PERSONAL LEARNING ENVIRONMENTS (PLES) IN A DISTANCE LEARNING COURSE ON MATHEMATICS APPLIED TO BUSINESS

José Bidarra [bidarra@uab.pt], João Araújo [jaraujo@uab.pt],
Universidade Aberta, Rua da Escola Politecnica 147, 1269-001 Lisbon, Portugal,
[http://www.uab.pt/web/guest/english/the-university]

Abstract

This paper argues that the dominant form of distance learning that is common in most e-learning systems rests on a set of learning devices and environments that may be outdated from the student's perspective, namely because it is not supportive of learner empowerment and does not facilitate the efforts of self-directed learners. For this study we gathered and examined data on student's use of Personal Learning Environments (PLEs) within a course on Mathematics Applied to Business offered by the Portuguese Open University (Universidade Aberta). We base the discussion on aspects that characterize student's conceptions of PLEs, the emergence of connectivism as a new account of how learning occurs in a networked global environment, and conclude that an important goal of online course design should be to let students explore what the emergent Web 2.0 tools have to offer in distance learning. The widespread adoption of PLEs, bringing together learning from different contexts and sources of learning, shows that students are capable of expression in different forms, generating an added-value to distance learning environments.

Keywords: Personal Learning Environments, Open and Distance Learning, Virtual Learning Environments, MOOC, course design

Introduction

In the era of the exciting new digital media the archetypal "passive recipient" of communication has finally become an active person capable of expressing a critical opinion about the world, someone skilled enough to create digital content to be published in Blogs, YouTube and Facebook, and able to reach a very wide public with these tools. Moreover, these are innovations that stem from the emergence of a new society, mostly networked, in constant interaction, allowing for rapid decisions, globally informed, and based on the integration of various digital media. In this context, it makes sense to consider the integration of learning tools that are managed by students, allowing them to set personal goals, author relevant content and communicate with each other within a particular environment. Unfortunately, in Open and Distance Learning (ODL) institutions the architecture and standardization of a Virtual Learning Environment (VLE) impose severe limitations, namely:

- Insufficient expressiveness offered to students as e-learning systems are directed to the typical student. Personalization capabilities are limited and rarely used;
- Current pedagogical practice is still instructor-centred. The process of education is primarily centred in the institution, rather than learner-centred;
- The institutional VLE is not open to activities occurring outside its realm. Usually there is no support for resources or contacts outside the system, and the capability to support collaboration and communication is limited.

ISSN 1027-5207

The VLE was created in the last century with the aim of bringing the best possible technology to bear on teaching and learning, and generally its first priority is to meet the needs of the organization in terms of identity integration, auto-population of courses, ease of institutional technology support, automatic grade processing, and similar issues that impact the organization's abilities to provide a consistent and reliable system (Severance et al., 2008). But VLEs have been slow in adapting to new developments on the Web in terms of social networking and widgets. They also remained fixed in the instructor-designated, top-down approach, which differs distinctly from the ever more collaborative environment which is the trademark of Web 2.0. There has been some evolution among VLEs, with Blackboard, for example, adding blogs and allowing third-party tools to be integrated. Despite Blackboard's stated plans several years ago to support Web 2.0 tools, Desire2Learn and Angel have gone further in providing new collaborative options for users. However, the most flexible and foremost VLE is Moodle. With its modular design in an open source package, it is fairly easy to add functions and features through installation of additional modules. There are compelling arguments for an institution to maintain a robust VLE such as Moodle. Typically an institution has devoted time, energy and manpower into setting up and running a VLE. So if students use services not hosted by a university the institution will not have control over that content or be responsible for its maintenance. This clearly raises issues of security and reliability as e-learning services have become strategic matters on campuses and many institutions may be wary of having essential services and data located on third-party servers. But let's not forget that most students and teachers use on a regular basis a variety of Internet-based services to manage much of their lives: to locate and obtain resources, buy goods, plan free time, maintain contact with peers, access media, and stay informed.

Perhaps what is needed today is not another institutional or corporate VLE application, such as the widespread Moodle, but an environment that is flexible and can be designed by the learner according to his learning style, needs and context (Bidarra et al., 2010). This Personal Learning Environment (PLE) concept has emerged within the UK and other countries around the beginning of this century as a strategy associated with the application of Web 2.0 technologies to education (Johnson & Liber, 2008). It gained momentum from 2005 onwards with research disseminated by authors like S. Wilson, M. van Harmelen, G. Atwell, S. Downes, G. Siemens and T. Anderson (Mota, 2009). They essentially highlight the learning environment as a collection of tools and services that a learner may choose to access resources and a network of people; sometimes there is an interface (such as Elgg) to integrate the different units. These so-called Personal Learning Environments, or PLEs, are today a privileged field of research in ODL, encompassing several technological perspectives that may include social networks, free virtual environments and open software, connecting various learning resources that may be suitable for inclusion in current educational frameworks (van Harmelen, 2008). However, PLEs are not just pieces of software, they comprise environments where people, tools, communities, and resources combine in a very loose kind of way (Wilson, 2008). They contrast with the current crop of VLEs that is very much focused on meeting the goals of the central institution in providing a basic technology platform for teaching and learning. Making a case for PLEs authors Attwell, Bimrose and Brown (2008) stated "a PLE should be based on a set of tools to allow personal access to resources from multiple sources and to support knowledge creation and communication" (p. 82), and suggest an inventory of the possible functions of a PLE:

- Access/search for information and knowledge;
- Aggregate and scaffold by combining information and knowledge;
- Manipulate, rearrange and repurpose knowledge artefacts;
- Analyse information to develop knowledge;
- Reflect, question, challenge, seek clarification, form and defend opinions;
- Present ideas, learning and knowledge in different ways and for different purposes;

ISSN 1027-5207

- Represent the underpinning knowledge structures of different artefacts and support the dynamic re-rendering of such structures;
- Share by supporting individuals in their learning and knowledge;
- Networking by creating a collaborative learning environment.

In the confrontation of the two perspectives, VLEs vs. PLEs, a compromise is needed. In a recent study, Conde et al. (2012) propose a possible way to facilitate the interoperability between the VLE and other external tools that could be integrated in a PLE. The approach is based on services and interoperability specifications that can be flexible enough to change the VLE, the tools or the communications employed. According to Bogdanov et al. (2012) the PLE components can be brought into a VLE via widgets that are portable Web applications implemented with HTML, CSS and JavaScript. But in the case of Moodle improvements in flexibility and adaptability can only be achieved via visual themes and server side plug-ins, thus an intervention of system administrators is required every time a change should be done.

Actually, both VLEs and PLEs have their pros and cons. Today VLEs are controlled and managed by universities, they are widespread and can be found in almost every university, they are robust systems, and students and teachers are used to them. The main criticism to VLEs comes from the lifelong learning perspective. First, VLEs are not flexible enough to be personalized by learners themselves, impose a specific learning process and an environment on students, and, second, they are disconnected from the Internet cloud of information (Wilson et al., 2007). In fact, these are the main limitations that gave birth to PLEs, where learners are in full control of their learning process and can create their own learning environments by aggregating tools and content required for specific tasks. However, PLEs also have several disadvantages:

- Rarely propose specialized learning content and tools;
- Insufficient visual tutorials for building personal spaces or tools usage;
- Inadequate collection of easy-to–use semantic tools;
- Problems in searching for relevant content;
- Need for significant computer skills in some cases.

Within this context, we reviewed the teaching/learning experience in the course *Mathematics Applied to Business* offered by the Portuguese Open University (Universidade Aberta). In this course many students used their own PLEs as a complement to the modules set on the Moodle platform, which is the official VLE for all courses at the Portuguese Open University. We found from previous distance teaching practice that, in order to break the isolation and engage with subject matter, students must became actively involved in the processes of distance learning, for instance, communicating with one another, trying different ways to solve problems, or creating and synthesizing material from multiple sources. We also knew that there was enough flexibility in the course for students to pursue their learning goals and workout the aggregation of external resources from the Internet. But what features and functions could be found in students PLEs?

The main objective of this study was to identify what PLEs and resources were being used by students for learning purposes, and confirm (or not) the notion that new and operational concepts, technologies or capabilities may become available within a university in a spontaneous way, so they can be driven by individuals or small groups (Marshall, 2010). This information is vital, as we believe that developer's intervention is needed to conceive flexible technological solutions that support learners in designing their PLE the way they want. What is expected from developers, and instructional designers, is not the development of a predefined "Personal Learning Environment" as its semantics confusedly suggests. Perhaps what learner's need is a "design tool" for the creation, maintenance and evolution of their own personal learning environment.

ISSN 1027-5207

PLE, instructional flexibility and mobile learning

Distance education should not be a "fast food" outfit in which the student uses something ready to consume. Instead, it should be a practice that allows for a balance between individual needs and respected educational processes. Environmental, cognitive, emotional, cultural and socioeconomic factors tend to influence all these processes. For students, before starting a PLE, it's important to know how they are affected by the instructional design, and understand the very processes of teaching and learning. This should be the main strategy to achieve the necessary flexibility in the choice of tools and services for learning.

According to Godwin-Jones (2009), in the case of language learning, there is a variety of use options in a PLE: writing in different contexts/registers, practicing speaking and listening, and reading short, peer posts as well as longer native speaker texts. But there tend to be varied kinds of tools and services that may be included in other course-oriented PLEs:

- **Chat**. Synchronous private or group communication, which may be through traditional instant messaging, or newer options such as Skype or Twitter;
- **Calendar/To-do-list**. Class assignments/announcements and keeping track of work done; Google Calendar is a good option;
- **News Feeds**. RSS feeds with the option of customizing to pull in items on a specific topic, from a particular source, or in a given assignment;
- **Personal Publication Tools**. Blogs or wikis, for individual or group reading/writing;
- **Social Bookmarking**. Services such a Delicious or Diigo provide a means to recommend sites to others in a group; some offer rating and annotation options;
- **Writing Tool**. Simple text editor or on-line word processor such as Google Docs;
- **Media Player**. For display of all kinds of streaming video, such as VLC; ideally should have a recording option like Audacity;
- **Language Tools**. On-line dictionaries, thesaurus and word lists;
- **File storage/distribution**. Could be a service such as Dropbox or an aggregator for a specific kind of file, like Flickr;
- **Quizzing/Polling**. Tools such as Blog Quiz provide basic assessment types; Doodle is also a good choice for decision making.

The flexibility in creating a learning environment also improves with the benefits of mobile learning, based on the emergence of many new portable and mobile devices such as laptops, PDA's, iPhones, iPads, etc. These are becoming ideal resources for global learning and lifelong learning. They also push forward the motivation to learn, combined with benefits such as speed, ease, and the cooperative construction of knowledge. Clearly "mobile technologies" are not just talk about "mobile devices" as it also means "collaborative and motivated minds", given the persistent involvement of a new generation of students in mobile learning, truly building communities of practice. This should be good news for mobile learning systems, which are often described as supporting informal learning (Sharples, 2002). So apparently, mobile learning systems are more like a PLE than a VLE, and therefore will be more appealing to the changing needs of students.

Using a mobile device or not, through online learning processes students have many opportunities to choose their learning environments, as there are hundreds of information and communication tools available (and many are free). Students thus may become more active, critical, selective, and may opt for new ways of interacting with the learning content. The wealth of information and the diversity of communication technologies are huge and allow for students to select the most adequate, and even combine different media for learning (Dias de Figueiredo,

ISSN 1027-5207

2002). In this way distance learning may be apparently an individual activity, but actually is never performed in isolation as new digital media connect students to their colleagues, teachers, and the world. In this regard, today we witness the emergence of Massive Open Online Courses (MOOCs) based on the idea of "connectivism" – a "learning theory" that George Siemens (2005) and Stephen Downes (2007) developed for a networked and digital world. In 2010, S. Downes, G. Siemens, D. Cormier and R. Kop actually created a MOOC on "Personal Learning Environments, Networks and Knowledge" (PLENK, 2010) and since that year the PLE conference has been a success. Perhaps connectivism is a not new "learning theory" but an account of how learning occurs in a networked global environment, and this dovetails nicely with the concepts of PLE and mobile learning.

From another point of view, a PLE may be simply described, as the name suggests, as a personal environment where an individual learns. This environment may be customized and designed by the learner according to his learning style, needs, context etc. The tenets of a constructivist learning theory apply here, as the rationale is that we learn through the interaction with others and by building shareable artefacts, so the socio-constructivist and constructionist views of learning are present (Harmelen, 2008). Because the learning style of each person is a combination of how he/she perceives, organizes and processes information, be it visual, auditory or kinaesthetic (Attwell, 2007), students have preferences in terms of pedagogical approach within certain contexts, and their choice of personal tools becomes a reflection of that.

Evidence also shows that students learn more by collaborating with their teacher and with each other in the context of educational narratives (Pachler & Daly, 2009). This points to a new model of education, one that is student-centred, networked, customized and collaborative, leading to the creation of mechanisms through which infusion experiences and other rich learning contexts may support activity in novel situations (Shaffer, 2004). The underlying reasoning is that social interaction and emotions are important in cognitive processes, and there is a growing body of evidence from the neurosciences supporting this. The Portuguese born neuroscientist António Damásio developed a theory of emotion that has evolved from his first book, Descartes' Error: Emotion, Reason and the Human Brain (1994), which explains how feelings are entangled in the cogitations of the brain and the circumstances of the body. In his second book, The Feeling of What Happens: Body and Emotion in the Making of Consciousness (1999), Damásio further explores the role of emotion; he attempts to connect the neurology of emotion to the neurology of consciousness and extends this to the existence of a sense of self. Essentially, Damásio states that mind and body are inseparable and integrated via mutually interactive biochemical and neural components, such as the endocrine, immune, and autonomic neural constituents, which produce chemical and electrical transmitters. So emotions are closely linked to the choices made by students, as they clearly benefit from the value of emotions in supporting the cognitive dimension, for instance, much of the research discussed above shows the dominant functions students attribute to a PLE and, consequently, some of the underlying presuppositions about how they conceive learning online as "cool": they privilege interaction with others (communication and collaboration) and also creating content (digital artefacts).

Beyond Moodle and into PLEs

A recurring problem in Distance Education relates to the fact that students often do not engage with the materials posted online, especially when dealing with abstract subject matter. Resources are often confined in a rigid structure such as that allowed by a Virtual Learning Environment (VLE) such as Moodle. We discussed before that the creation of Personal Learning Environments, which can substitute the institutional VLEs, are a valuable option for students, but nevertheless, the transition from the absolutely controlled and structured VLEs to the freely

ISSN 1027-5207

managed PLEs still raises questions that demand answers at both administrative and educational levels (Panagiotidis, 2013). The advantages and disadvantages of the Moodle platform in relation to the PLE choice by students were identified in previous research (Bidarra et al., 2010), summarized in Table 1.

Table 1: Moodle vs. PLEs

	Advantages	**Disadvantages**
Moodle	Ease of use and meeting point for all students; Security of data/resources posted by students and teachers; Software reliable and updated regularly; Advantage of an IT infrastructure guaranteed by the university.	No alternative; this the choice of the institution; Access to content may be limited in time; Tools and features are limited by the software and the institution; The environment limits the possibilities of communication via private messages.
PLE	Created/assembled by student; Identification of the student with the environment (tools, resources, outfit); Authoring ability and collaboration are vastly supported; Availability of online content indefinitely; More collaborative and social.	Requires higher management attention given the large number of tools/resources available; Possible scattering and waste of online resources; May lack a proper integration with the institutional Virtual Learning Environment.

There is a lot of potential in PLEs, however, according to recent research (Dabbagh & Kitsantas, 2012), even if a PLE can be entirely controlled or adapted by a student according to his or her formal and informal learning needs, not all students possess the knowledge management and the self-regulatory skills to effectively use social media, for instance, in order to customize a PLE to provide the learning experience they want. In this regard, giving students information and tools to promote effective self-regulated learning may help them acquire basic and complex personal knowledge management skills that are essential for creating, managing, and sustaining PLEs using a variety of social media.

According to Downes (2010) the pedagogy of a learning network (PLE) is very different from what we might find in a content-based course (VLE). The order and structure of the content is dissolved; while episodic content (such as books, simulations or lectures) maintain an internal logic and structure, the linear or hierarchal structure that previously defined courses is entirely absent. This is an important aspect to be considered by course designers, as they will have to facilitate the conversation and interaction around episodic learning events in a distributed environment.

The fact remains that in previous academic years our teaching practice with the institutional learning platform has been a successful one and did not write off Moodle as a valuable tool for learning. However, based on the literature reviewed and data gathered, we hypothesize that today it is not sufficient to provide students with inflexible models set out in advance by the teacher and the institution, no matter how established they are, and that we must also offer each student the opportunity to carry with him the tools and resources that best suit his style and personal goals in a given context. Thus the main objective of our study was to gather data on what tools students used to learn *Mathematics Applied to Business*, including their own choice of tools and resources, but always anchored in the university's official Virtual Learning Environment (Figure 1).

ISSN 1027-5207

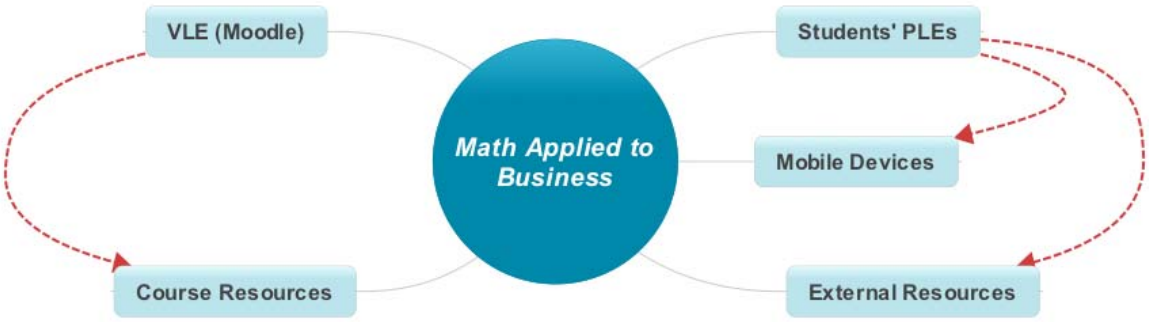

Figure 1. Student's global environment in the course Mathematics Applied to Business.

Context of the study

This study was carried out with the students enrolled in *Mathematics Applied to Business*, a course for the Business Administration Degree at Universidade Aberta. In this course, first year students are introduced to some basic statistical tools: populations, samples and statistics; organization of data into summary tables; how to graph the data; measures of central tendency and measures of dispersion; statistical correlation; time series; several price indexes, indicators and deflation series. The course has two possible assessment options: either a final examination (150 minutes), or two one-week e-folios (marked assignments) complemented by a p-folio (90 min. test). In our experiment half of the students chose final examination.

There were five different online classes of about 50 students each (the fifth class was smaller). Throughout the semester, and in each class, there were several discussion forums for news, admin matters, specific themes, and general issues. All the forums were supervised but not fully moderated by faculty, with any question being answered within 18 hours, maximum.

The major part of student activity took place in discussion forums. Altogether very few administrative questions were raised here, and the thematic forums (dedicated to special sets of exercises proposed by the teachers, including detailed solutions) also did not show any special activity. In the forums for general use, on the other hand, in average, there were about 40 active students participating on a daily basis, with a maximum of 120 on the third week, and a minimum of 10 on the eve of the last e-folio. The general forums were "pseudo-non-moderated", since officially these forums were "non-moderated", but the teachers actually intervened as they were bound by the obligation of replying to any question within 18 hours.

Faculty consisted of one professor and three tutors following all the virtual classes. The professor and the tutor assigned to a particular class would take part in the debates; the tutors of the other classes would (almost) never take part on the debate outside their assigned classes.

In addition to the general forum, a very important teaching tool was the tutor-marked assignments (or e-folios) allowing for detailed comments on performance to be issued to each student. Because each of the questions in the e-folios was assigned to one teacher, (s)he could focus on that specific topic, refine the assessment criteria providing equal outcomes to similar resolutions, but, most of all, (s)he would be in a better position to make a profound analysis of the misconceptions, and present a detailed report to the students. Thus, in the end, the students were provided with:

- A detailed solution of the e-folios presented by the teachers;
- A detailed analysis of most common errors;

ISSN 1027-5207

- An individual comment on performance.

These features of course organization produced very high satisfaction outcomes, with students expressing their deepest gratitude for the teachers' efforts and dedication.

In addition to the abovementioned interaction forums, the students also had a social room to interact with all the colleagues, a specific space for the online secretary and a list of each other's e-mails. Therefore, given all the support provided and the multitude of different places where the students could meet, it came as a kind of surprise to see how many of them decided to meet outside the Moodle platform and use many external (cloud) resources. Moreover, in addition to using different external communication tools, they even produced a Web site from scratch directed towards improving success in tutor marked assignments.

Clearly there are advantages in terms of resource savings in using software developed and hosted by someone else. However there are also issues to overcome such as those posed by quality assurance and software interoperability. For example, it is essential that work submitted for assessment be in a format that is easily accessible to professor and tutors. It is also a requirement that sometimes assessment items are not worked on after the deadline. If these processes cannot be automated there is a significant amount of additional work to be undertaken.

Data gathering and analysis

There are currently many ways of gathering student data, these range from the more formal, such as written questionnaires, to the more informal, such as a face-to-face chat with a tutor or student. For an exploratory study all the methods now available are valuable tools for obtaining the views of students about their experiences on their courses (Kirkwood, 2003). For this study a straightforward (and quick) online questionnaire was sent to all the students and 183 answers (out of 235) were received. This survey entailed 15 questions with a binary Yes/No answer allowing for blank responses. Many questions were created based on clues taken from previous chats with students and tutors. The main findings are summarized in the table below.

Table 2: Questions and answers by students on their PLE.

Nr.	Question	No	Yes	(blank)
1	Have you ever used Scribd or Google Docs to publish/share documents?	79.78 %	20.22 %	0.00 %
2	Have you ever used Slideshare to publish Powerpoint?	92.35 %	6.56 %	1.09 %
3	Have you ever used Delicious to share favorites?	98.36 %	0.55 %	1.09 %
4	Have you ever used a Wiki resource for group work?	73.22 %	24.59 %	2.19 %
5	Have you ever used MSN Messenger to chat with study purposes?	38.80 %	58.47 %	2.73 %
6	Have you ever used Skype to talk/study/work with colleagues?	77.60 %	18.58 %	3.83 %
7	Have you ever used Firefox add-ons for study purposes?	73.77 %	21.31 %	4.92 %
8	Do you habitually use Facebook to keep in touch with your colleagues?	67.21 %	26.78 %	6.01 %
9	Do you frequently use Twitter to publish small messages?	92.35 %	2.73 %	4.92 %
10	Do you regularly use MSN Messenger and/or Skype to socialize?	32.79 %	62.30 %	4.92 %
11	Do you prefer to access the Moodle platform from a portable computer?	22.40 %	71.04 %	6.56 %
12	Do you prefer to access the Moodle platform from your	19.13 %	74.32 %	6.56 %

ISSN 1027-5207

	home?			
13	Would you like to have had access to the Moodle platform from your workplace?	17.49 %	74.86 %	7.65 %
14	Have you ever used cellphones/smartphones/PDA to study?	79.78 %	14.21 %	6.01 %
15	Did you miss any communication tools to get in touch with your colleagues?	75.96 %	15.30 %	8.74 %

The first three questions concern the use of resources for information publishing and sharing. The most used are Scribd or Google Docs (20.22 %), while the use of either Slideshare or Delicious is very rare. Wiki resources are also fairly appointed (24.59 %).

Instant messaging tools (including the most common messengers) and voice/video chat, were covered in questions 5, 6 and 10. We found that the preferred communication tool is instant messaging (58.47 %), while voice/video chat was used by only 18.58 % of respondents. As we would expect these tools are used mainly for socialization (62.30 %).

Firefox add-ons are used by 21.31 % of the respondents as additional resources for study and information gathering. As we expected, in what concerns the use of social networks, Facebook is more often used than Twitter, and it may be the reason why students do not use the "approved" Moodle forum to socialize.

Mobility and access issues were addressed in the questionnaire from question 11 to 14. Although the majority of people has chosen to access Moodle from home (74.32 %), they still prefer to access it based on a laptop and be able to access from the workplace (71.04 % and 74.86 %, respectively), which leads to the conclusion that ODL students choose mobility for their e-learning interactions. Handheld devices were used by 21.04 % of the respondents to access the e-learning platform, we believe this will be increasing with the global dissemination of smartphones, tablets and other portable devices, but for now laptops and desktops are still the preferred platforms.

The last question asked if any other communication tools were missed. From the 183 respondents, 28 said yes (15.30 %). More specifically, 11 people mentioned that direct or face-to-face contact was missing, and 6 people missed voice/video chat or telephone contact. Other issues mentioned were limitations of chat rooms (3 students), need for a more interactive Moodle (3 students), more study resources (2 students) and support for study with colleagues (2 students).

In addition to the established communication channels via Moodle, usually asynchronously since the existing chat functionality on this platform was not stable enough for synchronous communication, there was an explicit need to seek and explore other means of communication by students. Though none of the usual applications of synchronous communication (messenger) was suggested or prescribed to them, it was found that their use was frequent and widespread. For more formal and personal communications, especially concerning the assessment of tutor marked assignments (e-folios), e-mail remains the most used channel by students.

Based on the literature reviewed and the data collected, we consider that the implications of this re-conception of education, as a personal, mobile and flexible exchange of ideas in a broad context, are profound. It surely goes beyond the traditional view of instruction as the transmission or construction of knowledge within the constraints set by a curriculum and an official VLE, into an on-going process of learning through many resources and a continual exploration and negotiation. Learning in this way is in fact pervasive or ubiquitous education, meaning that education is available 24 hours a day, 7 days a week, anywhere, and anytime. But is

ISSN 1027-5207

also a social process that connects learners to clusters of devices (individual PLEs), other people, and society, so that students can construct relevant and meaningful learning experiences, author specific content (text, images, audio, video), in locations and at times that they find meaningful and relevant.

Conclusions and implications

The findings show that PLE's allow many students to exercise a greater control over their learning activity, but it also show that Moodle is (still) the most important component of their learning environment at Universidade Aberta. It remains the key environment for contact with teachers, to access content, to allow for individual assessment, and to reach the institution. On the other hand, we found that students invested significant time and effort in their PLEs, searching for knowledge resources, using collaborative tools for text editing, interacting via online communication tools, creating a website, and other relevant activities in the cloud. The surprising outcome emerging from our experiment, and we believe not just for us, is that even if the teachers were very supportive and always willing to assist students in their needs, even with students admitting that, a relevant percentage shows they preferred to meet "in the cloud" where interaction could not be seen by the professor and tutors. This demands further investigation to clarify what really leads the students to that: are they just seeking privacy or does the learning environment provided not satisfy them? Perhaps the answer to this question may lead to improvements in the way we design interaction in our online courses.

Looking to the future with optimism, given the vast array of resources that can be used for learning, and today many of these are easily accessible and free, it is clear that the responsibility of students becomes greater, in line with their capability for autonomous learning and their dedication to achieve educational objectives. This does not mean that we have reached an ideal situation in distance learning, far from it, but this study indicates that this is the way forward, also involving greater accountability of institutions and faculty in setting the right context for learning. Current practice with inflexible e-learning tools might have a negative impact on students' attitudes towards the chosen learning model but we must also reflect on some of the challenges that such a change might require for distance learning organizations.

References

1. Attwell, G.; Bimrose, J. and Brown, A. (2008). Maturing learning: mashup personal learning environments. Mash-Up Personal Learning Environments. In *Proceedings of 1st Workshop MUPPLE'08. Maastricht.* Retrieved from http://dspace.ou.nl/bitstream/1820/1501/1/mupple08_dspace.pdf#page=84
2. Attwell, G. (2007). The Personal Learning Environments – The future of eLearning? In *eLearning Papers, 1(2)*, (pp. 1887-1542).
3. Bidarra, J.; Sousa, A.M.; Grazina, F.; Simões, P. and Azevedo, P. (2010). Personal Learning Environments no contexto virtual de um mestrado em Comunicação Educacional Multimédia. In Rodriguez, M. C., Silveira, R. A., Escudeiro, P. (eds), *TICs Aplicadas para el aprendizaje de la Ingeniería (TICAI)*, IEEE, Sociedad de Educación, Capítulos Español, Portugués y Colombiano. Retrieved from http://romulo.det.uvigo.es/ticai/index.php/ticai2010
4. Bogdanov, E.; Ullrich, C.; Isaksson, E.; Palmer, P. and Gillet, D. (2012). From LMS to PLE: a Step Forward through OpenSocial Apps in Moodle. In Popescu, E., Li, Q., Klamma, R., Leung, H., Specht, M. (eds.), *Advances in Web-based Learning – ICWL 2012*, (pp 69-78), Berlin Heidelberg: Springer.

ISSN 1027-5207

5. Conde, M.A.; García-Peñalvo, F.J.; Piguillem, J.; Casany, M.J. and Alier, M. (2012). Interoperability in eLearning contexts: interaction between LMS and PLE. A: Symposium on Languages, Applications and Technologies. In *Proceedings of 1st Symposium on Languages, Applications and Technologies – SLATE 2012,* (pp. 205-223), Braga.
6. Damásio, A. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain.* New York: Avon Books.
7. Damásio, A. (1999). *The Feeling of What Happens: Body and Emotion in the Making of Consciousness.* New York: Harcourt.
8. Dabbagh, N. and Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. In *The Internet and Higher Education, 15(1)*, January 2012, (pp. 3-8).
9. Dias de Figueiredo, A. (2002). *Redes e educação: A surpreendente riqueza de um conceito, in Redes de Aprendizagem, Redes de Conhecimento, Conselho Nacional de Educação, Ministério da Educação.* ISBN: 972-8360-15-0.
10. Downes, S. (2010). New technology supporting informal learning. In *Journal of Emerging Technologies in Web Intelligence, 2(1).* Retrieved from http://ojs.academypublisher.com/index.php/jetwi/article/view/02012733/1563
11. Downes, S. (2007). *What connectivism is.* Web log post, Retrieved from http://halfanhour.blogspot.com/2007/02/what-connectivism-is.html
12. Godwin-Jones, R. (2009). Emerging technologies: Personal learning environments. In *Language Learning & Technology, 13(2)*, (pp. 3-9). Retrieved from http://llt.msu.edu/vol13num2/emerging.pdf
13. Harmelen, M.V. (2008). Design trajectories: four experiments in PLE implementation. In *Interactive Learning Environments, 16(1)*, (pp. 35-46).
14. Johnson, M. and Liber, O. (2008). The Personal Learning Environment and the human condition: from theory to teaching practice. In *Interactive Learning Environments, 16(1)*, (pp. 3-15).
15. Panagiotidis, P. (2013). VLEs vs. PLEs for Higher Education Institutions. In R. McBride & M. Searson (eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2013*, (pp. 896-901). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/48225
16. Kirkwood, A. (2003). Understanding independent learners' use of media technologies. In *Open Learning, 18(2)*, (pp. 155–175).
17. Marshall, S. (2010). Change, technology and higher education: are universities capable of organisational change? *ALT-J, 18(3)*, (pp. 179-192).
18. Mota, J. (2009). *Da Web 2.0 ao E-learning 2.0: Aprender na rede.* Universidade Aberta. Retrieved from https://repositorioaberto.uab.pt/bitstream/10400.2/1381/1/web20_e-learning20_aprender_na_rede.pdf
19. Pachler, N. and Daly, C. (2009). Narrative and learning with Web 2.0 technologies: towards a research agenda. In *Journal of Computer Assisted Learning, 25(1)*, (pp. 6-18).
20. PLENK (2010). Retrieved from http://connect.downes.ca/index.html
21. Severance, C.; Hardin, J. and Whyte, A. (2008). The coming functionality mash-up in Personal Learning Environments. In *Interactive Learning Environments, 16(1)*, (pp. 47-62).

22. Shaffer, D.W. (2004). Epistemic Frames and Islands of Expertise: Learning from Infusion Experiences. In *Proceedings of the 6th International Conference on Learning Sciences 2004*, (pp. 473-480), June 22-26, UCLA, CA.

23. Sharples, M. (2002). Disruptive devices: mobile technology for conversational learning. In *International Journal of Continuing Engineering Education and Life Long Learning, 12(5/6)*, (pp. 504-520).

24. Siemens, G. (2005). *A learning theory for the digital age*. Web log post, retrieved from http://www.elearnspace.org/Articles/connectivism.htm

25. van Harmelen, M. (2008). Design trajectories: four experiments in PLE implementation. In *Interactive Learning Environments, 16(1)*, (pp. 35-46).

26. Wilson, S. (2008) Patterns of Personal Learning Environments. In *Interactive Learning Environments, 16(1)*, (pp. 17-34).

27. Wilson, S.; Liber, O.; Johnson, M.; Beauvoir, P.; Sharples, P. and Milligan, C. (2007). Personal Learning Environments: Challenging the dominant design of educational systems. In *Journal of eLearning and Knowledge Society, 2(1)*, (pp. 173–182).