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Many thanks to Dr. Tim Pychyl, for his valuable advice and for allowing this idea to take flight; Wayne Jones for his editing expertise and insight; Rick Karayanis, for his technical prowess in producing a visually enticing document; and to Margaret Haines for her support in moving this project forward.



Purpose

The purpose of this working paper is to examine the role of Personal Learning Environments (PLEs) in higher education. This information will serve as a framework to inform a study of PLE use at Carleton University.

Methodology

Research in this paper consists of a review of the current literature on PLEs as well as a look at PLE projects being undertaken worldwide.

Findings

In today's higher education setting, little emphasis is placed on preparing students for ongoing professional learning. PLEs allow students to create personalized, portable learning spaces they configure with tools, resources and communities of practice to extend learning beyond course boundaries. In doing so, students learn to self-direct and self-regulate, develop new literacies, engage with a greater collective and develop their learner identity, all of which translate into skills associated with informal and lifelong learning. More importantly, PLEs create opportunities for dialogue between educators and students about metacognitive learning or about learning to learn.

The real potential of PLEs is being harnessed as a result of current developments in cloud, mashup, widget, social semantic and mobile technologies. Intuitive mashup dashboards like [Symbaloo](#) make it easy for students to quickly assemble, configure and modify a learning space.

In Europe, a number of universities created their own institutional PLEs. Large-scale projects such as [ROLE](#) are also developing and researching the use of tools such as recommender services and learning analytics, a form of data harvesting, used to increase student's self-awareness and reflection about learning using a feedback system.

While some implementation barriers and challenges do exist, the findings show that students greatly benefit from the opening up of institutionally framed and controlled learning environments.

Conclusion and Recommendations

A scan of Carleton University's academic policies and infrastructure shows that there is a readiness for this initiative. Evidence-based research using pilot projects will help flag and address institutional issues related to the use of PLEs. These projects would benefit from institutional learning support in the form of a blog titled "Informed2Learn: insights into how we learn, create and innovate" and through resources and people in our future Discovery Centre. The blog will harness the collective research knowledge on campus and beyond in the areas of teaching and learning, as well as other areas related to learning, creativity and innovation such as psychology, cognitive science, neuroscience, computer science, sociology. This approach will be unique to Carleton University.

Formal learning has dominated the way we think about education. Content-driven curriculum alone will not prepare future graduates for work and life. In a connected, global, competitive society, lifelong learning is becoming the new way of being. The [2006-2016 map of future forces affecting education](#) outlines significant shifts in the ecology of the education landscape.

Lifelong learning relies on students' capabilities to adapt to ever-changing learning contexts and to rapidly expanding knowledge. Personal Learning Environments are portable, ubiquitous learning spaces that allow students to learn to learn, connect with multidisciplinary viewpoints, engage in critical and creative practices, and nurture and develop their learning identity. By extending learning beyond course and institutional boundaries, these learning environments provide students with skills, tools and insight that will help them transition into their professional careers and make learning an integral part of their lifelong journey.

1. Introduction: Why educational institutions should not ignore Personal Learning Environments (PLEs)

Today's learning landscape

In today's global competitive environment, educational institutions are now looking at ways to give students the necessary tools and skills for lifelong learning. Much of the learning that goes on in higher education is frequently limited to individual course environments that often do not connect students to a wider learning context and to their life experiences. In many instances, course management systems (CMSs) simply translate the content of the traditional classroom into electronic format, resulting in prescriptive environments where students share the same homogenous learning context, have predetermined roles, and strive to achieve the same learning regardless of their individual learning styles and needs (El Helou & Gillet, 2011). As a result, students are not learning beyond the boundaries of course environments, are not engaging in self-directed learning and are not learning how to learn.

Lifelong learning in higher education

In December 2006, the European Parliament approved its 2006/962/EC recommendation on key competences for lifelong learning (EUROPA, 2006). One of the eight competences cited in this document was the ability to "learn to learn," which they define as:

"the ability to pursue and persist in learning, to organize one's own learning, including through effective management of time and information, both individually and in groups. This competence includes awareness of one's learning process and needs, identifying available opportunities, and the ability to overcome obstacles in order to learn successfully. This competence means gaining, processing and assimilating new knowledge and skills as well as seeking and making use of guidance. Learning to learn engages learners to build on prior learning and life experiences in order to use and apply knowledge and skills in a variety of contexts: at home, at work, in education and training."

(EUR-Lex, 2006,16)

In institutions that have embraced this approach, we notice the use of a less hierarchical and exclusive approach to skill achievement, the opening up of learning to include informal learning settings where students have the opportunity to learn anytime, anywhere, and the integration of learning-by-doing throughout the curriculum (Visser, 2012). Wong and Looi (2011) identified this open, ubiquitous form of

learning as "seamless learning." In these learning environments, students gain better insight into what it means to learn on their own and thus transition more easily into the next phase of their life – the workplace. Research has shown that 80% of knowledge in the workplace is acquired through informal, self-directed learning (Attwell, 2007). The 2004 [Work and Lifelong Learning \(WALL\)](#) survey shows that 91% of adults in Canada participate in intentional informal learning activities 14 hours per week on average and that 84% of workers in Canada find informal learning the most important source of job-specific knowledge (Livingstone, 2007). Despite these findings, informal learning is far from being embraced and recognized in educational settings.

The role of PLEs in lifelong learning

PLEs are the result of individuals harnessing Web 2.0 and 3.0 technologies to organize, aggregate, create, share and collaborate. They give students the freedom to learn beyond course boundaries, and to personalize their own learning environment. The current generation of PLEs, as a result of developments in mobile and cloud technology, now allow students to learn anytime and anywhere. Most PLEs are not tied to a particular institution and therefore are easily portable to whichever environment the student transitions to when he or she graduates.

E-Portfolios are currently used by students in many higher education institutions as a tool to document and to reflect on their learning. They provide future employers with a snapshot of the student's learning history, learning achievements, and reflective practice. E-Portfolios, coupled with PLEs, would allow students to demonstrate their capabilities as reflective professionals with a lifelong learning plan. This approach is a more accurate reflection of the reality of professional practice – that individual and professional development are not only connected but are ongoing, evolving and lifelong pursuits.

To achieve this goal, institutions need to create a culture around learning that encourages not only critical and creative inquiry and multi-view perspectives but also emphasizes the importance of learning as a lifelong pursuit. In doing so, we are helping students transition with ease and flourish in the competitive global environment.

The intent of this working paper is to examine the role of PLEs in a higher education setting and how they can benefit students in their academic as well as their future professional life.



2. The nature of PLEs: A conceptual exploration

What is a personal learning environment?

The term “personal learning environment,” based on its current practice, was first mentioned in 2001 in an unpublished paper by Oleg and Olivier entitled “Lifelong learning: The need for portable personal learning environments and supporting interoperability standards.” PLEs represent an emerging e-learning area, tracing its origins to systems such as Colloquia, the first peer-to-peer learning system (Severance, Hardin & Whyte, 2008). Though there is no consensus on a single PLE definition, the definitions found in the literature provide some insight into the nature and characteristics of PLEs.

Here are a few examples:

Lubesky (2006)

“A facility accessed by learners where content is aggregated, organized and vetted for one’s own ongoing learning needs.”

Anderson (2006)

“The PLE is a unique interface into the owner’s digital environment. It integrates their personal and professional interests (including their formal and informal learning), connecting these via a series of syndicated and distributed feeds.

The PLE is also a portfolio system allowing the user to maintain their repository of content and selectively share that content as needed. It is also a profile system, exposing the user’s interests in a variety of ways allowing automated, but selective search of the individual and their digital contributions. Of course, the PLE is a social as well as an information environment, connecting the user to individuals and cooperative events and activities throughout the Net.”

Downes (2007)

“The PLE is a recognition that the ‘one size fits all’ approach characteristic of the LMS (Learning Management System) will not be sufficient to meet the varied needs of students. It is, indeed, not a software application per se, but is rather a characterization of an approach to e-learning ... the key to understanding the PLE consists not in understanding a particular type of technology so much as in understanding the thinking that underlies the concept....”

Van Harmelen (2006)

“Personal Learning Environments are systems that help learners take control of and manage their own learning. This includes providing support for learners to set their own learning goals, manage their learning, manage both content and process, communicate with others in the process of learning and thereby achieve learning goals. A PLE may be composed of one or more sub-systems: As such it may be a desktop application, or composed of one or more web-based services.”

Educause (2009)

“A platform of tools, communities and services that constitute the individual educational experience and where learners direct their own learning and pursue educational goals using a growing matrix of resources they select.”

Attwell (2010)

“PLEs are spaces in which people interact and communicate their learning and the development of collective knowhow. In terms of technology ... a collection of loosely coupled tools, including web 2.0 technologies, ... and in terms of the collective ... an opportunity to connect, collaborate and learn with others.”

Chatti (2011)

“A Personal Learning Environment (PLE) includes the tools, communities, and services that constitute individual educational platforms learners use to direct their own learning and pursue educational goals. This represents a shift away from the traditional model of learning, and towards a model where students draw connections from a growing matrix of online and offline resources that they select and organize.”





Based on these and other definitions, a PLE can be referred to as a “system,” a “platform,” an “interface,” a “facility” or even an “approach to learning.” Though the presence of tools and the ability to access and manage content is important, the role of personalization and the role of learning as part of a wider collective emerge as its core features. In addition, the following traits appear to be inherent to PLEs. They:

- are controlled by the learner
- contain resources that are digital and diverse
- aggregate resources into one interface
- support and facilitate lifelong learning
- evolve and grow over time
- have the capacity for collaborative and reflective practice
- facilitate the development of various types of learning skills and literacies under one roof
- help to connect both formal and informal learning

Recent studies demonstrated that students who used PLEs acquired new sets of skills in addition to content competence. Mödritscher, Wild and Sigurdardson (2008) labelled these new social, collaborative and hands-on skills as “transcompetences,” or rich professional competences. The nature and quality of the learning experienced by users is also transformed in PLE environments. According to Jafari, Magee and Carmean (2006), this learning can be described as:

- lifelong (i.e. portable system not tied to an institution or organization)
- global (i.e. connected to various learning sources worldwide)
- outsourced (i.e. tools are not institutionally tied as a result of ubiquitous technology)
- comprehensive (i.e. a “tool-box” for everyday learning)
- smart (i.e. as a result of the use of intelligent agents to guide users)

The conceptual representation of PLEs

PLEs reflect the unique and personal nature of its user. The EdTechPost wiki posting [PLE Diagrams](#) contains a collection of PLEs that illustrate the diverse and complex nature of these learning environments. These diagrams are in essence concept maps of specific users’ PLEs. The diagrams are organized into the categories based on use and function: tool-oriented PLEs, use/action-oriented PLEs, people-oriented PLEs, and hybrid/abstract/other PLEs. Some users rely on mindmapping software such as [Pearltrees](#) and [Mindomo](#) to organize their PLE environment. The current generation of PLEs often uses mashup platforms or dashboards such as Symbaloo and Netvibes. Users populate these interfaces with webtools and resources such as widgets, apps, rss feeds, social

media tools, games and videos. The advent of apps that run on mobile platforms such as Chrome and Android are slowly displacing some of these platforms. In fact, iGoogle, a personalized dashboard, will be retired as of November 2013.

The following are some examples of actual mashup- or dashboard-type PLEs created by or for students:

- [Symbaloo writing webmix](#)
- [Symbaloo Project Next STEP \(job search\)](#)
- [Sample Netvibes PLE page](#)
- [PLEX](#)

PLEs and related learning environments: Trying to make sense of the terminology

As for most emerging fields, concepts associated with PLEs are at times unclear and the terminology used may be inconsistent and confusing as researchers attempt to map out the area.

Where do Personal Learning Networks (PLNs) and Adaptive Learning Environments (ALEs) fit into the PLE picture? PLNs support learning through a community or network of people assembled by the learner where knowledge of the network is seen as greater than knowledge of the person alone. Though PLN and PLE are often used interchangeably, PLNs are more about a learner’s relational, community connections in support of learning. The [2012 NMC Horizon Report](#) identified ALEs as the next wave of PLEs. These environments respond to real-time changes in students’ learning needs using learning analytics, a form of educational data mining (NCM and Educause, 2012). ALEs that have recently been deployed include the [Carnegie Mellon University’s Open Learning Initiative](#) and India’s Amrita University’s [HP Catalyst Initiative](#) addressing literacy in STEM education.

As individuals and institutions use and experiment with these informal learning environments, we are witnessing changes in how PLEs are being adapted to various learning, research and work contexts. In the literature, we find evidence of this change through mPLEs (mobile PLEs), iPLEs (institutional PLEs), PWLEs (Personal Work and Learning Environments), MUPPLEs (Mashup Personal Learning Environments) and PRPs (Personal Research Portals).

Now that we have a sense of what PLEs are, questions remain about their place and use in a formal higher education setting. Being able to understand the differences between PLEs and the more traditional CMSs is key to understanding how to construct, configure and use these two learning environments effectively to enrich students’ learning experiences.

Recent studies demonstrated that students who used PLEs acquired new sets of skills in addition to content competence.

3. Learning beyond course boundaries: The roles of PLEs and CMSs in student learning

Are PLEs and CMSs complementary or opposing systems?

By favouring CMSs, educational institutions are making some heavy-handed assumptions that learning occurs best in a one-size-fits-all context. In doing so, they are dumbing down students' capability to engage and negotiate learning contexts for the sake of institutional efficiency. Students, as a result, are missing out on richer, more complex learning opportunities and experiences. Today's students cannot but feel a certain disconnect between their technologically rich personal environments and the institutionally framed silos of CMSs. The emergence of PLEs is a response to this need as well as to changes in knowledge generation and usage on the web. By examining and understanding the nature, context and underlying pedagogical features of PLEs and CMSs, institutions, pedagogues and students could make better decisions about the most effective and appropriate use of these environments to support and facilitate learning.

A number of differences between PLEs and CMSs are outlined in the literature (Wilson, Liber, Johnson, Beauvoir, Sharples, & Milligan, 2006; Goodwin-Jones, 2009; Chatti, 2010; Mott, 2010).

The following is a brief overview:

Differences between PLEs and CMSs	
PLE	CMS
Learner-centric	Course or teacher-centric
Tools selected based on learner needs	One-size-fits-all tools
Informal, personal lifelong learning support	Formal learning support
Distributed, loosely coupled, open	Centralized, closed, rigid, standard, compliant
Cognitive load = learn, unlearn, relearn	Simple to train and support
Inexpensive (open source tools)	Licensed software, can be costly for institutions
Identity and data security issues	Institutional control and management of data and security
Bottom-up, emergent, symmetrical	Top down, hierarchical, asymmetrical
Knowledge push and pull	Knowledge push

CMSs often rely on licensed software tools that lag behind the latest technological developments and are not quickly adaptable to the novel and current ways in which students connect and learn with the technology in their personal lives. PLEs function as a complementary learning environment that allows students to merge the knowledge they acquired in various courses while at the same time developing and updating their digital literacies and competencies.

Buchem, Attwell and Torres (2011) defined PLEs as a complex activity system. Using an activity theory (AT) framework, they examined over 100 PLE publications in order to establish a knowledge base from which to further study them. Conceptualized by Engeström (2001), AT is based in semiotics and looks at both individual and collective activity practices. The researchers in this study used a grounded theory approach to uncover some core dimensions of PLEs, which included subject, tools, community, object, rules and division of labour. Under subject, they identified key concepts such as ownership, control, literacy, autonomy and empowerment. Unfortunately, none of these concepts is clearly defined or theoretically grounded in the literature, and there are only loose references to andragogy and social constructivism. The authors attribute these findings to the recent emergence of this area and hope that future studies will support some of the dimensions uncovered in this study.

What do we know so far about the use of PLEs?

In 2006, University of Bolton researchers identified 77 different patterns of use of PLE tools and organized them into the following eight broad categories (JISC-CETIS, 2006):

1. Chat and messaging tools
2. Groupware and community tools
3. Calendaring, scheduling and time management tools
4. News aggregation tools
5. Weblogging and personal publishing tools
6. Social software tools
7. Authoring and collaboration tools
8. Integration tools



Since this study was completed, web environments and tools have evolved, resulting in new patterns of use. While the study demonstrated that some PLEs are used purely for the purpose of workflow efficiency, the focus is now on how PLEs can be used to support and enhance student learning.

The literature provides some evidence of this potential. Learning is complex and involves an active, creative, collaborative component that is coupled with an equally important reflective and introspective component (Levy, 2007). According to Ravet (2007) and Reinhard (2010), reflection and connection are defining features of the new generation of PLEs. These environments also allow students to become active, autonomous and reflective learners – skills that are closely associated with self-regulated learning (SRL). This type of learning is critical in a society that relies on individuals who need to upgrade their knowledge and skills throughout their lifetime.

PLEs could also serve as a toolkit or “learning laboratory.” These environments allow students to engage and experiment with various learning contexts as well as to develop their own learner identity. From a pedagogue’s perspective, PLEs could provide a context

in which to engage students in conversations about how to learn or metacognitive learning. Educators and students can gain, as a result, some valuable insight into informal, tacit learning processes (Lee & McLoughlin, 2010; Martindale & Dowdy, 2010).

PLEs have gone through a first generation of development. El Helou and Gillet (2011) anticipated that the next generation of PLEs will encourage active student participation in learning through social media paradigms. In addition, these PLEs will allow interaction and learning to take place in a flexible and ubiquitous way, and will offer dynamic community and content management support through such devices as contextual recommender services.

Is there a place for PLEs in higher education? By examining the teaching and learning research literature and asking the right questions, pedagogues and students could make more informed decisions on how to best use and configure these learning environments. Some of these questions may include:

Are PLEs and CMSs complementary or opposing systems? Are they technological or pedagogical in focus, or both? Where does informal, self-directed learning fit into the student learning experience?



4. Mapping out the theoretical landscape for PLEs

Recent developments in mashup, widget, mobile and cloud technology now allow students to harness the real potential of PLEs. Some of the theoretical underpinnings of PLEs are beginning to emerge as researchers in various disciplines, such as psychology, education, cognitive science, neuroscience, computer science and sociology, begin to explore the impact of these environments on student learning.

PLEs as they relate to constructivism, interactionist pedagogy and connectivism

Behaviourist and constructivist theories are learning theories that come from two different schools of thought. The behaviourist approach, whose founders and proponents are Watson and Skinner, examine how learning can be affected and controlled by changes in the environment. This approach does consider the influence that personal (Tobin, 2000), social (Lave & Wenger, 1991) and emotional (Linnenbrink-Garcia & Pekrun, 2011) factors play in student engagement. In other words, behaviourists are interested only in learning outcomes and not in what goes on in the learner's mind.

Constructivists such as Piaget and Vygostky propose that we learn more deeply and meaningfully through active participation and by engaging in social interaction (Palincsar, 1998). This theory emerged as a result of the extensive study of cognitive development. In a constructivist learning environment, rather than being a provider of knowledge, the teacher acts as a facilitator or guide for students and questions, encourages, motivates and challenges students to formulate their own ideas and conclusions. Boyle (1997) identified a number of constructivist principles that are associated with online learning environments. He found that these environments allow students to gain experience with the knowledge construction process and encourage ownership and voice in the learning process, resulting in self-awareness. These environments embed learning in realistic and relevant contexts and in social experience using multiple representation modes. In constructivist settings, students engage in collaborative, reflective, contextualized and intentional learning. These elements translate into rich and productive learning experiences (Jonassen, 1999).

Tapscott (1998) used a constructivist lens to examine how the Net generation learns. He observed how online learning environments create new learning paradigms, which involve a change from:

- linear to hypermedia learning
- instruction to construction and discovery
- teacher-centred to learner-centred approach
- absorbing material to learning how to navigate and how to learn

- school to lifelong learning
- one size fits all to customized learning
- the teacher as transmitter to the teacher as facilitator

As a response to this growth in the complexity of today's networked environments, Downes (2006) and Siemens (2005) developed what they refer to as a new learning theory called "connectivism." It describes how one learns through a network that is self-directed, open, and personal in nature. What is unique about this approach is the shift from learner/curriculum-centred focus (cognitivism, constructivism) to a learner-driven one. Connectivism takes into account the complex and organic nature of learning, the need for learners to adapt to rapid change of knowledge, and the increasing diversity of knowledge sources. In other words, connectivism acknowledges that learning in today's web environment is complex, multifaceted and chaotic, and is reliant on making connections. Chatti, Jarke and Frosch-Wilke (2007) examined the unique elements of connectivism by looking at the relationship between knowledge and learning. They found that learning is an ongoing network formation process, facilitated by technology. Knowledge rests in these networks that are made up of specialized nodes or information sources. The ability to see these networks, recognize patterns and make sense between disciplines, ideas and concepts becomes a critical skill for today's learner.

Though some debate exists as to whether connectivism is a new theory, it recognizes the need for a theory or a framework to help educators understand the learning that takes place in today's complex networked, socially and technologically enhanced environments.

It is clear that open, personalized learning environments such as PLEs are aligned with interactionist, connectivist and constructivist learning design elements. These environments give learners the freedom to choose, configure and experiment with learning approaches and resources. Researchers are now examining how these design elements play an important role in student motivation and achievement as well as in self-directed lifelong learning.

PLEs, metacognition, self-directed, lifelong learning and andragogy

Metacognition

In academic institutions, there is talk of the importance of self-directed lifelong learning. Unfortunately, educators rarely have conversations with students about what this involves. As a result, students are often unaware of the cognitive and metacognitive processes required for reflective, intentional, self-directed learning.



Unlike CMSs that are institutionally controlled, PLEs give students the freedom to choose, customize a learning environment that is best suited to their needs, and to take learning into their own hands. By engaging students in metacognitive dialogues about these experiences, educators allow students to develop an awareness of their identity and capabilities as learners. This is something that has long been ignored in formal educational settings. By having these ongoing conversations through key courses such as seminal or capstone courses, we can help students scaffold these experiences and insights about learning so that by the time they complete their program of study they can easily transition to their future professional career equipped with a “learning toolkit” that will help them to continue to build on these lifelong learning practices. Why teach these metacognitive skills? Research has demonstrated that metacognitive awareness and self-regulated learning skills can be taught to students and result in improved learning (Nietfeld & Schraw, 2002; Thiede, Anderson, & Therriault, 2003).

Self-directed lifelong learning

Dunlap and Grabinger (2003) define lifelong learning as the intentional learning that people engage in during their lifetime for personal as well as professional fulfillment in order to improve and thus to increase their quality of life. Intentional learners develop metacognitive skills along with social behaviours, attitudes and motivations that help them with their own knowledge building (Bereiter & Scardamalia, 1989). This learning complements and extends the learning that takes place in formal educational settings. In today’s professional and work environments, individuals often rely on self-direction in order to develop as a professional and remain competitive. Edmondson, Boyer and Artis’ (2012) meta-analysis examined the relationship between self-directed learning and related constructs that included academic performance, future aspiration, creativity, curiosity and life satisfaction. They found a significant positive correlation between each of these constructs and self-directed learning. In their conclusion, they recommended that self-directed learning should be an important element of the curriculum.

Andragogy

Lifelong learning is also closely associated with Knowles’s (1980) andragogical assumptions about how adult learners learn. He found that adult learners become more self directed as they mature, that they have an experiential base on which to underpin their future learning, that their motivation is directed to socially relevant learning, and that they have a keen interest in problem solving.

The flexible, social, open architecture of PLEs is a good fit for self-directed adult learners. Younger students and less self-directed mature students could use PLEs to develop and practise skills that are important in becoming self-actualized learners and in achieving learning autonomy.

PLEs and the workplace: Connecting Knowledge Management and Learning Management with e-learning

In the past, organizations treated Knowledge Management (KM) and Learning Management (LM) as two distinct workplace frameworks. These entities are now converging as new technologies facilitate access to organizational knowledge through social, collaborative tools. Knowledge Management’s traditional preoccupation was the archiving and delivery of best practices to inform future workplace decision making (Chatti, 2007). The convergence of distinct organizational frameworks such as PLM (Personal Learning Management), PKM (Personal Knowledge Management) and PPM (Personal Productivity Management) along with PLEs has given rise to today’s PLWE (Personal Learning and Work Environments). Rubio, Galan, Sanchez and Delgado (2011) suggested that the use of these online environments allows professionals to converge knowledge, learning and innovation into one platform, resulting in a number of learning outcomes such as an increase in work efficiency, the development of e-competencies, and the creation and evolution of a professional digital identity and reputation. In other words, the “e-Professional” is the connected individual who uses informal, social, self-managed learning networks coupled with formal organizational networks to develop personally and professionally (Rubio et al., 2011).

PLEs, the development of new literacies and their relation to participatory culture

PLEs allow students to learn in a collaborative, participatory and distributed way, which results in the development of “new literacies” (Lankshear & Knobel, 2007). But what exactly are new literacies? The *Handbook of Research on New Literacies* (Coiro, Knobel, Lankshear, & Leu, 2008) lists a number of terms associated with this construct, which include 21st century literacies, internet literacies, digital literacies, new media literacies, multiliteracies, information literacy, information and communications technology literacies, and computer literacy. These literacies share the following assumptions: they involve the acquisition of new skills, strategies and social practices associated with new technologies; they require full participation in a global community; they evolve as their defining technologies change; they are multifaceted; and they use multi-perspective





viewpoints (Leu, Zawilinski, Castek, Banerjee, Housand, Liu, & O'Neil, 2007). In other words, new literacies involve skills coupled with the ability to engage through technology with a community or a culture.

How do these new literacies impact student learning? Jenkins, Clinton, Purushotma, Robinson and Weigel (2006) identified the following skills and outcomes:

- Play – the capacity to experiment with one's surroundings, creating opportunities to problem solve and explore the process of creative design
- Performance – the ability to adopt alternative identities for the purpose of improvisation and discovery
- Simulation – the ability to interpret and construct dynamic models of real-world processes
- Appropriation – the ability to meaningfully sample and remix media content
- Multitasking – the ability to scan one's environment and shift focus as needed to salient details
- Distributed cognition – the ability to interact meaningfully with tools that expand mental capacities
- Collective intelligence – the ability to pool knowledge and compare notes with others toward a common goal
- Networking – the ability to search for, synthesize, and disseminate information
- Negotiation – the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms
- Judgement – the ability to evaluate the reliability and credibility of different information sources
- Transmedia navigation – the ability to deal with the flow of stories and information across multiple modalities

In other words, PLE environments, unlike CMSs, give students the opportunity to engage with emerging technologies in ways in which they continuously develop and integrate new literacies into their learning experiences and as a result pick up new cognitive skills, insights and ways of learning and thinking.

PLEs as creative spaces for design and innovation

A FutureLab series report by Loveless (2007) on “creativity, new technologies and learning” defined creativity as an essential life skill. The European Commission named 2009 as the European year of creativity and innovation, recognizing its importance in personal, social and economic development.

Why is creative practice important in learning? It is associated with psychological well-being (Rasulzada & Dackert, 2009), intrinsic motivation (Hon, 2012) and self-directed learning (Fischer, 1999). In creative environments, learners have the opportunity to play with information, materials and ideas (Craft, 2001), to take risks and make mistakes in a safe environment (Davies, 1999) and to engage in activities over time and space (Oliveira, Silva, Guglielmino & Guglielmino, 2010). Creativity is also associated with the process of design and lifelong learning and is enabled by online environments (Fischer and Nakakoji, 1997).

Weller (2012) found that creativity and digital mobile technologies such as those used in PLEs form a positive, sustainable feedback loop for learning. Two recent initiatives reflect a growing interest for research in the areas of creativity and online learning: the “Mobile Learning and Creativity Workshop” at the International EC-TEL 2012 conference as well as the Special Issue of the *International Journal of Mobile and Blended Learning* (IJMBL) titled “Mobile Learning and Creativity: Current Concepts and Studies.”

PLEs are open web environments that allow students to experiment and play with ideas, tools and content. Institutions that encourage this type of learning are therefore supporting and nurturing student creativity and innovation, practices that benefit both individuals and society.

PLEs, cognitive load and choice theory

The Art of Choosing, a book by Sheena Iyengar, a social psychologist at Columbia University, uses a multidisciplinary, multicultural approach to examine the topic of choice. Her research looks at the impact of choice on factors such as human performance, well-being, identity formation, motivation, creative practice and social interaction – areas that are all closely associated with self-directed learning. Her research demonstrated, in both individuals and animal models, that those who are given the opportunity to make choices performed significantly better on tasks, were more motivated, and thrived better.

In today's digital environments, choice is ever present. Too much choice is found to be counterproductive, even paralyzing, especially when one has to choose from more than seven items (Iyengar, 2010). PLE users could encounter this problem, which could be addressed through an institutionally guided framework. Educators, researchers, learning support specialists, librarians, technical services experts, and even communities of practice and peers could play a key role in guiding and mentoring students to making the right choices. An institutional blog or recommender service could provide students with reviews and regular updates of tools and resources relevant to their area of study. ROLE, the Responsive Open Learning Environment project, is turning to applications that harness the collective intelligence of users. Tools such as [ReMashed](#), [PLEShare](#) and [PLEM](#) are mashup-driven aggregators that use social media Application Program Interfaces (APIs) to filter and rank resources based on use. [PacMan](#) (Personal Activity Manager), a Firefox widget developed by the ROLE project, uses learning analytics to help students structure their learning. Calm technologies could also provide solutions to cognitive overload (Tugui, 2011). One approach would be by representing learning objects as widgets (Fiaidhi, 2010). Researchers are also finding solutions by harnessing the Social Semantic Web (SSW) through ontologies that define, structure and share information using collaborative software (Posea & Trausan-Matu, 2010). [DEPTHS](#) (DEsign Patterns Teaching Help System) and ADE ([AWESOME Dissertation Environment](#)) rely on both the SSW and linked data capabilities to improve student control over tool applications. They help students make better choices by providing insight into their learning through visual [learning analytics](#), a form of educational data mining.

This is but a cursory examination of a few of the theories behind PLEs. We can only assume that this area of knowledge will grow as PLEs mature and as researchers and pedagogues further explore their impact on learning.

Bringing theory into action: Creating new learning paradigms

We associate 21st century pedagogy with terms such as networked learning (Polsani, 2003), e-learning 2.0 (Downes, 2005), social learning 2.0 (Dron & Anderson, 2007), microlearning (Hug, Lindner & Bruck, 2006), nanolearning (Masie, 2006), university 2.0 (Barnes & Tynan, 2007) and curriculum 2.0 (Edson, 2007). PLEs are creating new learning paradigms and, as a result, are driving a reconceptualization of pedagogy in higher education. McLoughlin and Lee (2008) define this new pedagogy by its 3Ps:

- Personalization – involving learner choice, learner agency, customization, self-regulation and self-management
- Participation – involving communication, collaboration, connectivity and community
- Productivity – involving learner-created content, contribution to knowledge, generativity, creativity and innovation

PLEs represent a significant departure from current teaching/learning paradigms. Their implementation therefore will require a certain degree of institutional acceptance and support. Nevertheless, before jumping in, higher education institutions need to closely examine their own ecologies to determine whether PLEs are a good fit. This process would involve asking such questions as:

- Will there be institutional acceptance of informal modes of learning?
- If so, how would you promote and integrate this form of learning and make it part of the institutional culture?
- Which norms and skills guide the development of PLEs in different disciplinary contexts on campus?
- How would our institution support the development of new literacies required for students to establish a PLE?

PLEs allow students to learn in a collaborative, participatory and distributed way.

5. PLEs in an academic setting: Implementation challenges and opportunities

Institutions need to consider the process involved in the uptake of technology.

What do institutions need to know?

The 2011 Horizon Report listed PLEs as an emerging technology having a significant impact on both teaching and learning in higher education institutions around the globe (NCM and Educause, 2011). The report predicts it will take four to five years before PLEs become established (Johnson, Smith, Willis, Levine & Haywood, 2011). Though projections like these provide some guidelines and future direction, each institution needs to examine its own particular setting and issues before investing time and effort in any emerging practice. PLEs entail a significant paradigm shift away from traditional formal learning philosophies and require careful consideration before they are implemented as part of an institutional practice and learning culture. Those who approach PLEs as simply another social media device to empower their students will likely encounter institutional resistance (Hilton, 2009). On the other hand, institutions that ignore today's global learning trends will fail to prepare their graduates for a successful professional life.

JISC-CETIS (Centre for Educational Technology and Interoperability Standards) advises the U.K. higher education sectors on educational technology and standards. In its extensive [PLE/report](#), it developed criteria to evaluate current learning technologies (JISC-CETIS, 2007). The Centre proposes that these technologies should provide learning opportunities that are accessible to students, irrespective of the constraints of time, and that are available continually over the period of an individual's life. These environments should prioritize the individual needs and capabilities of students through the provision of effective communications tools as well as remove barriers to learning, whether they are institutional, technical or pedagogical.

In other words, this report acknowledges that the nature of learning has changed and that educational institutions should examine and integrate informal, personalized, connected, ubiquitous approaches to learning into their institutional teaching and learning practices.

Negotiating institutional change

Institutions need to consider the process involved in the uptake of technology. Unlike educational technologies from the past, such as films that were often accessible only in a classroom setting, web technologies are readily available to teachers and students alike. Rogers (1986), considered as the father of technological adoption/diffusion, revealed three important ways in which the adoption of interactive communications such as internet technologies differs from that of previous innovations. He found that a critical mass of adopters is needed to convince educators of the technology's efficacy and that frequent use is necessary to ensure success of the diffusion effort. Internet technology is a tool that can be applied

in different ways and for different purposes through a dynamic process that may involve change, modification and adaptation by users.

This process signals that the uptake of web technologies in institutions often relies, in many cases, on a grassroots approach. Faculty, instructors and students who are early adopters of technology often take the lead in experimenting and modelling novel ways to use technology in teaching and learning contexts using evidence-based pilot studies. These could provide the groundwork for the institutional implementation of PLEs, in addition to providing insight into institutional readiness as well as technical, social and pedagogical barriers and issues.

Implementation models

According to Sclater (2008), emerging technologies often struggle to coexist alongside more established technologies such as CMSs due to institutional pushback. On the other hand, new technologies such as PLEs emerge as a response to students' dissatisfaction with rigid, institutionally controlled learning environments. These tensions need to be identified, addressed and negotiated within institutions.

Three institutional implementation scenarios could be considered. In the first scenario, CMSs could be used to support formal learning while PLEs could be used independently by students for informal learning practices. In the second scenario, we have institutions opening up their CMSs to allow for a certain degree of interoperability with PLE-type environments. A recent example of such a CMS platform is [CANVAS](#). The third scenario involves the CMS co-opting PLE tools and resources. This third option may be less desirable as a result of institutional and instructor control, which is known to reduce the transformative powers of open, personalized learning environments (Wilson, Switzer, Parrish, & IDEAL Research Lab, 2007). The second option harnesses the strengths of both environments by facilitating the integration of formal with informal learning modes, thus optimizing the student's learning experiences (Hall, 2009).

Barriers to consider

Introducing PLEs into an academic setting is not simply a matter of allowing students to personalize a learning space. It involves among other things a change in how individual students learn, a change in relational dynamics that these students have with content and context, a shift from individual-group learning to individual-network learning, and a shift from being instructor/institution-led to being self-regulated and self-managed (Pettenati, 2010). To negotiate these changes in the long term, institutions need to embrace a learning culture that supports



self-directed lifelong learning. PLEs are not institutionally framed and controlled learning environments. This lack of control and standardization over the technology and student learning may be viewed as a significant barrier, as would institutional entrenchment in more traditional educational philosophies. Other implementation issues may touch not only pedagogical and organizational factors but also logistical, technical, social and proprietary issues.

Managing one's own digital identity and data

Though CMS environments are less adaptable than their PLE counterparts, they are considered to be secure, housed behind firewalls on institutional servers. PLEs' open, flexible digital platforms make them vulnerable to privacy and data security breaches. MacNeill and Kraan (2010) examined various architectural configurations of learning environments and identified five models of distribution:

- a system in the cloud with associated outlets
- plug-ins to existing CMSs
- a collection of widgets from the web assembled into a widget "container" or platform
- many providers and clients
- a single provider and client model

Mödrtscher (2010) found that most PLEs use the single-provider model and rely on a commercial server-sided approach where data are housed off site. It is only in the last year that we have seen the appearance of more secure client-sided solutions. One such example is PacMan (Personal Activity Manager), developed as part of the ROLE project. While these client-sided options provide users with more control over which data they wish to share and with whom, the more vulnerable server-sided PLEs prove to be best suited for collaborative learning.

The current generation of PLEs often consists of a "mashup" of tools and resources that require multiple sign-on and passwords. Identity and access managers (I&AM) such as Ping are addressing this user authentication issue in cloud environments. These managers rely on a user-centric identity system rather than a product or company-centric one. A recently developed digital identity manager called FingerID uses biometrics as a secure authentication mechanism to help users seamlessly connect to resources across multiple tools and websites. The NCM 2012 report projects that these digital identity managers could be used to personalize curriculum by assessing students' digital footprint through learning analytics (NCM and Educause, 2012).

Leadership and governance challenges

As with many initiatives on campus, shared leadership and governance will ensure a successful

implementation, integration and coordination of informal self-directed learning approaches with formal learning. The formalization of this process may involve the creation of a team of experts from areas such as IT support, student learning support, teaching support, academic units, and library support. Institutions that recognize the value of informal self-directed lifelong learning in their academic plan can use the directives of this institutional document as their guiding principles for implementation and use of PLEs.

Competencies challenges

Cognitive load and time demands placed on learners to learn and relearn how to navigate and configure their PLEs can be viewed as a significant barrier, especially for learners who are not savvy users of technology. By selecting simple, intuitive dashboard-type MUPPLEs, such as Symbaloo, institutions can make PLEs more accessible to all types of learners. Institutional support could also take the form of a "*Informed2Learn*" blog to help users gain some insight into the processes and skills associated with self-directed lifelong learning. Selecting the right webtools and resources may prove to be a difficult task for some students. Recommender services and learning analytics are currently being examined in the research literature. A few universities, such as Graz University in Geneva, are developing an in-house recommender system for their institutional PLE. As a quick alternative, institutions could create webmixes for various disciplines or dashboard templates containing widgets, webtools and resources that would serve as a starting point for students. Social Semantic Web (SSW) applications, such as the [ROLE widget store](#), allow users to add, share and comment on widgets related to learning.

Bookmarking/annotation systems, such as Diigo, could also be used to tag, review and share new educational resources and tools. In addition, institutions could encourage and support faculty and graduate students' use of PLEs for their own teaching and research practices so that they could model their use to students.

A gradual implementation process may also alleviate competencies challenges. Pettenati (2010) recommended a scalable roadmap that is broken down into three phases: PLE basic, intermediate and evolutionary. The basic model supports students' immediate learning needs, the intermediate builds on work-based needs and finally the evolutionary addresses lifelong learning skills and needs.

In order to negotiate a successful implementation of PLEs, institutions could examine how PLEs have been implemented in other settings. These case studies could provide valuable insight into how to best implement these learning environments into one's own institutional context as well as identify the pitfalls to avoid.

A gradual implementation process may alleviate competencies challenges.

6. PLEs in practice: Case studies and projects worldwide

Self-directed learning requires the learner to self-monitor and reflect on his or her learning.

PLEs have already gone through one cycle of development. They range from personal widget-based dashboards to larger-scale institutionally run systems. The **ROLE** project represents the latest development of a fully integrated PLE environment that uses such Social Semantic Web (SSW) tools as a pattern repository (see below).

The following is a quick scan of how PLEs are being used in higher education settings worldwide.

a. Large-scale projects

Europe

i. Responsive Open Learning Environments (ROLE)

The **ROLE** project takes a look at the next generation of PLEs. **ROLE** is a European collaborative project with 16 international research groups from six EU countries and China.

ROLE technology is based on the concept of self-regulated learning. It allows students to plan their learning process, search for the resources independently, and reflect on their learning process and progress.

ROLE's main goal is also to assist teachers in helping their students through the process. The project just entered its fourth year in 2012. Its main objective now is to test the operating learning environment and associated widgets.

Self-directed learning requires the learner to self-monitor and reflect on his or her learning. **CAMera** is a tool that was recently developed as part of the **ROLE** project to monitor and report on learning behaviour using Contextual Attention Metadata (CAM) that is made available to the learner.

Another **ROLE** device, **PLEshare**, is a pattern repository or a web-based application that acts as a storage and retrieval function for the activity patterns of PLE users. This tool depersonalizes data that can be accessed over a RESTful web API.

A list of scientific publications related to this project is available at <http://www.role-project.eu/Scientific-Publications>.

ii. Graaasp

Graaasp's main purpose is to support self-directed learners at the graduate and undergraduate level as well as knowledge workers in their daily online learning and Knowledge Management (KM) practices. The current version of **Graaasp** is being reconfigured to support institutional tools such as Moodle.

The goals of this project involve:

- providing the students with a set of learning tools, both formal and informal
- teaching students and teachers how to use these tools as well as examining the pedagogical use of these tools
- federating and recommending resources (i.e. tools and content) among institutions using a recommendation engine (RE)

Anticipated benefits:

- create a learner-centric learning environment
- create learning networks for knowledge and information sharing
- encourage active and collaborative learning, critical thinking and the building of knowledge creation
- encourage students to use web technologies to improve their learning
- support the development of new literacies
- provide teaching staff with new perspectives in knowledge construction

Potential users: About 30,000, mainly students (including PhDs), teachers and teaching assistants in Swiss higher education institutions already using CMSs and staff working in CCSPs (Skills, Service and Production Centres). The project is to be completed in late 2012 (University of Geneva).

iii. Mature IP (Womble)

MATURE is a large-scale project, co-funded by the European Commission, Unit for Technology-Enhanced Learning (TEL). The project ran from April 2008 until March 2012. It consists of an interdisciplinary team of 12 partners from five countries.

The **MATURE** project looks at how organizations and employees can work together to learn and develop competencies required in today's global economy. The project's focus is to study the knowledge-maturing process within work environments, to identify barriers, and to design tools and services to facilitate learning and intrinsically motivate learners.

The resulting learning environments include:

- Personal Learning & Maturing Environments (PLMEs) that are embedded into the work environment, enabling and encouraging the individual to engage in maturing activities within the organization and beyond
- Organizational Learning & Maturing Environments (OLMEs) that allow organizations to analyze and take up learning activities, to reseed innovation processes and to apply guiding strategies for creating an awareness of maturing activities

iv. Personal E-Learning In Communities And Networking Spaces (PELICANS)

PELICANS is a pilot project funded by the College of Social Science Research Development Fund. It examines how social sciences students use Web 2.0 platforms as part of their formal and informal learning in higher education. This project is based at the University of Leicester, U.K., and at the Universitat Politècnica de Catalunya, Barcelona, Spain.

v. iCamp Mash-up Personal Learning Environment

The **iCamp** project set out to create an open virtual learning space for Europe's Higher Education (HE) network. It is an infrastructure that provides students with learning experience similar to those of international distributed work environments.

vi. EU4ALL

EU4ALL is a European Commission-funded project about accessibility in higher education and lifelong learning. It offers components and services that can be adopted by universities to offer a framework to support accessible lifelong learning paradigms.

vii. GRAPPLE

GRAPPLE, or "Generic Responsive Adaptive Personalized Learning Environment," is an EU FP7 STREP Project. What is unique about GRAPPLE is that it works as an interface with both commercial and open source CMSs. The goal set by this project is to allow learners to use a Technology-Enhanced Learning (TEL) environment to develop lifelong learning skills. Users can automatically adapt this mobile environment to their personal preferences, their prior knowledge, their skills and competences, their learning goals and their personal or social context.

viii. PELE: Personal Exploratory Learning Environments

PELE is an ETS-project at RWTH Aachen University (Germany). Its completion date was April 2012.

"The aim of this project is to create an open, student-centered and research-oriented learning environment, in which students can determine the content of teaching, the learning process and learning objectives themselves. The learning process of the students will be assisted by the lecturers in a moderating way. By this integrated approach of lecture, practical training and seminars and through the use of web 2.0 technologies, students have the opportunity to learn self-paced, project-oriented and active in groups."

(Thüs, 2011).

North America

i. gRSShopper

gRSShopper is a personal web environment that combines resource aggregation, a personal dataspace, and personal publishing. It is a space to organize online content, to remix it and repurpose it, and to distribute it in the form of an RSS, web pages, or JSON data.

ii. PLENK 2010

PLENK was used as a unique prototype for a MOOC (Massive Open Online Course) that was offered in 2010 to the general public. The course was set up to mimic activities and learning outcomes of PLEs.

Downes (2010), one of its creators, provided the following course description:

"PLENK2010" is an unusual course. It does not consist of a body of content you are supposed to remember. Rather, the learning in the course results from the activities you undertake, and will be different for each person. In addition, this course is not conducted in a single place or environment. It is distributed across the web."

This course was a joint venture between the National Research Council of Canada (NRC), the Technology Enhanced Knowledge Research Institute (TEKRI) at Athabasca University and the University of Prince Edward Island. The course facilitators were George Siemens, TEKRI; Stephen Downes, NRC; Dave Cormier, UPEI; and Rita Kop, NRC.



Pacific

i. Mahara project (New Zealand)

Mahara is an electronic portfolio, weblog, resumé builder and social networking system that allows users to connect with others and communities of practice. Mahara can now be integrated into Moodle. The New Zealand government funded this project to create an integration layer between Moodle, an open source CMS, and Elgg. The end result is the creation of a learner-centred e-portfolio system that sits outside the CMS.

ii. YaPeng

In June 2009, Dapsang.com launched a PLE project, YPGoGo.com. Its approach is more aligned with theories of instructional design rather than falling within the European self-directed paradigm of PLEs. This is an example of how PLE characteristics and attributes vary depending on the cultural setting. As of January 2012, YPGoGo has been renamed YaPeng.

b. Institutional PLEs

Many of the current institutional PLEs take the form of a “mashup” of an institutional portal and a PLE. Institutional PLEs may appear to be a contradiction in terms. The debate is about the level of control and involvement that institutions should exert on the use of PLEs by their students.

Europe

i. Manchester PLE project

In 2007, an innovative system was created that merges social networking services with learning maps used to express a learning plan. The resulting product maps the knowledge gained by an individual or community.

ii. HOU2LEARN

Launched in 2010 at the Hellenic Open University, H2L is powered by Elgg, an award-winning open source social network engine, and runs alongside a traditional CMS. By allowing students to personalize their learning environment, H2L creates opportunities for informal learning.

iii. PLE projects at TU Graz

The TU Graz PLE is a web portal where students can access university resources and has the capability for students to fully adjust this environment to their own personal needs by adding or removing widgets. What is unique about this PLE widget engine is that it can discern between local university-generated widgets installed on the PLE server and remote widgets installed on any remote server. The user can access various widget zones, such as the Communication Centre LearnLand to create a special interface called a Personal Desktop. The future direction for this learning environment is to

introduce a widget recommender system. This is an example of a move toward a fully integrated PLE and University Portal.

iv. PLEX

In 2006, the University of Bolton in England released the beta version of PLEX. The basic structure of PLEX is similar to Colloquia. There is a resource manager, a people manager, and activities consisting of resources and people.

v. Sapo Campus (Portugal)

This platform was launched at the University of Aveiro (UA) in fall 2009 as a result of a research and development partnership between UA and a major internet portal/ISP called SAPO. The resulting learning environment used web 2.0 technologies to promote communication, sharing and collaboration skills.

vi. SLE Dashboard

SLE (Southampton Learning Environment) is much like a mashup between an institutional portal and a PLE, or more precisely anmPLEi.

Characteristics of the SLE are to:

- be location independent and platform agnostic
- enable a single point of access
- support lifelong learning
- give users control of their own data
- be personalizable but have sensible defaults (i.e. allow students to opt out of personalization features)
- do fewer things better
- provide the shortest path to key services
- support flexible use
- be open and inclusive by default

vii. PLEF

In 2009, RWTH Aachen University in Germany released the Personal Learning Environment framework, or PLEF. This PLE mashup service supports learners in aggregating, managing, tagging, commenting on and sharing their favourite resources, such as feeds and widgets, within a personalized space using PLEM, a Personal Learning Environment Manager.

North America

i. CCNB project

The Collège Communautaire du Nouveau-Brunswick (CCNB) submitted a proposal for a pilot project that will incorporate PLEs into its online learning courses. This project is the first of its kind in Canada (completion date is sometime in 2013).

Pacific

ii. UniSA's (University of South Australia) PLE

A PLE consisting of the following three components:

- a new learning management system – known as **learnonline**
- a program and course management system – known as PCMS
- a new student placement system – known as SPS

c. Disciplinary PLEs

Various institutions are recognizing the importance of preparing their students for lifelong learning in their disciplines. The HP Catalyst initiative recognizes that technology can be a critical enabler for learning in the STEM disciplines and is currently funding many institutional research projects worldwide in this area.

i. HP Catalyst Initiative for STEM disciplines

This initiative recognizes that STEM literacy is lagging behind and is exploring the root of this challenge. The goal is to combine emerging technology and teaching expertise to better prepare students to compete in the global economy.

The initiative is organized into various areas: the Multi-versity, Learning 3.0, Global collaboratory, the New Learner, Measuring Learning, and STEM-preneur.

ii. PLEbaum

PLEbaum is a project funded by the European Commission within the Leonardo da Vinci program. The project partners developed a PLE in arboriculture and forestry by using Web 2.0 technologies. This two-year project began in December 2011.

d. Research-related PLEs

PLEs are being used not only to enable learning but also as a tool to organize and coordinate research activities.

AWESOME

This widget-based dashboard-type Personal Research Environment (PRE) was developed to support important activities undertaken by researchers.

Flexible Personal Learning Environments (fPLEs) for fieldwork

Some fPLEs have been developed and adapted for fieldwork projects/research in geography, earth and environmental sciences, and biosciences.

e. Work-related PLEs

PLEs are also making their way into the workplace where informal learning is the predominant form of learning.

Personal Learning Work Environment (PLWE)

A PLE that is the result of the convergence of Knowledge Management (KM), Learning Management (LM) and Personal Productivity Management systems.

f. PLE-related technology projects

The Open ID project

The goal of this project is to determine how to allow internet users to log onto many different websites and webtools using a single username and password.

Eduglu

Drupal's creates a platform for building a new social learning environment, which "glues" together other CMS systems, student information systems, grading systems, and third-party tools such as Google Docs, wikis, blogs, and micro-blogging platforms such as Twitter.

The e-Framework for Education and Research

This project's aim is to create standards of interoperability for CMS and other webtools.

Google's Open Social

The goal is to create a set of common APIs (application program interfaces) for building social applications across many websites.

Moodle

This open source CMS has the capability of being a more learner-centred environment than your typical commercial CMS. It recently integrated Mahara, an e-portfolio application.

The Open Courseware Consortium

This consortium is a result of the collaboration of over 200 institutions to share open learning resources.

7. PLEs @ Carleton: Building student capability for lifelong learning

Some provinces acknowledge this changing e-landscape and its impact on learning in their policy documents.

The bigger picture: A quick look at the educational e-landscape in Canada and Ontario

The Canadian Council on Learning's (CCL) report on the State of E-Learning was written to help Canadians understand the e-learning landscape in Canada. The 2009 report recognizes the changing nature of e-learning and defines it as follows:

"While the learning outcomes of e-learning are similar to those of traditional learning, e-learning offers several distinct advantages:

- It is self-directed, enabling students to choose content and tools appropriate to their differing interests, needs, and skill levels.
- It reduces geographical barriers, thus broadening educational options.
- It is delivered "just in time"—when desired or necessary.
- Finally, e-learning encourages learners to think and learn independently and collaboratively, which can foster positive attitudes about the value of lifelong learning." (CCL, 2009, p. 30)

In their study on [The State of E-learning in Canadian Universities](#), Kaznowska, Rogers and Usher (2011) examined how students and higher education institutions were using technology. Their findings showed that e-resources were not being deployed evenly within institutions – the greater emphasis being in the physical and life sciences. The reason behind these disciplinary differences is unknown. They also found that larger institutions did not use e-resources more intensively than smaller ones and that students identified learning e-resources or their convenience of access rather as a means to enhance or add to their in-class experience. This may explain why the study did not find a direct correlation between access to e-resources and improved student outcomes. In their conclusion, the researchers recommended that institutions go through a gradual implementation-assessment process of e-resources so that it will move them closer to understanding how students can best harness their digital literacies to improve learning.

Some provinces acknowledge this changing e-landscape and its impact on learning in their policy documents. In Alberta, the Ministry of Education's 2010–2013 Business Plan advocates to "support a flexible approach to enable learning any time, any place and at any pace, facilitated by increased access to learning technologies" (Government of Alberta, 2010, p. 70).

In August 2011, the Ontario University Council on eLearning (OUCEL) Summer Institute was held at the Ontario Institute for Studies in Education at the University of Toronto. OUCEL is a professional association for learning technology leaders from Ontario universities and includes many well-known

experts in e-learning from across the province. The agenda included a review of emerging trends in the development and implementation of personal learning environments for students. Presentations on MOOCs (Massive Online Open Courses) and PLEs are included in the 2012 agenda (OUCEL, 2012).

Some higher education institutions are recognizing the value and importance of self-directed learning environments. The University of British Columbia created a [PLE wiki](#) and [PLE workshops](#) for students and faculty. In Ontario, Mohawk College (2012) included PLEs as part of its "Personal, flexible, and everywhere" learning strategies in its [Academic Plan](#).

An environmental scan: A look at our institution

The changes and challenges faced today by academic institutions are unprecedented. Administrative bodies are having to negotiate tensions created by financial pressures, technological innovation, public scrutiny, new faculty roles and changing demographics, all within the context of a rapidly changing global environment. In moving forward, institutions that clearly define their priorities, articulate their institutional vision and are cognizant of the unique nature of their institutions are more likely to make the informed choices about their practices, especially where learning and technology are involved.

Carleton's strategic plan

Carleton's strategic plan (CSP), *Defining Dreams* (2009), outlines a number of institutional priorities in the areas of research, teaching and learning. Enriching the student learning experience is an important mandate in the strategic plan. In the areas of teaching and learning we find "Our graduates are, and will be qualified for success in a new, digital age, a global society, and a rapidly changing marketplace requiring flexibility, ingenuity and intellectual resources garnered from more than one discipline of single, critical approach" (Carleton, 2009, p. 4).

This statement emphasizes the importance of preparing students to adapt and succeed in an ever-changing global knowledge landscape using innovative, multi-view, critical perspectives. This goal will be achieved through the use of innovative teaching methods and new digital media using computer and communication technology. Current development in cloud and mobile technology, along with emerging technologies such as PLEs, could be used to facilitate this process.

The Carleton Academic Plan

The Carleton Academic Plan (CAP) consists of five themes and seven goals with associated objectives. The five themes outlined include Academic Development (A), Research Development (B), Student Engagement



and Development (C), International and Global Outreach (D) and Regional and Global Outreach (E).

Under the first and second themes, we find the goal of promoting quality teaching and program excellence as well as supporting strategic multidisciplinary, interdisciplinary initiatives. Carleton will strive to enhance excellence in teaching and learning (objective 1.1) by embracing new technologies to improve quality teaching and student learning. PLEs provide opportunities for students and pedagogues to expand their learning horizons beyond the classroom walls. The university is also promoting ways to increase opportunities for “student engagement in the discovery and knowledge translation process to diminish disciplinary silos and expand opportunities for intellectual exchange” (Carleton, 2010, p. 9).

PLEs could help students achieve these research goals by connecting them to communities of practice within their discipline and related disciplines as well as by providing them with tools and resources for the construction and dissemination of knowledge.

Under the third theme, student engagement and development, we find goals that are associated with the promotion of active learning. PLEs are environments that allow students to self-direct and to engage in self-directed learning, discovery and meaning making.

These are just a few examples of guiding principles found in institutional documents that support the implementation of PLEs at Carleton.

In addition to the Strategic Plan and the Academic Plan, the following current initiatives on campus are also providing the groundwork for supporting a culture for ubiquitous, self-directed lifelong learning:

[Critical and creative inquiry](#)

[Community Engagement](#)

[Graduate Student Professional Skills Training](#)

The introduction in fall 2012 of Moodle ([cuLearn](#)), a CMS that has a scalable and flexible architecture, will allow mobile access to course content.

A lifelong learning culture @ Carleton: A look at infrastructure

Successful implementation of innovation relies on an institutional readiness to accept change, along with an understanding of the requirements of any new technology and the establishment of some foundational structures to move the change along. By examining the virtual and physical infrastructure, we can more easily identify the strengths and gaps in support of this change.

The learning collaboratory or idea incubator: A space for critical and creative inquiry, and the development of lifelong learning skills

In science e-research literature, collaboratories are creative spaces, frequently virtual in nature, that connect researchers across disciplines, institutions, geographic areas and research cultures. Many large-scale research projects in the sciences have relied on these collaborative frameworks. Similar environments exist at the local community level in many Canadian cities, in areas of design and innovation such as the arts, technology, and fashion. These environments, often referred to as idea incubators, serve a purpose similar to those of collaboratories: providing individuals from diverse specialties or disciplines with a space for sharing, discussing and collaborating. Many of these groups also provide mentorship for up-and-coming professionals through a supportive, nurturing and socially engaged environment.

Where on campus would we find a similar environment – that is, one that provides students with a place to interact and problem solve with other peers, directly or through technology? Is there an environment that breaks down the disciplinary silos and gives students opportunities to engage with others using different disciplinary perspectives?

In the Carleton Academic Plan, there is mention of a Discovery Centre. Its role is that of providing a “flexible, physical space in the Library for faculty and students to engage in novel ways to collaborate and discover new knowledge associated with societal issues” (Carleton, 2010, p. 11). This centre would certainly be an ideal fit as a collaboratory, given that the library is already considered a disciplinary nexus for research and learning. In addition, librarians could provide valuable insight into ways to access and evaluate information sources and tools to accomplish these tasks. Their role in the broader context of the web 2.0 university could be that of information specialists and managers.

The Discovery could bring together student teaching/learning specialist from various areas on campus such as Student Learning Support, Computing Services (CCS), Educational Development Centre (EDC), teaching faculty/instructors. In addition to initiatives such as a gaming area, the Discovery Centre could house such initiatives as a Lifelong Learning Institute along with a Centre for Critical and Creative Inquiry and a Centre for Design and Innovation.

The PLE could represent the virtual embodiment of the collaboratory or idea incubator. By examining the inherent characteristics of PLEs, we see that they transcend disciplinary and course boundaries, providing students with a virtual laboratory equipped with learning tools that not only facilitate access to resources but also allow them to play and experiment with ideas and collaborate with others. In the process, students are able to create and share new content as they develop personal insights into self-directed learning.

The PLE could represent the virtual embodiment of the collaboratory or idea incubator.

PLE implementation @ Carleton using evidence-based research

Setting up an effective support environment for PLEs requires some groundwork and research to identify and understand institutional strengths and gaps. Two studies conducted at Carleton University, one of which is already under way, will examine how graduate students use technology for both their formal and informal learning and how they use PLEs in different disciplinary streams.

Proposed timeline	
Spring/Fall 2012	Case study – an examination of the use of Symbaloo, a MUPPLE environment, students in the course "Seminar in University Teaching"
Fall 2012 – Summer 2013	A look at graduate students' use of Web 2.0/3.0 Technologies (surveys and various pilot studies) Compilation of a report

It is hoped the outcomes of this research will shed light on how to integrate and support PLEs and associated self-directed lifelong learning skills in various disciplines at Carleton.

Institutional support for PLEs @ Carleton

As part of the pilot studies, two forms of support will be provided to students. One will be a blog on "*Informed2Learn*". This resource is used to help students gain a certain level of awareness and insight into how we learn and to help them better understand what skills are required to engage in self-directed lifelong learning. The second will be an open source bookmarking/annotation tool called *Diigo*. This resource will serve as a recommender tool to give students access to resources that have some pedagogical value and to tools that may be useful in their particular disciplines.

Blog: Informed2Learn

The blog features will include the following sections:

1. The significance of lifelong learning

2. Insights into how we learn

Regular postings on learning and e-learning from experts on campus in such areas as teaching, technology, psychology, cognitive science, neuroscience, social science, design, computer science,

3. What PLEs can do for you

What are PLEs?
Sample PLEs
New developments

4. Web 2.0/3.0 tools for learning

Feature review of a web tool/app of the week (connected to *Diigo*)
Repository of award-winning tools for learning/education with accompanying reviews

8. Conclusion

CMSs frequently restrict students' learning experiences to a single course, and to a specific time frame. By transcending course boundaries, PLEs give students the opportunity to experiment with and experience more rich and personal modes of learning. They allow educators to engage students in dialogue and reflection about knowledge and meaning making, critical and creative inquiry, and metacognition. More importantly, PLEs help prepare students for their transition to the workplace by creating an awareness about learning and facilitating the development of skills required to engage in self-directed lifelong learning.

The 2009 EU Learnovation vision paper 4, "Learning innovation and learning communities: Informal learning in 2025," provides the following insight:

"Being a Lifelong learner becomes a condition of life. Thanks to their massive and natural use in everyday life, technologies acquire an emancipating power on people's opportunity and ability to learn, favouring a spontaneous tendency towards meta-cognition and ownership of their learning process."
(Nascimbeni, 2009, p. 1)

A higher education is no longer considered complete if we do not provide students with the tools and skills to continue on their learning journey. Toffler best summarizes this insight with

*"tomorrow's illiterate will not be the man who can't read;
he will be the man who has not learned how to learn."*
(Toffler, 1973, p. 414)



9. References

- Anderson, T. (2006, January 9). *Re: PLE's versus LMS: Are PLEs ready for prime time?* [Web log message]. Retrieved from <http://terrya.edublogs.org/2006/01/09/ple-versus-lms-are-ple-ready-for-prime-time/>
- Attwell, G. (2010). *The future of learning environments*. Retrieved from <http://www.scribd.com/doc/35193585/The-future-Learning-Environments-by-Graham-Attwell>
- Attwell, G. (2007). The personal learning environments – the future of eLearning? *eLearning Papers* 2(1). Retrieved from <http://www.elearningeuropa.info/files/media/media11561.pdf>
- Barnes, C. & Tynan, B. (2007). Learning in a Web 2.0 millenium. *ALT-J Research in Learning Technology*, 15, 189–200.
- Bereiter, C., & Scardamalia, M. (1989). Intentional learning as a goal of instruction. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 361–392). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Boyle, T. (1997). *Design for multimedia learning*. Upper Saddle River, NJ: Prentice Hall.
- Buchem, I. (2011). Serendipitous learning: Recognizing and fostering the potential of microblogging. *Formare Open Journal* (February 2011). Retrieved from <http://www.scribd.com/doc/54766936/Serendipitous-Learning>
- Carleton University, Office of the Provost and Vice-President (Academic). (2010). *2010/2011 – 2014/2015: Realizing our dreams as Canada's capital university*. Retrieved from <http://www1.carleton.ca/provost/ccms/wp-content/ccms-files/Carleton-Academic-Plan.pdf>
- Carleton University. (2009). *Defining dreams: A strategic plan for Carleton University 2009*. Retrieved from http://www1.carleton.ca/about/cu/wp-content/uploads/strategic_plan_final.pdf
- Canadian Council on Learning (CCL). (2009). *State of e-learning in Canada*. Retrieved from http://www.ccl-cca.ca/pdfs/E-learning/E-Learning_Report_FINAL-E.PDF
- Chatti, M. A. (2011, February 7). *Call for papers: The PLE conference 2011*. [Web log message]. Retrieved from <http://mohamedaminechatti.blogspot.ca/2011/02/cfps-ple-conference-2011.html>
- Chatti, M. A. (2010, March 2). *LMS vs. PLE*. [Web log message]. Retrieved from <http://mohamedaminechatti.blogspot.ca/2010/03/lms-vs-ple.html>
- Chatti, M. A., Jarke, M., & Frosch-Wilke, D. (2007). The future of e-learning: A shift to knowledge networking and social software. *International Journal of Knowledge and Learning*, 3, 404–420.
- Coiro, J., Knobel, M., Lankshear, C., & Leu, D. (2008). *The handbook of research on new literacies*. Mahwah, NJ: Erlbaum.
- Craft, A. (2001). *An analysis of research and literature on creativity in education*. Retrieved from http://www.ncaction.org.uk/creativity/creativity_report.pdf
- Davies, T. (1999). Taking risks as a feature of creativity in the teaching and learning of design and technology. *Journal of Design and Technology Education*, 4, 101–108.
- Downes, S. (2010). *PLENK 2010: Personal Learning Environments, networks and knowledge*. Retrieved from <http://connect.downes.ca/how.htm>
- Downes, S. (2007). Learning networks in practice. In *Emerging Technologies for Learning* (Vol. 2) (pp. 19–27). Coventry: Becta. Retrieved from <http://dera.ioe.ac.uk/1502/>
- Downes, S. (2006). Learning networks and connective knowledge. *Instructional Technology Forum*: 92. Retrieved from <http://it.coe.uga.edu/itforum/paper92/paper92.html>
- Downes, S. (2005, October 15). E-learning 2.0. *eLearn Magazine*. Retrieved from <http://elearnmag.acm.org/featured.cfm?aid=1104968>
- Dron, J., & Anderson, T. (2007). *Groups, networks and collectives in social software for e-Learning*. Paper presented at the European Conference on E-Learning ECEL 2007, Copenhagen Business School, Denmark. Abstract retrieved from <http://www.academic-conferences.org/pdfs/ecel07-booklet.pdf>
- Dunlap, J., & Grabinger, R. S. (2003). Preparing students for lifelong learning: A review of instructional features and teaching methodologies. *Performance Improvement Quarterly* 16(2), 6–25.
- Edmondson, D. R., Boyer, S., & Artis, A. (2012). *Self-directed learning: A meta-analytic review of adult learning constructs*. Retrieved from <http://www.aabri.com/OC2012Manuscripts/OC12058.pdf>
- Edson, J. (2007, June 25). Curriculum 2.0: User-driven education. *The Huffington Post*. Retrieved from http://www.huffingtonpost.com/jonathan-edson/curriculum-20-userdri_b_53690.html

- Educause (2009). 7 things you should know about personal learning environments. *Educause Learning Initiative (ELI)*. Retrieved from <http://www.educause.edu/library/resources/7-things-you-should-know-about-personal-learning-environments>
- El Helou, S., & Gillet, D. (2011). Four elements of a viable PLE. In E. Lai-Chong Law, M. Wolpers, F. Modritcher, & D. Gillet (Eds.), *Proceedings of 1st Workshop Exploring the Fitness and Evolvability of Personal Learning Environments (EFEPLE'11)* (pp. 30–33). Retrieved from <http://ceur-ws.org/Vol-773/EFEPLE-ALL-Proceedings.pdf>
- Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work* 14(1), 133–156.
- EUROPA (2006). *Key Competences for Lifelong Learning, Recommendation 2006/962/EC of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning*. Official Journal L 394 of 30.12.2006. Retrieved from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:EN:PDF>
- EUR-Lex. (2006). *Recommendation of the European Parliament of the Council of 18 December 2006 on key competences for lifelong learning*. OJ L 394, 30.12.2006, 10–18. Retrieved from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32006H0962:EN:NOT>
- Fiaidhi, J. (2010). Developing Personal Learning Environments based on Calm technologies. *Communications in Computer and Information Science*, 124, 134–146.
- Fischer, G. (1999). *Conceptual frameworks and innovative computational environments in support of self-directed and lifelong learning*. Retrieved from <http://www.cs.colorado.edu/~gerhard/reports/bmbf1998.pdf>
- Fischer, G., & Nakakoji, K. (1997). Computational environments supporting creativity in the context of lifelong learning and design. *Knowledge-Based Systems Journal*, 10, 21–28.
- Goodwin-Jones, R. (2009). Emerging technologies – Personal Learning Environments. *Language, Learning & Technology*, 13(2), 3–9.
- Government of Alberta. (2010). *Budget 2010: Education Business Plan 2010–2013*. Edmonton, AB: Alberta Education. Retrieved from <http://education.alberta.ca/media/1213923/20100122educationbusinessplan.pdf>
- Hall, R. (2009). Towards a fusion of formal and informal learning environments: The impact of the read/write web. *Electronic Journal of e-Learning*, 7(1), 29–40.
- Hilton, J. (2009, July/August 8–9). Essential versus strategic IT investments. *EDUCAUSE Review*, 44(3). Retrieved from <http://www.educause.edu/ero/article/essential-versus-strategic-it-investments>
- Hon, A. (2012). Shaping environments conducive to creativity: The role of intrinsic motivation. *Cornell Hospitality Quarterly*, 53, 53–64.
- Hug, T., Lindner, M., & Bruck, P. (Eds.). (2006). Microlearning: Emerging concepts, practices and technologies after e-learning. *Proceedings of the Microlearning Conference 2005*. Innsbruck: Innsbruck University Press. Retrieved from <http://www.microlearning.org/microlearning-conference-2005>
- Iyengar, S. (2010). *The art of choosing*. New York: Twelve.
- Jafari, A., McGee, P., & Carmean, C. (2006, July/August). Managing courses, defining learning: What faculty, students, and administrators want. *Educause Review*, 50-70. Retrieved from <http://www.educause.edu/ir/library/pdf/ERM0643.pdf>
- Jenkins, H., Clinton K., Purushotma, R., Robison, A.J., & Weigel, M. (2006). *Confronting the challenges of participatory culture: Media education for the 21st century*. Chicago, IL: The MacArthur Foundation. Retrieved from <http://www.digitallearning.macfound.org>
- JISC-CETIS (2007). *The personal learning environment: A report on the JISC CETIS PLE project*. Retrieved from <http://wiki.cetis.ac.uk/Ple/Report>
- JISC-CETIS. (2006). *The personal learning environments: A report on the JISC CETIS PLE project*. Retrieved from <http://wiki.cetis.ac.uk/Ple>
- Johnson, L., Smith, R., Willis, H., Levine, A., & Haywood, K. (2011). *The 2011 Horizon Report*. Austin, TX: The New Media Consortium. Retrieved from <http://net.educause.edu/ir/library/pdf/HR2011.pdf>
- Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional theory, Vol. II* (pp. 215–239). Mahwah, NJ: Lawrence Erlbaum Associates.
- Kaznowska, E., Rogers, J., & Usher, A. (2011). *The state of e-learning in Canadian universities, 2011: If students are digital natives, why don't they like e-learning?* Toronto: Higher Education Strategy Associates. Retrieved from <http://higheredstrategy.com/wp-content/uploads/2011/09/InsightBrief42.pdf>

- Knowles, M. (1980). *The modern practice of adult education: From pedagogy to andragogy*. New York: Cambridge.
- Lankshear, C., & Knobel, M. (2007). Sampling “the new” in new literacies. In M. Knobel & C. Lankshear (Eds.), *A New Literacies Sampler* (pp. 1–24). New York: Peter Lang.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: University of Cambridge Press.
- Lee, M. J. W., & McLoughlin, C. (2010). Beyond distance and time constraints: Applying social networking tools and web 2.0 approaches in distance education. In G. Veletsianos (Ed.), *Emerging technologies in distance education* (pp. 61–87). Edmonton: Athabasca University Press.
- Leu, D. J., Zawilinski, L., Castek, J., Banerjee, M., Housand, B., Liu, Y., & O’Neil, M. (2007). What is new about the new literacies of online reading comprehension? In L. Rush, J. Eakle, & A. Berger (Eds.), *Secondary school literacy: What research reveals for classroom practices* (pp. 37–68). Urbana, IL: National Council of Teachers of English. Retrieved from <http://www.newliteracies.uconn.edu/docs/whats%20new%20about%20online%20reading%20comprehension.pdf>
- Levy, D. (2007). No time to think: Reflections on information technology and contemplative scholarship. *Ethics and Information Technology*, 9, 233–236.
- Linnenbrink-Garcia, L., & Pekrun, R. (2011). Students’ emotions and academic engagement: Introduction to the special issue. *Contemporary Educational Psychology*, 36, 1–3.
- Livingstone, D. W. (2007). Re-exploring the icebergs of adult learning: Comparative findings of the 1998 and 2004 Canadian surveys of formal and informal learning practices. *Canadian Journal for the Study of Adult Education*, 20(2), 1–24.
- Loveless, A. (2007). *Creativity, technology and learning*. Report 4 update. Futurelab Series. Retrieved from http://archive.futurelab.org.uk/resources/documents/lit_reviews/Creativity_Review_update.pdf
- Lubesky R. (2006, December 18). *The present and future of personal learning environments (PLE)*. [Web log message]. Retrieved from <http://www.deliberations.com.au/2006/12/present-and-future-of-personal-learning.html>
- Martindale, T., & Dowdy, M. (2010). Personal Learning Environments. In G. Veletsianos (Ed.), *Emerging technologies in distance education* (pp. 177–193). Edmonton: AU Press, Athabasca University.
- Masie, E. (2006, January). *Nano-learning: Miniaturization of design*. Retrieved from [http://www.cedma-europe.org/newsletter%20articles/Clomedia/Nano-Learning%20-%20Miniaturization%20of%20Design%20\(Jan%2006\).pdf](http://www.cedma-europe.org/newsletter%20articles/Clomedia/Nano-Learning%20-%20Miniaturization%20of%20Design%20(Jan%2006).pdf)
- MacNeill, S., & Kraan, W. (2010). *Distributed learning environments: A briefing paper*. JISC CETIS. Retrieved from http://wiki.cetis.ac.uk/images/6/6c/Distributed_Learning.pdf
- McLoughlin, C., & Lee, M. (2008). The three Ps of pedagogy for the network society: Personalization, participation, productivity. *International Journal of Teaching and Learning in Higher Education*, 20(1), 10–27.
- Mödritscher, F. (2010). Client-sided vs. server-sided MUPPLEs: Can add-ons beat platform-based solutions? In *Proceedings from the MUPPLE Workshop, EC-TEL Conference, Barcelona*. Retrieved from http://eur-ws.org/Vol-638/moedritscher_mupple10.pdf
- Mödritscher, F., Wild, F., & Sigurdarson, S. (2008). Designing for change: Mash-up personal learning environments. *eLearning Papers*, 9. Retrieved from <http://www.slideshare.net/elearningpapers/mashup>
- Mohawk College. (2012). *Mohawk College academic plan*. Retrieved from <http://www.mohawkcollege.ca/Assets/academic-plan/mohawk-college-academic-plan-v7-pdf.pdf>
- Mott, J. (2010). Envisioning the post-LMS era: The open learning network. *EDUCAUSE Quarterly*, 33(1), 1–9.
- Nascimbeni, F. (2009). *Learning individuals and learning communities: Informal learning in 2025*. (Learnovation paper 4). Retrieved from <http://learnovation.files.wordpress.com/2010/10/learnovation-vision-paper-4-informal-learning.pdf>
- NCM, & Educause. (2012). *The NMC Horizon Report: 2012 higher education edition*. Retrieved from <http://www.nmc.org/publications/horizon-report-2012-higher-ed-edition>
- NCM, & Educause. (2011). *The NMC Horizon Report: 2011 higher education edition*. Retrieved from <http://www.nmc.org/publications/horizon-report-2011-higher-ed-edition>
- Nietfeld, J., & Schraw, G. (2002). The role of knowledge and strategy training on metacognitive monitoring. *The Journal of Educational Research*, 95, 131–142.
- Oliveira, A., Silva, J., Guglielmino, L., & Guglielmino, P. (2010). A cross-cultural study of self-directed learning readiness, performance, creativity, and problem-solving in a sample from Portugal. *International Journal of Self-Directed Learning*, 7(1), 45–59.

- OUCEL. (2012). *Summer Institute 2012*. Retrieved from http://kumu.brocku.ca/oucel/Summer_Institute_2012
- Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology*, 49, 345–375.
- Pettenati, M.C. (2010). Roadmap to PLE – A research route to empower the use of personal learning environments (PLEs). *Interaction Design & Architecture Journal (Special Issue)*, 9–10, 11–21.
- Polsani, P. (2003). Network learning. In K. Nyiri (Ed.), *Mobile learning: Essays in philosophy, psychology and education* (pp. 139–150). Vienna, Austria: Verlag.
- Posea, V., & Trausan-Matu, S. (2010). Bringing the social semantic web to the Personal Learning Environment. *ICALT' 10 Proceedings of the 2010 10th IEEE International Conference on Advanced Learning Technologies* (pp. 148–150). Retrieved from doi: 10.1109/ICALT.2010.48
- Rasulzada, F., & Dackert, I. (2009). Organizational creativity and innovation in relation to psychological well-being and organizational factors. *Creativity Research Journal*, 21, 191–198.
- Ravet, S. (2007). *For an ePortfolio enabled architecture*. European Institute for E-Learning (EifEL). Retrieved from <http://www.eifel.org/publications/eportfolio/documentation/positionpaper/>
- Reinhardt, W. (2010). *A widget-based dashboard approach for awareness and reflection in online learning communities based on Artefact-Actor-Networks*. Paper presented at the PLE Conference 2010, Barcelona, Spain. Retrieved from http://www.slideshare.net/wolfgang_reinhardt/a-widgetbased-dashboard-approach-for-awareness-and-reflection-in-online-learning-communities-based-on-artefactornetworks-13603855
- Rogers, E. M. (1986). *Communication: The new media in society*. New York: The Free Press.
- Rubio, E., Galan, M., Sanchez, J., & Delgado, D. (2011). *E-professional: From PLE to PWLE*. Paper presented at the PLE Conference 2011, Southampton, U.K. Retrieved from http://ulpgc.academia.edu/DavidDelgado/Papers/1502538/EPROFESSIONAL_FROM_PLE_TO_PLWE
- Slater, N. (2008). Large-scale open source eLearning systems at the Open University UK. *Research Bulletin*, 12. Retrieved from <http://confluence.nau.edu/confluence/download/attachments/9732166/open+university+moodle.pdf>
- Severance, C., Hardin, J., & Whyte, A. (2008). The coming functionality mash-up in personal learning environments. *Interactive Learning Environments*, 16(1), 47–62.
- Siemens, G. (2005). Connectivism: Learning as network creation. Retrieved from <http://www.elearnspace.org/Articles/networks.htm>
- Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. New York: McGraw-Hill.
- Thiede, K. W., Anderson, M. C., & Theriault, D. (2003). Accuracy of metacognitive monitoring affects learning of texts. *Journal of Educational Psychology*, 95, 66–73.
- Tobin, D. (2000). *All learning is self-directed: How organizations can support and encourage independent learning*. Alexandria, VA: ASTD Press.
- Toffler, A. (1973). *Future shock*. New York: Bantam Books.
- Tugui, A. (2011). Calm technologies: A new trend for educational technologies. *World Future Review*, 3(1). Retrieved from http://www.wfs.org/Upload/PDFWFR/WFR_Spring2011_Tugui.pdf
- Van Harmelen, M. (2006) *Personal Learning Environments*. Retrieved from http://www.cs.man.ac.uk/~mark/PLEs_draft.pdf
- Visser, L. (2012). Why don't we simply call it "Environmental design for the provision and use of distributed learning resources"? In Y. L. Visser, L. Visser, M. Simonson, & R. Amirault (Eds.), *Trends and Issues in Distance Education: International Perspectives*, 117 – 129. Greenwich, CN: Information Age Publishing.
- Weller, M. (2012). *The openness-creativity cycle in education – A perspective*. *Journal of Interactive Media in Education*, 2. Retrieved from <http://www.jime.open.ac.uk/jime/article/viewArticle/2012-02/html>
- Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., & Milligan, C. (2006). Personal Learning Environments: Challenging the dominant design of educational systems. *Journal of e-Learning and Knowledge Society*, 3(2), 27–38.
- Wilson, B., Switzer, S., Parrish, P., & the IDEAL Research Lab. (2007). Transformative learning experiences: How do we get students deeply engaged for lasting change? In M. Simonson (Ed.), *Proceedings of selected research and development presentations*. Washington, DC: Association for Educational Communications and Technology.
- Wong, L.H. & Looi, C.K. (2011). What seems do we remove in mobile assisted seamless learning? A critical review of the literature. *Computers & Education*, 57(4), 2364 – 2381.

Appendix A: A Chronology of PLEs

The development of Personal Learning Environments is marked by a number of milestones. The following is a brief chronology of some of the key developments that have led to the current conceptualization of PLEs. The history of PLEs has been documented by Daniel Schneider (2012) and Wikipedia (2010).

1998

FLE (Future Learning Environment) or Fle3 – a web-based learning environment designed by Media Lab (Helsinki) to support learner and group work.

2000

Colloquia, created by Oleg Liber, is the first to use peer-to-peer social networking for learning.

2001

NIIMLE – the Northern Ireland Integrated Managed Learning Environment Project is a large-scale consortial JISC-funded project that supports the mobility of the lifelong learner between secondary and tertiary sectors.

2002

Edutella uses P2P protocols to enable the construction of a distributed global learning object network based on social networking capabilities.

2003

The Open University (Netherlands) initiates the **ROMA project**, focusing on connections within social networks to support learning using a feedback system (similar to the **INSEAD** project in France).

2004

Elgg personal learning system was developed by Dave Tosh and Ben Werdmuller. Originally described as an e-portfolio system, Elgg integrated many elements of PLEs (social networking, feeds, a high degree of personalization).

PACE (University of Wolverhampton) was a pilot study with 160 students in four academic subject areas. While PACE was intended as an ePortfolio system, the inclusion of planning, sharing and commenting features along with links to webtools on the internet created a learning setting that closely resembled today's PLEs.

The **2004 JISC/CETIS** Conference – first recorded use of the term “PLE” based on its current interpretation.

2005

Scott Wilson posted a diagram described as the “future VLE” (later used in the Bolton project).

Wilson's model demonstrates the link between e-portfolios and PLEs.

iCamp project (EC-funded) – development of a Mash-Up Personal Learning Environment (MUPPLE).

Stephen Downes publishes **E-Learning 2.0** to denote the changes in education as a result of new technologies.

JISC-CETIS Conference 2005 – PLE was a theme at this conference.

2006

PLEX Beta (University of Bolton) – similar structure to Colloquia. A desktop and a web-based version were produced.

2008

GRAPPLE (Generic Responsive Adaptive Personalized Learning Environment) and Mature IP (Womble) Project are technology-enhanced learning (TEL) environments for lifelong learning.

2009

Personal Learning Environment framework (PLEF) – a PLE mashup service (designed by RWTH Aachen University) to support learners in aggregating, managing, tagging, commenting, and sharing their favorite resources.

Personal Competence Manager (PCM), an open source and open standards system to support lifelong learning, allowing users to manage, create, use and share eportfolios, learning activities, and social interaction.

YPGoGo.com – launched by Dapsang (China).

2010

Wendy Drexler completes her dissertation research on the construction of PLEs in a middle school science course. A student who participated in this project created a video “**Welcome to My PLE**” (posted on YouTube).

PLE Conference 2010 (Barcelona) – Selected papers were published in the **International Journal of Virtual and Personal Learning Environments**.

Steve Wheeler publishes “**Anatomy of a PLE**” and “**Physiology of a PLE**,” which respectively describe the components and functionality of PLEs.

2011

PLE Conference 2011 The 25th annual SLOAN-C Conference on Online Learning (w3ple initiative)

2012

PLE Conference 2012 Responsive Open Learning Environments (ROLE) – European collaborative project with 16 international research groups. The technology is based on the concept of self-regulated learning.

HP Catalyst initiative for STEM disciplines.

Appendix B: Webtools for PLEs

Here is just a small sample of PLE-type educational webtools that would be suitable for PLE environments. The landscape of webtools and resources continues to evolve. As a result, some of the categories and tools listed below may integrate with others, or be replaced by new, emerging tools. This list does not take into account the multitude of widgets/apps in existence that help students create, organize, and analyze content and ideas. Criteria for selection and use of PLE tools and resources should be based on evidence of their pedagogical value.

Platforms

Social networks and community platforms

- LinkedIn
- Edmodo
- Google+
- Yammer
- Ning

Dashboards, start pages or social software integrators

- [Chadler](#)
- [EyeOS](#)
- Netvibes
- [Symbaloo](#)
- iGoogle

E-portofolio portals

- Mahara
- [Elgg](#)

PLE tools based on function/activity

Audio tools

- Audacity
- iTunes
- Blogging
- Edublogs
- Weebly
- Wordpress

Capture/screencasting tools

- Jing
- Screenr
- Snagit

Document creation and hosting tool

- Etherpad + clones – real text collaboration
- Google Docs
- Scribd

File resource sharing

- Dropbox
- LiveBinders

Live communication/conferencing tools

- Adobe Connect
- BigBlueButton
- Illuminate
- Fuze meeting
- Skype

Photo sharing/organizers

- Flickr
- Picassa

Presentation creation/sharing tools

- Adobe Captivate
- Adobe Presenter
- CourseLab
- e-Learning Authoring Tool
- eXe
- Flash Demo Builder
- Google Docs
- Knowledge Presenter
- OpenOffice
- Prezi
- Slideshare
- Voicethread
- Wimba Create

RSS readers

- Google Reader
- iGoogle
- Netvibes

Social bookmarking tools

- Delicious
- Diigo

Video creation/hosting tools

- Animoto – videos from images
- Khan Academy – learning platform
- Teacher Tube – educational video sharing
- Vimeo – video-sharing site
- YouTube – video-sharing site

Wiki tools

- Google Sites
- PBWorks
- Wikispaces

Appendix C: PLEs and research

PLE journals

Digital Education Review, International Journal of Virtual and Personal Learning Environments (IJVPLE)
Interactive Learning Environments (ILE)

Journals featuring PLEs articles (sample)

Canadian Journal of Learning and Technology
Computers and Education
Educational Technology & Society
European Journal of Open, Distance and E-Learning
IEEE Transactions on Learning Technologies
Interactive Learning Environments
International Journal of Technology Enhanced Learning
Journal of Interactive Learning Research
Pedagogies: An international journal

Disciplinary specific applications of PLEs: A sample of journal articles/ conference proceedings

Business

Kompen, R., Edirisingha, P., and Monguet, J. (2009). Using Web 2.0 applications as supporting tools for personal learning environments. *Communications in Computer and Information Science*, 49, 33–40.

Engineering

Gillet, D. (2010). Tackling engineering education research challenges: Web 2.0 social software for personal learning. *International Journal of Engineering Education*, 25, 1134–1143.

Malinka, I., & Chatti, M. A. (2011). Competences mapping for personal learning environment management (pp. 1–13). *Proceedings of the PLE Conference 2011*, 11–13 July 2011, Southampton, UK. Retrieved from <http://journal.webscience.org/569/>

Saleh, M. (2010). Flexible learning in engineering education: A reflection on the model (pp. 24–28). *IEEE International Conference on E-learning in Industrial Electronics*, 2010, 7–10 November, Dublin, Ireland.

Hydrology

Pathirana, A., Gersonius, B., & Radhakrishnan, M. (2012). Web 2.0 collaboration tools to support student research in hydrology – An opinion. *Hydrology and Earth System Sciences Discussions*, 9, 2541–2567.

Linguistics

Guth, S. (2009). Personal learning environments for language learning. In Thomas, M. (Ed.), *Handbook of research on web 2.0 and second language learning* (pp. 451–471). Hershey, PA: Information Science Reference.

Underwood, J., Luckin, R., & Winters, N. (2012). Managing resource ecologies for mobile, personal and collaborative self-directed language learning. *Procedia – Social and Behavioral Sciences*, 34, 226–229.

Graduate studies

Dürnberger, H., Bülow, C., & Hofhues, S. (2011). Research cloud: Creating a personal learning environment for research-based learning (pp. 148–159). In L. Cantoni, P. Dillenbourg, & D. Euler (Eds.), *Proceedings of the Red-Conference: Rethinking Education in the Knowledge Society*. Lugano: Università della Svizzera Italiana.

Marin, Victoria, & de Benito, Bárbara. (2011). A design of a postgraduate course on Google Apps based on an Institutional Personal Learning Environment (iPLE) (pp. 1–5). *Proceedings of the PLE Conference 2011*, 11–13 July 2011, Southampton, UK. Retrieved from journal.webscience.org/652/

Conferences/Workshops

The PLE Conference

This annual conference is intended to produce a space for researchers and practitioners to exchange ideas, experiences and research around the development and implementation of PLEs – including the design of environments and the sociological and educational issues that they raise. The first conference was held in 2010 in Barcelona.

1st Workshop Exploring the Fitness and Evolvability of Personal Learning Environments (EFEPLE'11)

The workshop's aim is to identify and examine characteristics and mechanisms for successfully evolving PLEs.

Conferences featuring PLEs (sample)

Asclite Conference

European Conference on Technology Enhanced Learning

IADIS International Conference Mobile Learning

IEEE International Conference on Advanced Learning Technologies

International Conference on Networked Learning

International Workshop on Collaboration and e-Learning

International Workshop on Interactive Environments and Emergent Technologies for e-Learning

mLearn: World Conference on Mobile and Contextual Learning

PLE Podcasts/Blogs

TELeurope MUPPLE lecture series

Terry Anderson

<http://terrya.edublogs.org/>

Graham Attwell

<http://www.pontydysgu.org>

Ilona Buchem

<http://ibuchem.wordpress.com/>

Mohamed Amine Chatti

<http://mohamedaminechatti.blogspot.com>

Dave Cormier

<http://davecormier.com/edblog/>

Stephen Downes

<http://www.downes.ca/>

Martin Ebner

<http://elearningblog.tugraz.at/>

Tony Karrer

<http://elearningtech.blogspot.com/>

Rita Kop

<http://ritakop.blogspot.com>

Ismael Pena Lopez

<http://ictlogy.net>

Michelle Martin

<http://www.michelemmartin.com/>

George Siemens

<http://learningemergence.net/people/canada/>

Steve Wheeler

<http://steve-wheeler.blogspot.com/>

Scott Wilson

<http://scottbw.wordpress.com/>

Appendix D: Additional key readings/presentations

Policy documents, briefing papers and reports

Ala-Mutka, K., Bacigalupo, M., Kluzer, S., Pascu, C., Punie, Y., & Redecker, C. (2008). *Learning 2.0: The impact of web 2.0 innovation on education and training in Europe*. Report on a validation and policy options workshop organized by IPTS, Seville, 29–30 October 2008. Retrieved from <http://ftp.jrc.es/EURdoc/JRC50704.pdf>

Ala-Mutka, K., Punie, Y., & Redecker, C. (2008). *ICT for learning, innovation and creativity: A policy brief*. Retrieved from <http://ftp.jrc.es/EURdoc/JRC48707.TN.pdf>

Bohn, M., Bailey, P., & MacNeill, S. (2012). *Extending the learning environment*. (JISC briefing paper). Retrieved from <http://www.jisc.ac.uk/publications/briefingpapers/2012/extending-the-learning-environment>

Commission of the European Communities. (2008). *The use of ICT to support innovation and lifelong learning for all – A report on progress*. Retrieved from <http://ec.europa.eu/education/lifelong-learning-programme/doc/sec2629.pdf>

Educause. (2009). *7 things you should know about personal learning environments*. Retrieved from <http://www.educause.edu/ir/library/pdf/ELI7049.pdf>

Hammond, M., Shreeve, M., & Davies, C. (2008). *Developing personalization for the information environment: Final report*. Retrieved from http://www.jisc.ac.uk/media/documents/programmes/amtransition/dpie2_personalisation_final_report.pdf

Jefferies, A., Bullen, P., & Hyde, R. (2009). *STROLL: A JISC funded project (student reflections on lifelong e-learning)*. Retrieved from <http://www.jisc.ac.uk/media/documents/programmes/elearningpedagogy/strollanalysis.pdf>

Johnson, M., & Liber, O. (2006). *Personal learning environments. A JISC Final Report*. http://www.jisc.ac.uk/media/documents/programmes/elearningframework/plejiscprep_hw_1.pdf

Mauger, S. (2008). Technological change: IFLL thematic paper 2. Retrieved from <http://www.niace.org.uk/lifelonglearninginquiry/docs/IFLL-TechnologicalChange.pdf>

Payton, S. (2012). *Developing digital literacies*. (JISC briefing paper). Retrieved from <http://www.jisc.ac.uk/publications/briefingpapers/2012/developing-digital-literacies.aspx>

Slater, N. (2008). Web 2.0, personal learning environments and the future of learning management systems. *Educause Research Bulletin*, 13. Retrieved from <http://net.educause.edu/ir/library/pdf/ERB0813.pdf>

Articles, book chapters

Attwell, G. (2007). The personal learning environments – The future of eLearning? *eLearning Papers*, 2(1). Retrieved from <http://elearningeuropa.info/files/media/media11561.pdf>

Chatti, M.A., Mohammad, Agustiawan, R., Jarke, M., & Specht, M. (2010). Toward a personal learning environment framework. *International Journal of Virtual and Personal Learning Environments*, 1(4), 20.

Carneiro, R., Lefrere, P., & Steffens, K. (2007). *Self-regulated learning in technology enhanced learning environments: A European review*. Retrieved from <http://www.lmi.ub.es/taconet/documents/srlinteles3.pdf>

Fiedler, S.H.D., and Völjätaga, T. (2011). Personal learning environments: Concept or technology? *International Journal of Virtual and Personal Learning Environments*, 2(4), 1–11.

Martindale, T., & Dowdy, M. (2010). Personal learning environments. In G. Veletsianos (Ed.), *Emerging technologies in distance education* (pp. 177–193). Edmonton: AU Press, Athabasca University.

White, S., and Davis H. (2011). *Making it rich and personal: Crafting an institutional personal learning environment*. *International Journal of Virtual and Personal Learning Environments*, 2(3), 23–39.

Wilson, S., Liber, P. O., Johnson, M., Beavoir, P., & Sharples, P. (2007). Personal learning environments: Challenging the dominant design of educational systems. *Journal of e-Learning and Knowledge Society*, 3(2), 27–28.

Presentations

Many conference presentations on personal learning environments are posted on sites such as SlideShare.net. They can also be found in institutional repositories or aggregators such as [Key perspectives](#).

Examples

Mikroyannidis, A., & Connolly, T. (2012). Introducing personal learning environments to informal learners: Lessons learned from the Open Learn case study. *PLE Conference 2012*, 11–13 July 2012, Aveiro, Portugal. Retrieved from <http://www.slideshare.net/alexmikro/open-learn-pleconf>

Fournier, H., and Kop, R. (2011). *Connecting the dots: Facilitating quality learning in a personal learning environment through educational research*. Canadian Institute of Distance Education Research, Elluminate Presentation, May 4. Retrieved from http://cider.athabasca.ca/CIDERSessions/hfournier/CIDER%202011_20110429%20final2.pdf

