

Personal Learning Environments as Support for More Successful and Self-Regulated Learning

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Abstract

This paper examines Personal Learning Environments (PLEs) as support for more successful and self-regulated learning in digitally mediated educational contexts. The study addresses the gap between conceptual discussions of PLE and learners' everyday practices by analysing how individuals organise digital tools, resources, and support relations for learning. Using a qualitative, exploratory design, the empirical part draws on semi-structured interviews with eight participants from Slovenia and Austria. The small purposive sample enabled in-depth insight into diverse educational and life contexts rather than statistical generalisation. The findings show that participants construct PLEs mainly pragmatically and situationally, while elements of self-regulated learning are evident in planning, organisation, adaptation, and evaluation of resources. Effective PLE use depends on digital competence, reflective learning strategies and institutional support. The paper highlights implications for educators and institutions in supporting learners' autonomy, digital competence and more open learning environments.

Keywords: personal learning environment (PLE); self-regulated learning; lifelong learning; digital competence; learner autonomy; digital learning environment; educational practice

INTRODUCTION

Statement of the Research Problem

In contemporary society, learning is no longer confined to formal education but has become a lifelong and increasingly self-directed process. Individuals are expected to adapt continuously, update their knowledge, and develop new competences across formal, non-formal, and informal contexts. As Toffler (1983) argues, the central challenge of contemporary society is not merely access to information, but

the ability to learn, unlearn, and relearn. European policy documents similarly emphasise the importance of more open, flexible, and personalised forms of lifelong learning that respond to social, technological, and educational change (Commission of the European Communities, 2002).

These developments have also transformed the understanding of the educational process. Contemporary educational paradigms emphasise the active role of learners in constructing meaning, managing learning activities, and taking responsibility for their own progress. Constructivist and andragogical approaches understand learning as a process closely related to experience, reflection, motivation, autonomy, and independent decision-making regarding learning pathways (Bruner, 1966; Knowles, 1980; Knowles et al., 2005). Within this framework, self-regulated learning represents a key condition for high-quality learning, especially in contexts in which individuals are expected to navigate diverse information sources, digital tools, platforms, and social learning networks (Schunk & Zimmerman, 1998; Winne, 1998).

At the same time, digitalisation has reshaped the meaning of the learning environment. Learning environments can no longer be understood only as physical or institutionally organised spaces, but as complex configurations of technological, social, psychological, pedagogical, and organisational conditions that enable or constrain learning. Contemporary learning environments are therefore expected to support constructive, collaborative, personalised, and self-regulated learning (De Corte, 2010; Nelson et al., 2021; Kokko & Hirsto, 2021). Digital technology is not merely an additional instructional tool, but has become an integral dimension of how learners access information, organise learning, communicate, collaborate, and reflect on their progress.

In this context, the concept of the Personal Learning Environment (PLE) is particularly relevant. A PLE refers to a personalised set of digital tools, resources, strategies, and social connections through which individuals organise, direct, monitor, and reflect on their own learning. It should not be understood merely as a technological arrangement, but as a dynamic learning ecosystem that supports the search, organisation, creation, sharing, and evaluation of knowledge (Buchem et al., 2011; Castañeda & Adell, 2013). The concept is closely connected to self-regulated learning because it enables learners to set goals, select resources, choose learning pathways, monitor their progress, and adapt their learning strategies more autonomously (Olivier & Liber, 2001; Castañeda et al., 2022).

The relevance of PLE becomes especially evident when compared with institutional digital learning environments (DLEs), such as learning management systems and virtual learning environments. These systems are usually designed from the institutional perspective and tend to emphasise standardisation, administration, content delivery, and control. By contrast, PLE emerges from the learner's perspective and highlights flexibility, personalisation, learner autonomy, and the integration of diverse tools and resources across learning contexts (Sclater, 2008; Ebner et al., 2011). However, this does not mean that PLE and institutional systems should be understood as opposing models. Rather, the central issue is how institutional environments can support learners in developing more reflective, connected, and self-regulated personal learning practices.

Despite growing international interest in PLE, several gaps remain. First, PLE is often discussed at a conceptual or technological level, whereas less attention is given to how learners actually construct and use such environments in everyday learning practices. Second, the relationship between PLE and self-regulated learning is frequently assumed, but not always sufficiently examined through learners' own experiences. Third, in the Slovenian context, PLE remains relatively under-researched and is only rarely

systematically integrated into educational practice. Although Slovenia has a comparatively well-developed digital infrastructure, this does not necessarily mean that DLEs are used in pedagogically meaningful, reflective, and self-regulated ways. Previous research points to uneven levels of digital competence, insufficient institutional support, and limited emphasis on learner autonomy and self-regulation (Bregar & Puhek, 2017; Bregar et al., 2020; Klemenčič Mirazchiyski, 2024).

The present study addresses this gap by examining PLE not primarily as a prescribed technological model but as a learner-shaped, context-dependent learning practice. This understanding is consistent with approaches that define PLE as a dynamic configuration of tools, resources, strategies, and social connections rather than as a single digital platform (Buchem et al., 2011; Castañeda & Adell, 2013). The contribution of the study lies in providing qualitative insight into how individuals from different educational and life contexts in Slovenia and Austria use digital tools to organise, regulate, and support their learning. The cross-national dimension is not treated as a systematic comparison between the two countries, but as a way of including diverse learning contexts and experiences, which is appropriate for an exploratory qualitative design focused on meaning, practice, and contextual variation (Flick, 2014). In this way, the study contributes to a more nuanced understanding of PLE formation, especially in relation to self-regulated learning, digital competence, and institutional support, which have been identified as important conditions for meaningful digital learning (Schunk & Zimmerman, 1998; Winne, 1998; Ng, 2012; Castañeda et al., 2022).

Aim and Research Questions

This paper aims to examine how Personal Learning Environments support more successful and self-regulated learning and to identify the factors that enable or constrain their effective use. The study starts from the assumption that digital tools are already embedded in individuals' everyday learning practices, but that they are not always connected in a structured, reflective, and consciously organised way.

The study therefore does not focus primarily on whether individuals explicitly recognise or name their environments as PLEs. Instead, it examines how they use digital tools within their learning strategies, how these tools support planning, organisation, monitoring, reflection, and adaptation, and which barriers, needs, and support conditions they perceive in this process.

On this basis, the paper addresses the following research questions:

- RV1: How do individuals design their Personal Learning Environments and how do they use them to support self-regulated learning?
- RV2: What barriers, needs, and conditions arise in the effective use of Personal Learning Environments?

The first research question examines the relationship among PLE design, digital tool use, and self-regulated learning strategies. The second addresses the broader individual and institutional conditions of PLE use, with particular attention to digital competence, accessibility, support, and systemic incentives.

Structure of the Article

The article is structured as follows. First, the theoretical section discusses contemporary understandings of learning, self-regulated learning, and learning environments, with particular emphasis on digital

learning environments and PLE. The next section presents the qualitative research design, including the sample, data collection, and thematic analysis procedure. The empirical section then presents and discusses the findings in relation to the two research questions. The final section synthesises the main findings, outlines practical implications for educators and institutions, discusses the study's limitations, and proposes directions for further research.

LEARNING, SELF-REGULATION AND LEARNING ENVIRONMENTS

Learning is an active and self-regulated process

In contemporary educational and andragogical discussions, learning is no longer understood as the linear transmission of information from teacher to learner. Instead, it is interpreted as an active process in which individuals acquire, organise, connect, interpret, and apply knowledge in different contexts. Learning therefore does not simply involve the accumulation of information but also the transformation of understanding, action, and the learner's relation to the world (van Rossum & Hamer, 2010; Gandhi & Mukherji, 2023).

This shift is closely connected with constructivist and social constructivist perspectives. These approaches emphasise that learners do not passively receive knowledge, but construct it through prior knowledge, experience, interaction, and participation in social and cultural contexts (Bruner, 1966; Piaget, 1970; Vygotsky, 2013). Lave and Wenger (1991) further show that learning is situated in practice and shaped by participation in communities. From this perspective, the learner is not merely a recipient of instruction but an active participant in the educational process.

Such an understanding of learning is particularly important for adult education and lifelong learning. Adults enter learning with prior experience, practical goals, and a stronger need for autonomy, relevance, and meaning in the learning process (Knowles, 1980; Knowles et al., 2005). Heutagogical perspectives extend this view by emphasising self-determined learning, in which learners make decisions about goals, resources, strategies, and evaluation of their own progress (Hase & Kenyon, 2001). In the context of lifelong learning, this means that learning increasingly moves beyond formal institutional frameworks and becomes connected with flexibility, self-organisation, and individual responsibility (Jelenc, 2016).

For this reason, self-regulated learning is a central concept for understanding contemporary learning. It refers to the learner's ability to plan, monitor, evaluate, and adapt learning activities. Although self-regulated learning is often discussed alongside self-directed learning, both concepts point to a shift from external control toward greater learner activity, responsibility, and reflection (Loyens, 2007; Loyens et al., 2008). Schunk and Zimmerman (1998) place self-regulated learning within the broader framework of learning how to learn, because it involves not only the acquisition of knowledge, but also the selection of strategies, regulation of motivation, monitoring of progress, and response to learning difficulties.

Self-regulated learning includes cognitive, metacognitive, motivational, and behavioural dimensions. It does not depend only on the use of particular learning techniques, but on the learner's awareness of goals, prior knowledge, strategies, and contextual conditions. Winne (1998) emphasises self-observation, self-assessment, and self-response as key elements of this process, while Marentič Požarnik (2000) highlights the importance of goal setting, time management, progress monitoring, and self-evaluation. Zimmerman's cyclical model further explains self-regulation through three connected phases: forethought, performance, and self-reflection. In the forethought phase, learners define goals

and strategies; in the performance phase, they monitor and regulate their activity; and in the reflection phase, they evaluate outcomes to guide future learning (Panadero & Alonso-Tapia, 2014).

Self-regulated learning is especially relevant in digitally mediated learning contexts. Digital environments can support planning, organisation, monitoring, collaboration, feedback, and self-assessment, but only when learners use them in meaningful and reflective ways (Johnson & Davies, 2015). Recent research also highlights the role of e-portfolios, mobile learning, learning analytics, artificial intelligence, and other personalised technologies in supporting learners as they organise resources, monitor progress, and adapt learning strategies (Brünner et al., 2025). However, these possibilities depend on the learner's autonomy, digital competence, and ability to connect tools with concrete learning goals. This connection between self-regulation, digital competence, and the organisation of learning is central for understanding the role of PLE.

Learning environments as conditions for learner autonomy

The concept of the learning environment is also important for understanding PLE. In contemporary educational theory, the learning environment is no longer treated as a neutral background to instruction, but as an active condition that shapes how learning takes place. It includes not only physical space, but also pedagogical, technological, social, organisational, and symbolic dimensions that can support or constrain learning (Kokko & Hirsto, 2021).

A learner-centred understanding of education has changed how learning environments are conceptualised. Land and Hannafin (2000) describe student-centred learning environments as contexts that support inquiry, reflection, collaboration, and the active construction of knowledge. Similarly, Li (2018) shows that learning environments should be understood in relation to the practices and interactions they enable, not merely as spaces for delivering content. Research on learning environments also indicates that educational quality cannot be improved only through curricular change if the broader learning environment does not support active engagement, feedback, and participation (Walberg & Anderson, 1968; Fraser, 2023).

Contemporary learning environments are increasingly understood as dynamic and hybrid systems. They span physical, virtual, and social spaces and encompass relationships, tools, resources, communities, expectations, and institutional arrangements (Nelson et al., 2021; Kerres, 2016). In such environments, access to information is not sufficient. High-quality learning environments must also support constructive, situated, collaborative, and self-regulated learning, while enabling learners to take increasing responsibility for their own learning processes (De Corte, 2010).

This broader understanding is also reflected in the concept of educational ecosystems. Learning is not limited to a single classroom, platform, or institution, but is embedded in networks of formal and informal resources, digital tools, communities, and social relations (OECD, 2017; Global Education Futures, 2020; The Economist Group, 2022). This is particularly relevant in the context of digitalisation, where learners increasingly combine institutional platforms with open resources, communication tools, social networks, and personally selected applications (Guettat et al., 2024).

At the same time, learning environments cannot be evaluated solely by the availability of technology. Technological infrastructure does not automatically produce better learning. Learning environments also include relationships, expectations, identities, support mechanisms, and possibilities for participation

(Blackmore et al., 2011). A meaningful learning environment must therefore empower learners, support active engagement, and gradually strengthen their capacity for self-regulation and responsibility (McLennan & Peel, 2012).

From this perspective, PLE can be understood as a specific form of learning environment that places the learner's activity, autonomy, and organisation of learning at the centre. It is not only a set of tools, but a way in which learners connect resources, strategies, digital technologies, and social relations into a personally meaningful learning configuration. This provides the theoretical basis for the next section, which focuses more specifically on digital learning environments and PLE.

DIGITAL LEARNING ENVIRONMENTS AND PERSONAL LEARNING ENVIRONMENTS

Digital learning environments as pedagogical ecosystems

DLEs represent an important framework for contemporary learning in conditions marked by technological mediation, access to diverse resources, and increasingly flexible forms of educational participation. They do not refer only to technological infrastructure or digital content, but also to spaces in which learner roles, communication, collaboration, and the organisation of learning are transformed. Their significance is therefore linked not merely to technical development, but to changing conceptions of teaching and learning that emphasise active participation, personalisation, collaboration, and self-regulation (Veletsianos, 2016; Lodge et al., 2020).

The concept of the digital learning environment is broad and multidimensional. It includes infrastructure, tools, learning resources, communication channels, analytics, support mechanisms, and organisational practices (Veletsianos, 2016; Brown et al., 2015). For this reason, DLEs should not be evaluated solely on technical availability but also on the pedagogical relationships and learning practices they enable. Their educational value depends on whether they support meaningful learning activity, reflection, feedback, collaboration, and learner autonomy (Schneider, 2004; Hattie & Donoghue, 2016; Johnson & Davies, 2015).

DLEs can also reshape the teacher–student relationship. The teacher increasingly becomes a mentor, facilitator, and designer of learning conditions, while the learner assumes a more active role in organising, directing, and evaluating learning (Hattie & Donoghue, 2016; Geier et al., 2025). However, technology in itself does not guarantee high-quality learning. Its value depends on thoughtful pedagogical integration and on the learner's ability to use digital tools in purposeful and reflective ways.

This is closely connected with digital competence. Digital competence includes not only technical skills but also the ability to search for and evaluate information, communicate in digital environments, use technology ethically and safely, and select tools to meet learning goals (Ng, 2012). Without such competence, digitalisation may lead to superficial use of tools or deepen existing inequalities. This is particularly relevant in the Slovenian context, where relatively good technological infrastructure coexists with uneven levels of digital competence and with challenges in the pedagogically meaningful use of digital technologies (Bregar & Puhek, 2017; Bregar et al., 2020; Klemenčič Mirazchiyski, 2024).

Recent developments in artificial intelligence, learning analytics, mobile learning, and personalised digital systems have expanded the possibilities of DLEs. These technologies can support personalisation, feedback, progress monitoring, content generation, and the design of individual learning

pathways. At the same time, they raise questions of autonomy, privacy, responsibility, and pedagogical meaningfulness (Guettat et al., 2024; Brünner et al., 2025). DLEs must therefore be understood not only in relation to technological innovation but also to the conditions under which technology supports more autonomous, reflective, and self-regulated learning.

Personal Learning Environments as learner-shaped learning practices

Within this broader context, the concept of the Personal Learning Environment is particularly important. A PLE is not a single platform or a fixed technological system, but a personalised configuration of digital tools, resources, strategies, and social connections through which individuals organise and develop their own learning. What is central to PLE is not institutional control over the learning process, but the learner's active role in selecting tools, connecting resources, regulating learning activities, and reflecting on progress (Buchem et al., 2011; Castañeda & Adell, 2013).

A distinctive feature of PLE is its connection with learner autonomy and self-regulated learning. PLE includes activities such as accessing information, organising learning materials, planning learning activities, reflecting on progress, sharing knowledge, and collaborating with others. Castañeda and Adell (2013) classify PLE functions into three broad groups: tools and strategies for accessing information, tools and strategies for reflection, and tools and strategies for establishing and maintaining social relationships. This shows that PLE is not simply a collection of applications, but a learning environment in which informational, metacognitive, and social dimensions of learning are connected.

PLE can also be understood as a dynamic educational ecosystem that brings together individual goals, selected tools, communities, resources, and learning practices. Although it is based on learner autonomy, it is not individualistic in a narrow sense, because it is always embedded in broader social, cultural, technological, and organisational contexts (Buchem et al., 2011). This is especially important for adult, lifelong, and workplace learning, where individuals often combine formal educational resources, informal digital resources, peer networks, and personally selected applications (Olivier & Liber, 2001; Milligan et al., 2006; Castañeda et al., 2022). In organisational contexts, such practices are also relevant to knowledge management, since effective learning depends not only on formal systems, but also on how individuals access, share, apply, and develop knowledge in everyday work practices (Imam & Jagodič, 2021).

The educational value of PLE depends on whether learners can use digital tools critically, strategically, and reflectively, rather than merely operationally. In this sense, PLE supports a shift from using digital tools as isolated instruments towards connecting them into a meaningful learning practice (Castañeda et al., 2022; Ng, 2012). This distinction is important for the present study, which does not examine PLE primarily as a predefined digital system, but as a learner-shaped practice that may be more or less conscious, structured, and supported.

Personal Learning Environments and institutional learning systems

One of the key issues in understanding PLE is its relationship to institutional digital learning systems, especially learning management systems and virtual learning environments. These systems support the organisation and administration of educational processes, distribution of materials, communication among participants, monitoring of activities, and data management. Their underlying logic is therefore

predominantly institutional, because they are usually designed around programme requirements, course structures, administrative procedures, and formal assessment (Milligan et al., 2006; Sclater, 2008).

The difference between institutional learning systems and PLE is not only technical, but also pedagogical. Learning management systems usually place learners within predefined structures and provide limited possibilities for personalisation within institutional frameworks. By contrast, PLE is based on the learner's selection and integration of tools, resources, and networks according to personal needs, goals, and learning strategies. This makes PLE more open, flexible, and learner-centred, while institutional systems remain more standardised, secure, and administratively stable (Schaffert & Hilzensauer, 2008; Ebner et al., 2011).

However, the relationship between PLE and institutional learning systems should not be understood as purely oppositional. Institutional systems perform functions that PLE cannot fully replace, including formal organisation, data protection, programme implementation, assessment, course communication, and institutional support. PLE, on the other hand, offers greater adaptability, learner control, and the possibility of connecting formal learning with informal and non-formal resources (Sclater, 2008; Ebner et al., 2011). A more productive perspective is therefore complementarity rather than exclusion.

This complementary perspective is consistent with newer models of digital learning environments, which emphasise interoperability, integration, personalisation, analytics, collaboration, and flexible access to resources. Such models suggest that the future of digital education is unlikely to depend either on closed institutional systems alone or on fully individualised learning outside institutions. Rather, it is likely to involve more open digital ecosystems that combine organisational stability with learner autonomy and self-regulated learning (Brown et al., 2015; Buchem et al., 2011).

The relationship between PLE and institutional systems is therefore not only a technical question, but also a question of educational orientation. It concerns whether learners in digital environments are treated primarily as users of institutional systems or as active co-creators of their own learning environments. This issue is central for the empirical part of the present study, which examines how individuals organise their digital learning practices and which individual and institutional conditions support or restrict their effective use.

METHODOLOGY

Research design, participants and sampling

This study adopted a qualitative research design to examine how individuals understand, organise, and use their Personal Learning Environments in everyday learning practices. A qualitative approach was appropriate because the study did not aim to measure the frequency of PLE use or test causal relationships, but to gain insight into participants' experiences, meanings, learning strategies, and perceived support needs. The design made it possible to examine PLE not as a fixed technological model but as a lived, learner-shaped practice that varies in its level of awareness, structure, and institutional support (Flick, 2014).

The empirical part of the study was based on a purposive sample of eight participants who had experience using digital tools for learning. The participants came from different educational and life contexts, including informal education in Maribor and Graz and study contexts at DOBA Faculty and

FH Joanneum. They differed in age, professional background, educational experience, and familiarity with digital learning tools, which enabled the inclusion of diverse perspectives on PLE formation and use.

The relatively small sample size is consistent with the study's qualitative and exploratory orientation. The aim was not statistical representativeness or generalisation to a broader population, but an in-depth understanding of selected cases and the meanings participants attribute to their learning practices. In qualitative research, smaller purposive samples are methodologically appropriate when the purpose is to obtain rich, contextualised, and analytically relevant data rather than numerical generalisability (Flick, 2014).

The inclusion of participants from Slovenia and Austria should not be understood as a systematic comparative design between the two national contexts. Rather, the cross-national element broadened the range of educational and life contexts included in the study. The purpose was therefore exploratory diversity, not direct national comparison. This distinction is important because the sample does not allow conclusions about national differences between Slovenia and Austria. Still, it supports a richer understanding of how PLE-related practices appear across different learning contexts.

Data collection

Data were collected through semi-structured interviews. This method was selected because it balances thematic comparability across participants with openness to individual experiences, interpretations, and examples. Semi-structured interviews are particularly appropriate for researching subjective educational practices because they allow participants to describe both expected and unanticipated aspects of their learning experiences in their own terms (Flick, 2014; Banjac, 2020).

The interviews were conducted individually, predominantly online and, in some cases, in person. This mode of data collection enabled flexibility and accessibility, especially given that participants were geographically dispersed and came from diverse educational and life contexts. Before each interview, participants were informed about the purpose of the study, the interview procedure, the recording of data, and the principles of voluntary participation and anonymity.

The interview questions were open-ended and focused on participants' experiences with digital tools for learning, their ways of organising learning, their perceptions of self-regulation, their assessment of their own digital competences, and the barriers and support conditions they associated with PLE use. This was important because PLE often does not appear in practice as an explicitly named concept, but rather as a constellation of tools, habits, resources, and strategies embedded in everyday learning.

With participants' consent, the interviews were audio-recorded and then transcribed. Interviews conducted in Slovenian were transcribed manually. Interviews conducted in German were first processed with the TurboScribe tool and then manually checked. This procedure enabled more efficient transcription while preserving substantive accuracy, terminological consistency, and fidelity to participants' meanings.

Data analysis

The data were analysed using thematic analysis. This method enables the systematic identification, organisation, and interpretation of patterns of meaning within qualitative material. It is therefore

appropriate to examine how participants describe PLE use, self-regulated learning, digital competence, barriers, and support conditions (Braun & Clarke, 2006).

The analysis was carried out in several steps. First, the interview transcripts were read repeatedly to become familiar with the data. Second, open coding was used to identify relevant meaning units related to learning strategies, digital tools, self-regulation, digital competence, barriers, institutional support, and evaluations of PLE use. Third, related codes were grouped into broader thematic clusters. Finally, the themes were interpreted in relation to the theoretical framework and the two research questions.

The coding process combined deductive and inductive elements. Deductive codes were informed by the theoretical framework, especially the concepts of PLE, self-regulated learning, digital competence, and institutional support. Inductive codes were developed from the interview material itself, allowing themes to emerge from participants' descriptions rather than from predefined theoretical categories. This combination was important because the study aimed to both connect the empirical findings to existing theory and remain open to participants' own understandings of digitally supported learning.

The analysis identified 14 inductive and 6 deductive codes, which were organised into four broader thematic categories: learning as process, digital certainty and uncertainty, Personal Learning Environment, and system and support. For this article, particular attention was given to two analytical foci: first, the design of PLEs and their relationship to self-regulated learning; and second, the barriers, needs, and conditions that influence effective PLE use.

The analysis was supported by MAXQDA software. The software was used to organise the data, manage codes, compare coded segments, and improve the traceability of analytical decisions. However, the interpretation remained qualitative and researcher-led. MAXQDA therefore supported the transparency and organisation of the analysis, but did not replace interpretive judgement.

Ethical considerations and analytical transparency

The research was conducted in accordance with basic ethical principles for qualitative research. Participants were informed about the purpose of the study, the voluntary nature of participation, the recording and processing of data, and the protection of anonymity. They were coded as I1–I8, and identifying information was removed or generalised in the presentation of findings.

To strengthen analytical transparency, the findings are presented through thematic categories connected with the research questions. In the results section, each main theme is supported by interpretive explanation and representative interview excerpts. This makes the connection between data, interpretation, and theory more visible, which is particularly important in qualitative research (Braun & Clarke, 2006; Flick, 2014). The study does not aim at statistical generalisation, but at analytical understanding of how selected participants construct and use PLEs in relation to self-regulated learning and the conditions of digital learning.

RESULTS

Overview of themes

The thematic analysis identified four main thematic categories that describe how participants understand, organise, and use PLEs in their learning practices. The themes show that PLEs are present

in participants' everyday learning, but mostly as pragmatic and situational configurations rather than as fully planned and theoretically articulated learning systems. The analysis also shows that PLE use is closely connected with self-regulated learning, digital competence, and institutional support.

Table 1: Themes, subthemes and representative interview excerpts

Main theme	Subthemes	Analytical meaning	Representative excerpt
Pragmatic and situational construction of PLE	Use of tools according to immediate needs; combination of communication, organisation and resource-access tools; limited systematic planning	Participants construct PLEs as practical responses to concrete learning tasks rather than as fully planned learning systems.	"A learning environment is something you adapt to yourself and use the tools that are most useful at that moment." (I8)
Self-regulated learning as an implicit learning practice	Personal responsibility; planning; time management; adaptation of strategies; motivation	Participants demonstrate elements of self-regulation, although they do not always explicitly connect these practices to PLE.	"If the student has motivation, they will use every tool and every opportunity to raise their thinking." (I5)
Digital competence as a condition for effective PLE use	Information literacy, critical evaluation of sources, safe use, confidence, and uncertainty in tool use	Digital competence affects whether PLE remains a set of operational tools or becomes a more reflective and strategic learning environment.	"I think information and data literacy are really crucial. Probably the most important thing is knowing how to store and organise something in the digital space." (I6)
Institutional support and the LMS–PLE relationship	Need for guidance; limited institutional recognition of PLE; tension between closed LMS and open personal tools.	PLE development depends not only on individual motivation but also on educational support, openness and institutional conditions.	"LMS is focused on teachers; they decide, design and structure. PLE is shaped by the user, by the student." (I4)

Pragmatic and situational construction of Personal Learning Environments

The first theme shows that participants construct their PLEs mainly in pragmatic and situational ways. Their use of digital tools is usually connected with concrete learning needs, such as finding information, organising materials, communicating with others, managing time, or completing specific learning tasks. In this sense, participants' PLEs are not usually described as consciously designed systems, but as flexible configurations of tools and practices that have developed through experience.

Several participants described their use of digital tools as task-dependent. They selected tools according to what they needed at a particular moment: communication tools for coordination, search engines and online resources for information, cloud services for storing materials, calendars or reminders for organisation, and learning platforms for access to formal course content. One participant defined a personal digital learning environment as "an environment that you adapt entirely to yourself and in which you use the tools that are most important or useful at that moment" (I8). This indicates that PLEs

are embedded in everyday learning routines rather than constructed as separate or explicitly named learning environments.

The analysis also shows that some participants organise their learning in a partly structured way, while others rely more on immediate needs and ongoing adaptation. For example, I8 described learning as a process of completing tasks step by step: “I look at what I have to do, and when I finish one part, I already look at what comes next.” This reflects a practical form of self-organisation, but not necessarily a fully systematic or theoretically reflected PLE.

This finding shows that PLE is present as a lived practice even when participants do not explicitly use the term. The empirical material supports the understanding of PLE as a dynamic configuration of tools, resources, strategies, and social relations rather than as a single digital platform (Buchem et al., 2011; Castañeda & Adell, 2013).

Self-regulated learning as an implicit learning practice

The second theme concerns the relationship between PLE and self-regulated learning. Participants’ responses show several elements of self-regulation, including personal responsibility, planning, time management, monitoring progress, adapting learning strategies, and reflecting on learning needs. However, these elements are often implicit rather than explicitly connected with a formal understanding of self-regulated learning.

Participants frequently described learning as requiring initiative and active organisation. I6 emphasised lifelong learning as an unavoidable and active process: “We will all learn throughout life, whether we want to or not. You cannot avoid constantly developing. That is why it is even more important to decide what you want to learn actively.” This statement illustrates the connection between lifelong learning, learner agency and self-direction. It also shows that participants do not understand learning merely as participation in formal education, but as an ongoing process of personal and professional development.

Another participant emphasised that digital tools cannot replace the learner’s own motivation and responsibility. I5 stated: “The student must understand why they are there and what they want to achieve through learning. That is motivation. If they have this motivation, they will use every tool, every opportunity, to raise their thinking.” This statement is analytically important because it places digital tools in a supportive rather than a substitutive role. It confirms that PLE can support self-regulated learning only when learners are motivated, purposeful, and able to organise their learning activities.

Participants also described concrete self-regulatory practices. These included dividing learning tasks into smaller units, checking weekly requirements, saving materials in folders, taking notes, revisiting recorded lectures, searching for additional sources and adapting learning strategies when necessary. These practices correspond to key dimensions of self-regulated learning, especially planning, monitoring and self-evaluation (Schunk & Zimmerman, 1998; Winne, 1998; Panadero & Alonso-Tapia, 2014).

These findings show that PLE can support self-regulated learning when learners use digital tools to set goals, organise resources, monitor progress, evaluate information, and adapt their strategies. In participants’ accounts, such practices are visible, but they are not always systematically developed or pedagogically supported.

Digital competence as a condition for effective PLE use

The third theme shows that digital competence is a key condition for effective PLE use. Participants differ in their confidence, autonomy and critical awareness when using digital tools. Some participants use digital tools fluently and strategically, while others report uncertainty, dependence on external support, or difficulty selecting appropriate tools and evaluating digital information.

Digital competence appears not only as technical ability but also as the capacity to meaningfully select tools, evaluate the reliability of resources, organise information, and use digital environments safely and responsibly. I1 identified critical evaluation of sources as one of the most important competences for digital learning: “For effective learning, it is important to recognise which sources are reliable and which are not.” This finding supports the broader understanding of digital competence as a combination of technical, cognitive and socio-emotional dimensions (Ng, 2012).

The interviews also show that digital competence is uneven and often developed through practice rather than formal training. I2 described herself as a competent user in some areas, but also pointed to clear limitations: “I would need the most help with safe internet use and with certain applications, especially in terms of what they offer and how to use their different functions effectively.” She also mentioned artificial intelligence as an area where users increasingly need guidance, especially in formulating prompts and obtaining useful answers. This indicates that digital competence is not stable or complete, but must be continuously developed as technologies change.

I6 similarly emphasised information and data literacy as central to learning in digital environments: “You also need the desire and willingness to use digital tools. If you lack motivation for digital learning, it is difficult. I think information and data literacy are really crucial.” This statement connects digital competence with motivation and self-regulation. Learners need not only access to tools, but also the confidence and willingness to use them meaningfully.

The findings indicate that weaker digital competence can lead to fragmented use of PLEs. This supports the argument that access to digital tools is insufficient for meaningful digital learning, especially in contexts where technological infrastructure coexists with uneven digital competences (Bregar & Puhek, 2017; Bregar et al., 2020; Klemenčič Mirazchiyski, 2024).

Institutional support and the relationship between PLE and learning management systems

The fourth theme concerns institutional support and the relationship between PLE and formal digital learning systems. Participants’ responses indicate that institutions can either support or limit the development of PLE. Learning management systems are generally perceived as useful for access to course materials, communication, structure and administrative clarity. However, they are also experienced as relatively closed and pre-structured environments, offering limited possibilities for personalisation.

The distinction between LMS and PLE was expressed particularly clearly by I4: “A learning management system is a very concrete technical tool, an application. It is like a container. A personal learning environment is not one thing. It can be several different things at the same time. LMS is focused on teachers; they decide, design and structure. PLE is shaped by the user, by the student.” This statement

captures the key empirical distinction between institutionally structured and learner-shaped digital environments.

Other participants also described PLE as a more flexible and personal arrangement. I8 stated that when one studies, “you create something for yourself, a learning environment, because you have to, and you adapt it.” However, she also added that such an environment may be more or less organised. This suggests that personalisation alone does not guarantee systematic or reflective use of PLEs. Learners may adapt their environments pragmatically without developing a broader learning strategy.

The need for institutional and social support was also strongly expressed. I6 argued that many people lack digital competences and do not know that digital forms of learning could be useful or enjoyable for them. She added that there is often “no central point where someone could help you with learning,” whether this concerns practical skills or more advanced digital learning. Similarly, I5 referred to existing adult education institutions, such as folk universities and universities of the third age, but questioned whether they still understand their mission in relation to contemporary learning needs.

The relationship between PLE and institutional systems should therefore be understood as complementary. Learning management systems provide structure, stability, and formal support, while PLE enables personalisation, autonomy, and the integration of formal, non-formal, and informal resources. This corresponds to literature that contrasts institutional standardisation with learner autonomy, openness, and flexibility (Sclater, 2008; Schaffert & Hilzensauer, 2008; Ebner et al., 2011).

DISCUSSION

Personal Learning Environments between practice and reflection

The findings show that PLEs are already present in participants’ learning practices, but mostly as pragmatic, situational configurations rather than as fully structured, reflective learning systems. This confirms the relevance of the PLE concept, but also suggests a gap between theoretical models of PLE and actual learning practices. In the literature, PLE is often defined as a learner-controlled environment that supports access to information, reflection, knowledge creation, sharing and social interaction (Buchem et al., 2011; Castañeda & Adell, 2013). In the present study, these dimensions are visible, but they are not always consciously integrated by participants.

The empirical findings therefore suggest that PLE formation should not be understood as a purely technical process. Participants do not simply choose tools and combine them into a learning environment. Rather, their PLEs develop through learning habits, immediate needs, previous experiences, institutional expectations and levels of digital competence. PLE is therefore best understood as a learner-shaped practice that can be more or less reflective, more or less systematic and more or less supported by the educational environment.

This distinction is important for interpreting the study’s contribution. The findings do not show that participants lack PLEs. Rather, they show that participants already use PLE-related practices, but often without conceptualising them as part of a coherent personal learning environment. This supports the view that PLE exists both as a theoretical concept and as a practical reality of contemporary learning. The challenge is to strengthen the practice's reflective and strategic dimensions.

Conditions for effective PLE use

The findings show that effective PLE use depends on the interaction of self-regulation, digital competence and institutional support. Learners who can plan, organise, monitor, and adapt their learning can use digital tools more meaningfully, thereby confirming the theoretical connection between PLE and self-regulated learning (Schunk & Zimmerman, 1998; Winne, 1998; Panadero & Alonso-Tapia, 2014). At the same time, digital competence determines whether PLE remains a fragmented set of tools or becomes a more reflective and strategic learning environment. This competence includes not only technical skills, but also the ability to evaluate information, select appropriate tools, manage resources and use technology safely and purposefully (Ng, 2012; Kühn, 2017).

Institutional support is also necessary, even though PLE is grounded in learner autonomy. Institutions shape PLE development through the platforms they provide, the openness of learning arrangements, mentoring support and the extent to which learners are encouraged to connect institutional resources with personally selected tools. This confirms that PLE should not be understood as an isolated individual environment, but as a learner-shaped practice embedded in broader educational, technological and organisational contexts (Buchem et al., 2011; Castañeda et al., 2022).

Practical implications for educators and institutions

The findings have several practical implications for educators and institutions. Educators should not assume that learners automatically know how to construct effective PLEs simply because they use digital tools. Learners may be operationally competent but still lack strategies for planning, monitoring, evaluating, and connecting digital resources. Educational practice should therefore include explicit support for learning to learn, self-regulation, critical digital competence, and the use of reflective tools.

Teachers and mentors can help learners move from intuitive tool use towards more coherent PLE development by guiding them in selecting tools, evaluating digital resources, organising learning materials, reflecting on progress, and connecting formal learning with informal and non-formal resources. Institutions should also consider how learning management systems can become more open and complementary to learners' personal digital environments. The aim is not to replace institutional systems with PLE, but to create conditions in which formal platforms provide structure and support while allowing learners to connect them with personally meaningful tools and resources.

Overall, PLE should be understood as both an individual and institutional issue. It depends on learners' motivation, self-regulation, and digital competence, but also requires educational environments that are flexible, open, and supportive of learner-shaped digital learning practices.

CONCLUSION

Main contribution of the study

This study examined PLE as support for more successful and self-regulated learning in digitally mediated educational contexts. The findings show that participants already use PLE-related practices in everyday learning, but mostly as pragmatic, situational configurations rather than as fully planned, explicitly articulated learning systems. This confirms the relevance of understanding PLE not as a single digital platform, but as a learner-shaped environment that connects tools, resources, strategies and support relations (Buchem et al., 2011; Castañeda & Adell, 2013).

The study contributes to the discussion on PLE by showing that the main challenge is not access to digital tools alone, but the development of reflective and self-regulated learning practices. Effective PLE use depends on digital competence, learner motivation, self-regulation and institutional support. The Slovenian-Austrian qualitative perspective adds insight into diverse learning contexts without claiming systematic national comparison. The findings suggest that educators and institutions should support learners in developing digital competence, learning-to-learn strategies and more autonomous ways of organising digital learning.

Limitations

The findings should be interpreted in light of the study's methodological limitations. The research was based on a qualitative design and a purposive sample of eight participants. The aim was therefore not statistical generalisation but an in-depth, contextualised understanding of how selected individuals construct and use their PLEs. Such an approach is appropriate for exploratory qualitative research, but it does not allow conclusions about the broader population of learners in Slovenia, Austria or other educational contexts (Flick, 2014).

Another limitation concerns the sample's heterogeneity. The participants differed in age, educational experience, professional background, digital competence and familiarity with the concept of PLE. This diversity enriched the analysis, but it also limits the possibility of systematic comparison across groups. The inclusion of participants from Slovenia and Austria should therefore be understood as a way of broadening the range of learning contexts, not as a comparative national research design.

A further limitation concerns participants' varying levels of conceptual awareness. Since not all participants were familiar with the term Personal Learning Environment, some responses indirectly referenced PLE by describing digital tools, learning habits, and support needs. This is methodologically relevant because PLE often appears in practice as a constellation of tools and strategies rather than as an explicitly named concept. At the same time, it means that the interpretation of PLE-related practices required careful analytical reconstruction by the researcher, which is characteristic of thematic qualitative analysis (Braun & Clarke, 2006).

Directions for further research

Further research should include larger, more differentiated samples to examine how PLE formation varies by age, educational level, professional background, learning context, and digital competence. More homogeneous samples would enable more precise comparison between specific groups of learners, while mixed-method studies could provide a broader picture of PLE use in different educational settings.

Longitudinal research would also be valuable, since the present study suggests that PLE development is gradual, pragmatic, and only partially reflected. Future studies could examine how learners' PLEs change over time and whether structured support for self-regulated learning, digital competence, and reflective tool use leads to more coherent PLE practices.

Further research should also examine the relationships among PLE, learning management systems, artificial intelligence, learning analytics, and adaptive learning systems. These technologies may support personalisation, feedback, and progress monitoring, but they also raise questions of autonomy, privacy,

responsibility, and pedagogical meaningfulness (Guettat et al., 2024; Brünner et al., 2025). Further conceptual and terminological clarification of PLE is also needed, especially in educational contexts where the concept is still insufficiently recognised.

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