessible to learners is critical to its successful implementation. ICT expert interviewee 2 was more concerned about the technical hurdles that may arise when attempting to integrate the ChatGPT with existing PLE platforms. Moreover, he added that it is vital to ensure that the ChatGPT does not replace human interaction and personalization in the learning experience, and ethical considerations around the use of AI in education must be addressed.

Two university teacher interviewees pointed out the challenge for ChatGPT to adapt to different learning styles and preferences of learners, as students have different ways of learning and retaining information. Another challenge they mentioned is to ensure that the ChatGPT can effectively assess student progress and provide personalized feedback to promote further learning. University teacher interviewee 4 highlighted the challenge for ChatGPT to handle complex and abstract concepts. University teacher interviewee 1 indicated the importance of ChatGPT to effectively interact with other components of the PLEs, such as other learning tools and resources. Moreover, university teacher interviewee 3 indicated the lack of training as a major challenge. He further raised concerns on the ethical issue of using ChatGPT for assessment:

"……as ChatGPT technology continues to evolve, its negative impact on higher education and assessment is obvious."

University teacher interviewee 6 was more concerned about the potential impact of ChatGPT on the role of teachers and the teaching profession as a whole. She said: "As AI technology becomes more integrated into our education systems, it is important to critically examine how this will impact the work that teachers do, their responsibilities, and their relationship with students."

Question 5: What pedagogical adjustments are necessary to align more closely with the principles of PLEs?

The two ICT expert interviewees gave five suggestions for pedagogical adjustments to align more closely with the principles of a PLE:

(1) The incorporation of user-generated content, such as blogs, videos, podcasts, and social media posts, broadens perspectives and fosters community and collaboration among learners.
(2) The use of open educational resources (OERs), which are freely accessible and openly licensed materials, promotes equity in education by providing all learners access to high-quality resources, irrespective of their financial situation.
(3) Encouraging self-reflection and self-assessment can enhance metacognition and self-awareness, empowering students to take ownership of their learning and become more self-directed.
(4) Utilizing social media and other online communities can create spaces for learners to connect, share ideas, facilitate discussions, debates, and share resources.
(5) Personalizing the learning experience can engage and motivate students, promoting deeper learning and retention by allowing learners to focus on areas most relevant to their interests and goals.

The six university teacher interviewees recommended seven ways for pedagogical adjustments to align more closely with the principles of a PLE:

(1) Transition from traditional, teacher-centered methods to learner-centered approaches, promoting self-directed learning and giving students more control over their learning process.
(2) Prioritize the development of students' digital literacy skills, emphasizing the ability to evaluate the quality and credibility of digital information.
(3) Encourage lifelong learning, allowing teachers to explore their interests and engage in experiential and project-based learning.
(4) Focus on competence-based learning over traditional seat-time approaches, assessing students' abilities to apply learned knowledge, fostering practical skills usable in real-life scenarios.
(5) Encourage self-actualization over score orientation, aiding learners in identifying their interests, strengths, and weaknesses, thereby tailoring their learning experience accordingly.
(6) Enable learners to become "producers of knowledge" rather than mere consumers, offering the necessary tools and resources for them to create their own learning experiences and take ownership of their learning.
(7) Foster a growth mindset by encouraging students to embrace challenges, learn from mistakes, and persist in the face of obstacles.
(8) Advocate for diversity and inclusion by creating an educational environment that values diverse perspectives, encourages students to share their unique experiences, and provides opportunities to learn from others of different backgrounds and cultures. The third set of questions

Question 6: How can ChatGPT help to improve the assessment and evaluation methods in PLEs to optimize learning outcomes?

ICT expert interviewees highlighted the importance of a shift from traditional assessments to higher-order thinking skill-focused and competence-based assessments. The ultimate goal of assessment and evaluation in PLEs is to provide learners with meaningful feedback that supports their ongoing learning and helps them achieve their learning objectives, especially their creativity, ICT literacy and AI-human cooperation skills. For instance, ICT expert interviewee 1 said:

"ChatGPT can boost our analytic and decision-making abilities and creativity. Learners and teachers should know how to combine their distinctive human skills with those of a smart machine to get a better outcome than what they can achieve alone."

Among the six university teacher interviewees, four of them were quite positive towards using ChatGPT and believed that teachers should evolve, innovate, and redesign teaching to focus on how students can learn with ChatGPT rather than debating the negative ways it would bring. The six teacher interviewees gave the following five ways of assessment and evaluation methods that can be implemented in PLEs:

(1) Develop clear metrics and methods to evaluate learning in PLEs to ensure effectiveness (Interviewee 4).
(2) Design higher-order thinking activities that stimulate students' curiosity and critical thinking skills, making use of responses from ChatGPT (Interviewee 2).
(3) Integrate emotional intelligence and creativity into curriculum design to encourage students to appreciate their own creative contributions to the learning process rather than focusing on final outcomes (Interviewee 6).
(4) Use ChatGPT to assess reflection competence and information literacy, enabling students to understand the tool's capabilities and limitations. This way, students learn to judge the relevancy, authority, and accuracy of the sources provided by ChatGPT (Interviewee 1).
(5) Utilize ChatGPT to assess diverse learning experiences in PLEs creatively, aiming to augment, enhance, and enrich students' educational experiences, as well as improve assessment quality (Interviewee 3).Question 7: How to apply ChatGPT to enhance learner engagement within PLEs?

The two ICT expert interviewees gave the following five suggestions on pedagogical strategies that can encourage learner engagement within PLEs:

1) Emphasize active learning: Active learning is a pedagogical approach that involves learners in the learning process, using methods such as project-based learning, collaborative learning, and problem-based learning.

2) Personalization: Use chatGPT to provide learners with personalized learning paths and content to make them feel more connected to the material and be more motivated to learn. For instance, using adaptive learning technologies and learning analytics.

3) Gamification: Gamification can take many forms, such as points, badges, and leaderboards. By incorporating ChatGPT for gamification in PLEs, learners can be more engaged and motivated to learn.

4) Use ChatGPT to increase interaction: ChatGPT can be used to increase interaction and instant feedback to enhance learner engagement in PLEs.

5) Use ChatGPT to facilitate social learning: Social learning is a pedagogical approach that involves learners interacting with each other to share knowledge and ideas. This can be achieved through applying ChatGPT for group discussion, and collaborative projects, such as case studies and interviews.

The six university teacher interviewees gave the following five ways of pedagogical strategies that can encourage learner engagement within PLEs:

(1) Involve students in the design and implementation process: By allowing learners to choose their own learning paths, resources, and assessment methods, educators can encourage autonomy and self-directed learning, leading to increased engagement and satisfaction (University teacher interviewee 4).
(2) Consider the needs and preferences of diverse learners: PLEs should be adaptable, accommodating a wide range of learning styles, preferences, and needs, and should be capable of integrating with other learning systems and tools (University teacher interviewee 3).
(3) Scaffolding: Provide professional development programs, training workshops, and online resources to guide the effective and efficient use of PLEs, leading to improved learning outcomes (University teacher interviewee 5).
(4) Align PLEs with the learning outcomes of the course or curriculum: Educators should identify the learning outcomes that can be achieved through PLEs and determine how to assess student learning using this platform (University teacher interviewee 6).
(5) Foster a sense of community: Creating a sense of community, for instance through group discussions or virtual social events, can enhance engagement and motivate learners within PLEs (University teacher interviewee 3).

Question 8: What are the obstacles to effective pedagogical design in PLEs and what are the solutions to address them?

The ICT expert interviewee 1 pointed out that one major obstacle is the lack of understanding of PLEs by both students and teachers. Another big issue is the way to integrate PLEs with existing LMS. Many institutions use LMS to manage their courses, and integrating PLEs with these systems can be a technical challenge. This can result in "a lack of support and resources for teachers to design effective PLEs, and can hinder the adoption of PLEs as a learning tool." The ICT expert interviewee 2 indicated that "the design process requires a deep understanding of learning objectives, course content, and student needs, and requires careful consideration of how PLEs can support these factors. This can be a daunting task for teachers who already have heavy workloads."

To address these obstacles, the two ICT experts offered several solutions:

(1) provide professional development and training to educators on the use of PLEs. This can help to increase their understanding of PLEs and their potential to enhance student learning.
(2) Institutions can provide technical support and resources to help integrate PLEs with existing LMS. This can reduce the technical barriers for teachers and encourage them to incorporate PLEs into their courses.
(3) Institutions can allocate time and resources for educators to design effective PLEs. This can involve collaborative design efforts with other educators, instructional designers, and IT professionals, which can provide additional support and expertise.

The six university teacher interviewees listed eight types of obstacles to effective pedagogical design in PLEs, including lack of learner agency, difficulty in designing personalized and adaptive PLEs, limited scaffolding competence for facilitating learning in PLEs, difficulty in aligning different learning requirements in PLEs with course/curriculum outcomes, insufficient ICT literacy, limited time for designing personalized activities, misunderstanding of PLEs, and learners' strict schedule and heavy workload.

As for solutions, they gave suggestions from three perspectives: first, from teacher perspective, in order to empower learners in PLEs, teachers should engage them in designing and implementing their own learning experiences. Besides, teachers should provide support for scaffolding in PLE learning, provide clear guidelines and expectations, as well as regular feedback and support to help learners stay on track and manage their workload effectively. Second, from ICT perspective, ICT support teams are needed to help teachers create PLEs that can easily adapt to students' needs, are user-friendly, and can be customized. Meanwhile, ICT experts can provide training and support to teachers on basic ICT skills and the use of PLEs. Moreover, ICT experts can provide clear and concise explanations of what PLEs are, how they work, and their benefits for learning. Third, from institution perspective, institutions can build PLEs which is aligned with the learning goals of the course or curriculum. They should design flexible and adaptable PLEs that can be accessed at any time and from anywhere.

Question 9: How can ChatGPT help to cultivate digital literacy in the context of rapidly evolving technology?

The two ICT expert interviewees gave the following four ways to cultivate teachers' digital literacy: first, utilize ChatGPT for research and learning. ChatGPT can provide access to a wealth of information, including research articles, textbooks, and multimedia resources; Second, stay up to date with the latest digital tools and technologies; Third, collaborate with ICT experts. Teachers can collaborate with ICT experts to design and implement effective digital literacy programs. ICT experts can provide insights into emerging technologies such as ChatGPT and best practices for cultivating digital literacy. Fourth, exchange with colleagues about the latest trends and tools to learn from each other.

The six university teacher interviewees recommended the following five ways to cultivate teachers' digital literacy:

(1) Professional Development: Engaging in professional development programs, either online or in-person, can help teachers acquire the necessary digital literacy skills for the technological age.
(2) Peer Mentoring: Teachers can collaborate with more technologically proficient peers through mentoring programs, either online (e.g., via ChatGPT) or in-person, to improve their digital skills.
(3) Technology Integration in Lessons: Teachers can gradually incorporate technology into their lessons, enhancing their comfort level with various tools and promoting their digital literacy skills.
(4) Professional Learning Communities: Participating in professional communities focused on technology offers teachers access to extensive knowledge and resources, enabling them to learn from others, share their experiences, and stay updated on the latest technological trends.
(5) Continuous Learning: Teachers should foster a mindset of continuous learning, which can involve reading articles, attending conferences, exploring online resources, and experimenting with new tools.

5. Discussion

What are the main challenges teachers encountered when implementing ChatGPT in higher education?

Dede [24] suggests that personalized learning in Personal Learning Environments (PLEs) necessitates a shift towards learner-centered approaches that value diversity, flexibility, and autonomy, giving learners greater control over their learning paths and speed. However, data indicates that transitioning from a teacher-centered to a learner-centered approach requires awareness of PLEs, familiarity with PLE platforms, and new technologies like ChatGPT. Teachers should align their educational philosophies with PLE principles.

As outlined by Attwell & Hughes [25], PLEs prioritize competence-based learning over the traditional seat time approach, assessing learners based on their proficiency in certain subjects or skills, not the time they've spent on them.

Furthermore, PLE pedagogy promotes self-actualization and self-regulated learning over score orientation [14]. For teachers to support this, they must re-evaluate the meaning of teaching and education, reshape their evaluation ideology, and develop lifelong learning skills and scaffolding competence. This includes understanding learners' needs, creating effective learning strategies, building feedback literacy, and facilitating the development of learners' self-regulated learning awareness and skills.

In PLEs, teachers need to transition from traditional roles as knowledge providers to facilitators and guides, fostering a new teacher-learner relationship. PLEs allow learners to take control of their learning, becoming active knowledge creators rather than passive recipients [1][26]. This implies that learners can create and share content, connect with peers and experts, and participate in collaborative learning activities, contributing to an active learning community. Teachers need to understand the workings of PLE learning communities and maintain an open-mindedness towards seeing students as learning peers, learning alongside them in the ever-evolving digital environment.

Finally, with the rapid advancement of ICT in education, teachers might struggle with insufficient ICT literacy. They need support from external resources such as collaborations with ICT experts, up-to-date training, and peer mentoring. Additionally, they need more practical exploration, such as utilizing ChatGPT in classroom teaching and designing PLEs with new AI widgets, to transition from being PLE users to designers and educators.

How can ChatGPT help to solve these main challenges?

Assessment and evaluation are critical components of Personal Learning Environments (PLEs), as emphasized by Dede [24]. However, the challenge lies in devising clear methods to evaluate PLEs due to their personalized nature and the variety of tools and resources employed [27]. Innovative approaches, such as correlating formal assessment with social network activity within a PLE [28], could help overcome this. Additionally, considering the impact of PLEs on higher-order thinking skills and satisfaction is an important research area [29].

PLE design should also promote collaboration and community building, integral aspects of social learning [25]. Incorporating social media, chatbots, and other communication tools into the PLE can enhance this. However, privacy and security concerns must also be addressed [30].

Scaffolding is essential for PLE development, particularly for novice teachers. They could use tools like ChatGPT for designing activities and teaching content in PLEs [31]. Aligning PLEs with course or curriculum outcomes is also critical [2]. This involves assessing how PLEs can help achieve learning objectives and evaluating student learning.

6. Conclusion and future research

Personal Learning Environments (PLEs) present significant potential in enhancing personalized learning and empowering learners in higher education, but their effective implementation faces several challenges. These include learners' agency, teachers' capability in designing adaptive PLEs, appropriate scaffolding, alignment of diverse learning needs with curricular outcomes, and developing effective assessment methods. Economic implications, particularly for developing economies, can't be ignored, even though AI tools like ChatGPT can offer scalable solutions for personalized learning.

ChatGPT can help address these challenges by improving PLE personalization, aiding in pedagogical adjustment to align PLEs with formal education, designing innovative assessments, increasing learning engagement in PLEs, and promoting digital literacy. As AI grows, teachers will need to develop emotional intelligence, information literacy, and higher-order thinking skills, all of which require professional training and lifelong learning to effectively implement PLEs.

Although our research focuses on higher education, the findings are versatile and applicable across various educational levels, indicating their potential to transform teaching and learning practices. Future research could include additional data collection methods to better understand teachers' experiences in implementing PLEs. It's essential to remember that ChatGPT is still evolving, so our understanding and knowledge of this technology will grow over time.

References

[1] Attwell G. Personal learning environments - the future of elearning? eLearning Papers, 2021;2(1):1-8. https://www.openeducationeuropa.eu/en/article/Personal-Learning-Environments-the-future-of-eLearning%3F

[2] Van Harmelen M. Personal learning environments. In Proceedings of the Sixth International Conference on Advanced Learning Technologies (ICALT'06), 2006;815-816. https://doi.org/10.1109/ICALT.2006.1652451

[3] Kirmani AR. Artificial intelligence-enabled science poetry. ACS Energy Letters, 2022;8(1): 574-576.

[4] Dabbagh N, Kitsantas A. Personal learning environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. The Internet and Higher Education, 2012;15(1):3-8. doi: 10.1016/j.iheduc.2011.06.002

[5] Rahimi E, van den Berg J, Veen W. Investigating teachers' perception about the educational benefits of Web 2.0 personal learning environments. Educational Technology & Society, 2013;16(3), 207-222. https://www.jstor.org/stable/24504295

[6] Nguyen LAT, Habók A. Tools for assessing teacher digital literacy: A review. Journal of Computers in Education. 2023; https://doi.org/10.1007/s40692-022-00257-5

[7] Ertmer PA, Ottenbreit-Leftwich AT, Sadik O, Sendurur E, Sendurur P. Teacher beliefs and technology integration practices: A critical relationship. Computers & Education, 2012;59(2):423-435. doi: 10.1016/j.compedu.2012.02.001

[8] Bouchaib B. Exploring teachers' assessment practices and skills. International Journal of Assessment Tools in Education, 2016;4(1): 1–18. https://doi.org/10.21449/ijate.254581

[9] Cheung SK, Wang FL, Kwok LF, Poulova P. In search of the good. practices of personalized learning. Interactive Learning Environments, 2021;29(2):179-181.

[10] Rahimi E, van den Berg J, Veen W. Designing and implementing PLEs in a secondary school using Web2. 0 tools. In PLE Conference Proceedings, January 2012; 1(1).

[11] Yue Y, Chi C, Zhong K, Xu X. Do learners' preferred learning styles affect learning outcomes and satisfaction in PLE: a pilot study of the supervised-PLE-IELTS platform. Journal of Educational Technology and Innovation, 2021;1(01).

[12] Vázquez MM, Nistal ML. A metacognitive learning organizer to introduce learning strategies for PLE users and SRL students. In Proceedings of 2013 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE), August 2013; p. 141-146.

[13] Quintana MGB, Sáez JLC, Fernández MÀP. Use of PLE-portfolio to assess the competency-based learning through web 2.0 in technical engineering education. The International Journal of Engineering Education, 2014;30(3), 675-682.
[14] Tur G, Castañeda L, Torres-Kompen R, Carpenter JP. A literature review on self-regulated learning and personal learning environments: Features of a close relationship. Interactive Learning Environments, 2022;1-20. https://doi.org/10.1080/10494820.2021.2029766
[15] Ramírez Mera UN, Tur G. Supporting students' control and ownership of learning in the multimodal learning from a PLE perspective. In Ninth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'21), October 2021, p. 495-500.
[16] Kop R, Hill A. Connectivism: Learning theory of the future or vestige of the past? The International Review of Research in Open and Distributed Learning, 2008;9(3): 1-13.
[17] Yen CJ, Tu CH, Sujo-Montes LE, Armfield SWJ, Chan JY. Learner self-regulation and Web 2.0 tools management in personal learning environment. International Journal of Web-Based Learning and Teaching Technologies, 2013;8(1), 46-65. https://doi.org/10.4018/jwltt.2013010104
[18] Haworth R. Personal learning environments: a solution for self-directed learners. TechTrends 2016;60: 359–364. https://doi.org/10.1007/s11528-016-0074-z
[19] Corin EN, Jones MG, Andre T, Childers GM, Stevens V. Science hobbyists: Active users of the science-learning ecosystem. International Journal of Science Education, Part B, 2017;7(2):161-180.
[20] Miller FQ. Experiencing information use for early career academics' learning: a knowledge ecosystem model. Journal of Documentation, 2015;71(6): 1228-1249.
[21] Fake HEL. A Delphi Study on the Dimensions of Personalized Learning in Workforce Training and Development Programs (Doctoral dissertation, George Mason University), 2018.
[22] Braun V, Clarke V. Using thematic analysis in psychology. Qualitative Research in Psychology, 2006;3:77–101.
[23] Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. Journal of advanced nursing, 62(1), 107-115.
[24] Dede C. Comparing frameworks for 21st century skills. 21st Century Skills: Rethinking How Students Learn, 2010; 51-76.
[25] Attwell G, Hughes J. Pedagogical approaches to using technology for learning. In G. Attwell & H. Brown (Eds.), Personal learning environments: Voices, Challenges, Solutions. 2010, Sense Publishers, p. 33-45.
[26] Fiedler SH, Väljataga T. Personal learning environments: concept or technology? International Journal of Virtual and Personal Learning Environments, 2011;2(4){ 1-11.
[27] Xu XS, Hong WC, Zhang YF, Jiang HY, Liu J. Learning paths design in personal learning environments: The impact on postgraduates' cognitive achievements and satisfaction. Innovations in Education and Teaching International, 2023;1-17. https://doi.org/10.1080/14703297.2023.2189603
[28] Koulocheri E, Xenos M. Correlating formal assessment with social network activity within a personal learning environment. International Journal of Web-Based Learning and Teaching Technologies, 2019;14(1): 17–31. https://doi.org/10.4018/ijwltt.2019010102
[29] Elfeky AIM. The effect of personal learning environments on participants' higher order thinking skills and satisfaction. Innovations in Education and Teaching International, 2018;56(4):505–516. https://doi.org/10.1080/14703297.2018.1534601
[30] Huang R, Chen G, Huang W. Personal learning environment (PLE) readiness and its relationship with self-regulated learning and technology-enhanced learning (TEL) competencies. Educational Technology Research and Development. 2019;67(5), 1085-1107. doi: 10.1007/s11423-019-09683-y
[31] Moreno-Murcia, J. A., Belando, N., Huéscar, E., & Torres, M. D. (2017). Social support, physical exercise and life satisfaction in women. Revista latinoamericana de psicología, 49(3), 194-202.

Appendix A: Interview questionnaire

1) How do you understand Personal Learning Environment (PLE) and ChatGPT?
2) Can you describe your experience with PLE platforms and your familiarity with ChatGPT?
3) In your opinion, what potential benefits could ChatGPT bring to PLEs?
4) What challenges do you foresee in incorporating ChatGPT into PLEs?
5) What pedagogical adjustments are necessary to align more closely with the principles of PLEs?

6) How can ChatGPT help to improve the assessment and evaluation methods in PLEs to optimize learning outcomes?
7) How to apply ChatGPT to enhance learner engagement within PLEs?
8) What are the obstacles of effective pedagogical design in PLEs and what are the solutions to address them?
9) How can ChatGPT help to cultivate digital literacy in the context of rapidly evolving technology?