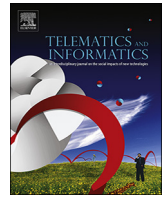




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# Personal learning Environments based on Web 2.0 services in higher education

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## ABSTRACT

The emergence of Web 2.0 has not only changed the available Web technologies, but also the way people communicate and relate to one another; technology is continuously impacting society and the behaviour of individuals. The growing ubiquity of Web access, and the variety of devices that allow us to interact with it, have made it possible for learners to choose the tools and services that better adapt to their needs, providing a means of personalizing the learning experience. In this paper, we report the results of research on learner-created Personal Learning Environments (PLEs) based on Web 2.0 services, in the context of higher education, as both a means of transforming learning and teaching processes, and as preparation for the learners' future professional lives in a dynamic environment with a heavy digital and technological influence. The methodology used was Design-Based Research, by carrying out an intervention in practice settings in a subject at higher education level; this intervention and its successive iterations allowed for a continuous process of data collection and analysis, which was in turn used to modify and create new interventions. The original pilot test and successive iterations ran from 2009 to 2012, with a second round of data collection carried out between 2014 and 2016. The analysis of the data provided evidence of PLEs as tools for learning and acquiring skills, strengthening social interactions, and improvement in the organization and management of content and learning resources; it also helped identify obstacles and barriers, and possible solutions. The main outcome of this research is presented as a set of guidelines for using PLEs as tools for supporting formal learning, either by teachers or by the learners themselves.

## 1. Introduction

The emergence of Web 2.0 has made a huge impact on many areas of society, including education. As processes with a strong social component, it seems obvious that teaching and learning could benefit enormously from the use of Web 2.0 applications and services. One of the concepts that have gained popularity in the educational field since mid-2000s is Personal Learning Environments (PLEs) (CETIS, 2007; Adell and Castañeda, 2010; Attwell, 2006; Downes, 2006; Olivier and Liber, 2001). As Wilson et al. (2007, p. 4)

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write, “the discourse of PLE began to emerge from conversations amongst a diverse group of educational technologists in early 2005”, and built momentum with the publishing of a conceptual model for a new type of system, which at the time was dubbed “the VLE of the future”.

Although there is not yet a widely accepted definition, it usually refers to a group of Web technologies, with various degrees of integration and interaction, which help users and learners manage the flow of information that relates to the learning process, the creation of knowledge, and the development of skills.

The advocates of PLEs (eg., Downes, 2006; Attwell, 2007; Taraghi et al., 2009; Castañeda and Adell, 2011) suggest that by building and actively using a PLE, learners would regain control of their learning process by being able to choose and mix from several alternatives for (among other actions) capturing, storing, classifying, analyzing, creating, sharing, disseminating and processing information, thus creating knowledge. In practice, the application of PLEs in a diversity of educational levels and areas is still under experimentation (Torres-Kompen et al., 2009; Prendes et al., 2014; Santos et al., 2014; Rahimi et al., 2015; Conde-González et al., 2014). Personal Learning Environments is a growing field in educational research, as shown by the number of position and research papers being published in the last 10 years, and the launch of The PLE Conference, also known as PLEConf ([pleconf.org](http://pleconf.org), n.d.).

The main objective of the research presented in this paper was to develop general guidelines for the implementation and use of Personal Learning Environments by learners, in formal education contexts, at higher education level; and to analyse their experience, both as students and, after graduation, as young professionals, and the impact PLEs had in their learning process and their first steps in the professional world. As Fiedler and Våljataga (2011, p. 1) suggests, PLEs may play a role in the “transformation of the monolithic, centralised systems that dominated and are still dominating formal education”.

PLEs may not only play a role in transforming education by allowing for the use of new methodologies and approaches, but they can also be useful in preparing learners for their transition into a workplace market that is also in continuous change.

One of the main limitations of this research, and the proposed guidelines, is that they are based on data collected from a specific teaching and learning context (formal, higher education), which should be taken into account when considering their application in other settings.

## 2. Personalization in learning and PLEs

Learning, from a social constructivist perspective, is a process that varies from individual to individual, and is focused on the learner rather than on the teacher. Similarly, teaching is not understood as just the transmission of knowledge and information, but it is also about helping learners along their own learning path and process (Freire, 1970; Ilich, 1970). The popular phrase that states that teachers have changed from “sage on the stage to guide on the side” (King, 1993, pp 30–35) exemplifies the spirit of social constructivism in the learning process: the role of teachers has seen a shift from transmitters of information to facilitators and guides. According to this view, teachers are no longer considered as the “owners” of information and knowledge, because resources for learning may already be available on the Internet as well as in print (eg., in libraries). This is not to say that teachers are no longer needed: on the contrary, their role becomes even more important, to help students develop their ability to sort, understand, analyze and use information creatively, and to guide them in their learning paths.

PLEs can be considered as a potential means of achieving personalization in learning. The idea of PLEs is underpinned by the concept of Web 2.0: an evolution of the original Web and its services, with an increasing number of applications and resources being developed by the actual users, as well as an important participation of users in the generation and sharing of content. It is about the democratization of the Internet (von Hippel, 2005): users stop being just consumers to become producers, blurring the lines and embodying the idea of “prosumers” (Toffler, 1984). Prosumers thus choose the services and applications they need for generating or consuming content, and adopt them based on their needs. It also embodies the view of personalization through participation (Williams, 2008): involving users actively in determining the aims and mode of delivery of the service – in this case, the knowledge and the learning experience.

## 3. PLE definitions and approaches

A number of definitions for PLEs have been proposed through the years, and they vary from those firmly rooted in the technological (van Harmelen, 2008) to those with a more social orientation (Adell and Castañeda, 2010). Fiedler argues that emphasis should shift from the tools PLEs are based on, to the learners’ patterns of control and responsibility. The literature about PLEs published since the mid-2000s shows two schools of thought: a more pedagogical one (where PLEs are seen as a methodology or concept) and a more technological one (where PLEs are seen as an object, a platform or infrastructure), with some authors proposing a middle-ground approach. In any case, the existing definitions and perceptions of PLEs show that there are different approaches to defining what a PLE is, ranging from the information systems view (technological) to a more organic perspective that takes into account not only the technological components, but also how these tools are used for learning and creation of knowledge, focusing on the non-technological components of the PLE, the relationships with other learners, peers, and facilitators of the learning process.

### 3.1. Defining PLEs

When discussing Web 2.0-based PLEs, it is clear that most of the ingredients of these learning environments are web applications and services, which means that the information technology element is crucial. Adell and Castañeda (2010, p. 7) propose that PLEs are

“a set of tools, sources of information, connections and activities which each individual uses on a regular basis to learn”. They also agree with [Attwell \(2007\)](#) in the sense that PLEs are structured around those tools and services that facilitate three basic cognitive processes: reading, reflecting and sharing.

[Alter \(2008\)](#) definition of Information Systems is a useful starting point for defining PLEs as it resonates well with the key elements of PLEs. [Alter’s \(2008, p. 8\)](#) definition for Information Systems is: “a work system whose processes and activities are devoted to processing information, i.e., capturing, transmitting, storing, retrieving, manipulating, and displaying information.” Alter went on to include the human intervention in an information system: “... human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce informational products and/or services for internal or external customers” (Ibid, p. 8).

PLEs may thus be defined as *an information system that supports the learning process of the user, and whose processes and activities are devoted to processing information, i.e., capturing, transmitting, storing, retrieving, manipulating, and displaying information.* This is the wider approach used throughout this paper.

### 3.2. PLEs as an object (a technological view of PLEs)

As discussed early in [Section 3](#), one school of thought on PLEs is to consider them as an actual object, an environment, common to all users (although customizable to certain extent), that allows them to organize, collect, process and share information and knowledge. This is a more structured visualization of a PLE, but one that raises many problems (mostly technical ones). A common framework or platform is needed to bring together and support the different services and applications, by providing the necessary application program interfaces (API). It needs to be more or less fixed, reliable and available in the long term, while being flexible allowing for changes and updates of the different components. Users should be able to easily customize or change the PLE structure. Some examples of PLEs based on this approach are the PLEW (server) and PLEX (desktop) applications ([Wilson, 2007](#); [Hirst 2008](#)); and the MUPPLE (Mash-Up Personal Learning Environments) ([Wild et al., 2008](#)).

### 3.3. PLEs as a concept or an approach to using Web 2.0 tools (a pedagogical view of PLEs)

In this view of PLEs, they are not a specific tool or a platform as such, but rather an approach to organizing a variety of Web 2.0 technologies; the “Environment” in PLE according to this approach is the Internet itself and the chosen Web 2.0 technologies but not to any particular application. The PLE is unique for each user, and changes according to the user’s needs and experiences.

Although there is evidence that students use a variety of Web 2.0 tools and applications ([ECAR 2007](#); [Trinder et al., 2008](#); [Humanante-Ramos et al., 2017](#)), there is limited evidence that students use these tools in an integrated manner suited for academic learning ([McLoughlin and Lee, 2008](#)). Such integrated and purposeful use of Web 2.0 tools would suit a constructivist approach to learning, with students constructing their own personal learning environment and thus their knowledge. In this sense, the PLE will be the result of using and connecting a range of tools and applications.

In this conceptualization of PLE, each learner chooses their own Web 2.0 tools and connects them to collect, organize, process and share information, and manage their knowledge. Thus the sum effect of the tools, information, connections, storage and resultant knowledge is what actually creates the PLE.

Not surprisingly, the choice of tools also changes with the evolution of technology: [Barrett \(2009\)](#) associates PLEs with e-portfolios; [Williams \(2008\)](#) mentions social bookmarking and virtual worlds (Second Life) as part of the applications commonly used by students; [Drexler \(2010\)](#) proposes the construction of PLE through blogs and Google Reader among other applications; [Chatti et al. \(2011\)](#) proposed PLE based on mashups, and [Conde-González et al. \(2014\)](#) associate them with mobile learning.

The advances in technology and the emergence of Web 2.0 tool, the increasingly widespread access to it, the view of the learner as a central actor in his or her learning process, and a social constructivism perspective on learning have all allowed for the emergence of the Personal Learning Environment as a concept that requires further investigation. The main driver behind the research reported in this paper was to develop an understanding of how learners appropriate these tools and how they can be used to enhance and support their learning processes, providing them with the freedom to choose and personalize their learning process, while at the same time helping teachers maintain a coherent approach to teaching within the confines of formal education programs.

## 4. Methodology

The main objectives of the project were:

- 1) To help students incorporate Web 2.0 tools and services for formal studies. Although a large majority of students enter university with prior Web 2.0 experience, their use of such tools and services is usually confined to creativity and entertainment ([ECAR 2007](#); [Trinder et al., 2008](#); [McLoughlin and Lee, 2008](#)) Students need help to extend their knowledge of Web 2.0 for learning.
- 2) To guide students in their learning to use Web 2.0 for lifelong learning. By helping students to develop a personal learning, research and networking space, they will be able to access and update their learning material regardless of their geographical location, and stage in their life and career.
- 3) Preparing HE students for future employment. The role of learning and development is becoming more important in corporate and professional life. Students familiar with Web 2.0 tools and services hosting formal and informal content that is portable across the education/employment frontier will be well placed for future employment.

The main questions aligned to these objectives were:

- How can PLEs help learners improve their learning process in a formal education environment?
- How can PLEs help practitioners in a formal education environment?
- How can PLEs be used by learners to support lifelong learning?

Following the design based research approach, the research project, carried out from 2008 to 2016, consisted of a methodology divided into two main phases.

- 1) Proposing a **conceptual framework** for developing PLEs (2008–2009).
- 2) **Implementation** of the PLEs in a HE setting. This phase involved a **pilot study** and **two iterations**. **Data** on students’ use of PLEs were also collected during this phase.
  - 2008–2009: pilot study and data collection.
  - 2009–2010: First iteration of the Project and data collection.
  - 2010–2011: Second iteration of the Project and data collection.

In addition, a set of follow up interviews and testing in other contexts were carried out which helped the development of guidelines for using PLEs (2012–2016).

In summary, the project started with a conceptual framework for the development of PLEs based on Web 2.0 tools. A pilot test was then run to test and refine this framework in practice before implementing it in a subject taught by the first author of this paper. The pilot test and successive iterations were conducted at a Higher Education institution, in the context of a Business Administration programme. The first author of this paper was directly involved by being the teacher leading the subject that provided the context for the project. The project ran until 2011, in successive iterations. The use of Design Based Research allowed enough flexibility for working through consecutive iterations of this intervention, while providing a structured approach to analyze the outcomes of each stage and implement the necessary changes and modifications required for the subsequent iterations based on the feedback and results (See Fig. 1).

During 2009–2012 the project ran in parallel with a separate, but connected, intervention in a secondary education setting. From 2012 until 2015, the proposed methodology was also tested in other institutions and contexts of learning. These interventions, which are not the subject of this paper, contributed to the formulation of the final set of guidelines presented here. Between 2015 and 2016, a set of interviews was conducted with some of the participants in the project.

4.1. Phase 1: Proposing a framework for developing personal learning Environments using Web 2.0 tools

The framework was based on the idea that learners could manage the various components of their PLE by choosing an application as a “hub”. Using such a hub as the centre of the PLE has many advantages: potentially users’ easy to access their collection of Web 2.0 tools; management of different logins and passwords; in some cases, the ability to share data between some applications that compose the PLE. Four potential approaches to building a PLE with Web 2.0 tools were identified, according to the choice of hub. These were all chosen based on the authors’ experience and observation of the existing Web 2.0 ecosystem in 2008–2009.

- Wiki-based PLE (Google sites)
- Social network-based PLE (Facebook)
- Social aggregator-based PLE (Netvibes)
- Browser-based PLE (Flock)

It is important to note that the project framework was proposed and developed between July 2008 and April 2009. Therefore, several tools and services mentioned in this discussion are no longer available (such as Flock, for example), and some services that are relatively popular nowadays (Pinterest, for example) are not included, as they did not exist at the time or its use was not yet widespread. Although the use of smartphones was on the rise during 2008–2009, but not yet as high as it is today. Therefore, while PLEs on mobile devices was explored as an emerging trend whose impact would continue to increase, smartphones were not considered as a hub in this framework. An examination of papers published during the last decade shows other proposals for implementing PLEs based on tools that at the time were popular or were expected to be adopted in educational settings, such as e-portfolios (Barrett, 2009), social bookmarking and Second Life (Williams, 2008), blogs (Drexler, 2010), mashups (Chatti et al., 2011)

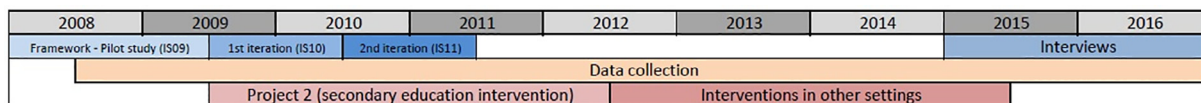


Fig. 1. Timeline of the project (in blue) and other interventions (in red). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

and smartphones (Conde-González and García-Peñalvo, 2014).

Some considerations of the approaches chosen for this framework are:

- Users do not need to pay for a license/a subscription fee to ‘use’ a PLE, since it is built with tools and applications that are available free on the Internet.
- Support might vary between the different applications
- The learning curve for the applications will be different (some applications will take more time for the users to master them than others)
- There is a need for users to constantly update their knowledge of the tools, as the tools themselves are being improved and upgraded. This “learning how to use the tools” precedes any learning that might be done with the tools (JISC, 2007).
- The choice of a Web 2.0 application as the starting hub of the PLE means that the PLE depends on the availability and stability of this tool. Alternative paths should be provided in case a particular tool is not available at any given time. The “hub” should only be used for convenience of access and login to various applications, but not as the central repository of files.

#### 4.1.1. A wiki-based PLE: Google sites

Barrett (2007) discussed how some Google tools may be connected; she also explained how to add and connect these tools to create e-Portfolios (Barrett, 2009). This idea was considered as something that can easily be expanded to create a PLE, due to the intrinsic connectivity of the various Google services.

#### 4.1.2. A social- network based PLE: Facebook

A Social Networking application (e.g., Facebook) was also considered as useful as a hub for a PLE. One advantage of this approach is that a high number of users are already a captive audience as regular users of Facebook.

#### 4.1.3. Aggregator-based PLE: Netvibes

Netvibes is an aggregator that allows users to connect a variety of Web 2.0 tools and access them from one site. It offers connectivity with a wide range of tools, and it adds the social element by providing connections (“Widgets”) to Facebook, [del.icio.us](http://del.icio.us), Flickr and other applications.

#### 4.1.4. Browser-based PLE: Flock

Flock was a Firefox-based browser that offered full integration with a number of social-networking sites, as well as with blogging tools. It could also collect information from feeds, allow users to share text, pictures and videos, and be integrated with bookmark and photo storage services. It was included in this framework as an example of a browser-based hub, but the site was closed in 2011.

Web 2.0-based PLEs are by definition dependent on technology, which also means they are subject to the phenomenon of technology transience. One of the issues with so-called new technologies is the fact that there is no guarantee that a given tool will be available over a given period of time. Online services today are created and disappear at a dizzying rate, applications quickly evolve or are replaced, and new users follow early adopters as they move on from one big product launch to the next. This is nothing new: old models are replaced, new technologies make others obsolete and consumers crave the “best next thing”.

The impact of technology transience on this framework is clear: it makes it dynamic by definition. This was one of the main reasons why during the pilot stage of the project we decided not to discuss the framework with the participants until after they had started creating their PLEs. The actual usefulness of the framework was to help us classify the approaches used by the students, identify the main advantages of each one, and pinpoint limitations and disadvantages.

### 4.2. Phase 2: PLE implementation (Pilot study and first implementation)

The project started with a pilot study, which was conducted between September 2008 and May 2009, with a group of 33 students (labeled as **IS09**) from a Business Management programme. Two additional iterations took place during the 2009–2010 (**IS10**) and 2010–2011 (**IS11**) academic years. The first author of this paper played a dual role as researcher and teacher, guiding the students in the development of their own PLEs, while gathering empirical evidence on the students’ engagement with PLEs.

The subject in which the project took place was called Business Information Systems. The learning outcomes of this subject were to help students understand the scope and range of information systems available to support business processes; show students the importance of digital literacy in today’s business world; and introduce students to the development of web-based projects, and allow them to estimate the hours and efforts required for the successful completion of such projects.

#### 4.2.1. Introducing students to Web 2.0 tools and applications

Discussions with students at the planning stage of the pilot study revealed the students’ interest in learning and using Web 2.0 tools, which gave rise to a bottom-up approach to introducing PLEs and changed our approach to testing the framework.

During the first part of the academic year, a range of Web 2.0 tools were gradually introduced to the students. The first one was Twitter; it was the only one presented by the teacher, and was suggested as a new channel of communications for the class. By the third week (the class was scheduled for a weekly, two-hour sessions), 90% of students were using Twitter as their main channel of communications, not only for academic purposes, but also for social and casual chat. The engagement and participation varied during the semester, showing peaks of activity around exams and school events.

After the first session, the Web 2.0 tools to be considered and discussed were suggested by the students themselves, either because they were already using them and thought they could be interesting for their classmates, or because they felt the need to learn a specific tool; it was made clear to the students that they were free to choose whichever tool they felt was the most appropriate for their situation. Thus, Flickr, FriendFeed, Clipperz, Jooce, RSS, Blip.fm, last.fm, MOG, Blogger, Picasa (among others) were all discussed, and some of them were used in class activities or online e-tivities (Salmon, 2002). This way, instead of following one of the four approaches in our framework, students were free to choose their own combination of tools, and had to make decisions about organizing and managing them. This made for a more enriching experience, both for them as learners and us as researchers: students “discovered” the concept of PLEs, and used their own ideas and proposals to develop them.

4.2.2. Creating “Web 2.0 diagrams”

At the beginning of the 4th month of the academic year, students were asked to draw pictures of their “ideal” work environment, based on Web 2.0 tools, or any other tools they used: this was called the “Web 2.0 diagram”, and was designed as an introduction to the concept of PLEs. It was made clear that this exercise was not limited only to the tools and applications that they had been using during the previous months, and it was also emphasized that this environment should not be restricted to tools, platforms or applications that they already knew: it was rather focused on their objectives, the way they used the tools, and their needs.

The participation in this activity was optional, which resulted on 10 students dropping out of the study. They pointed out that they were not interested in PLE activity because it was not a graded activity. Two of these students were not interested in creating their PLEs because they were neither “heavy nor frequent” users of these applications.

As the project continued, three students from the original group transferred to another school, while an exchange student joined the class and the study. Therefore, the group of students who were actively engaged in developing their PLEs (which were still being referred to as “Web 2.0 diagrams”) became 21 students. Of these, 6 submitted very simple diagrams, showing only the tools they used while 8 students went so far as to attempt to establish links among the tools, and even checked which of those links actually existed.

Students’ proposals for creating PLEs (“Web 2.0 diagrams”) covered a wide range of approaches: 8 students proposed a platform or web service that would allow them to access their collections of tools, and most of them pointed out that some kind of one-time, safe access should be provided as part of the service. One student called the diagram his “personal page of everything” and included not only the tools he used for academic purposes, but also the ones he used for leisure, or communication with friends and family. His diagram matched one of our approaches – The browser-based PLE. Some of these diagrams are shown below, with some comments (See Figs. 2 and 3).

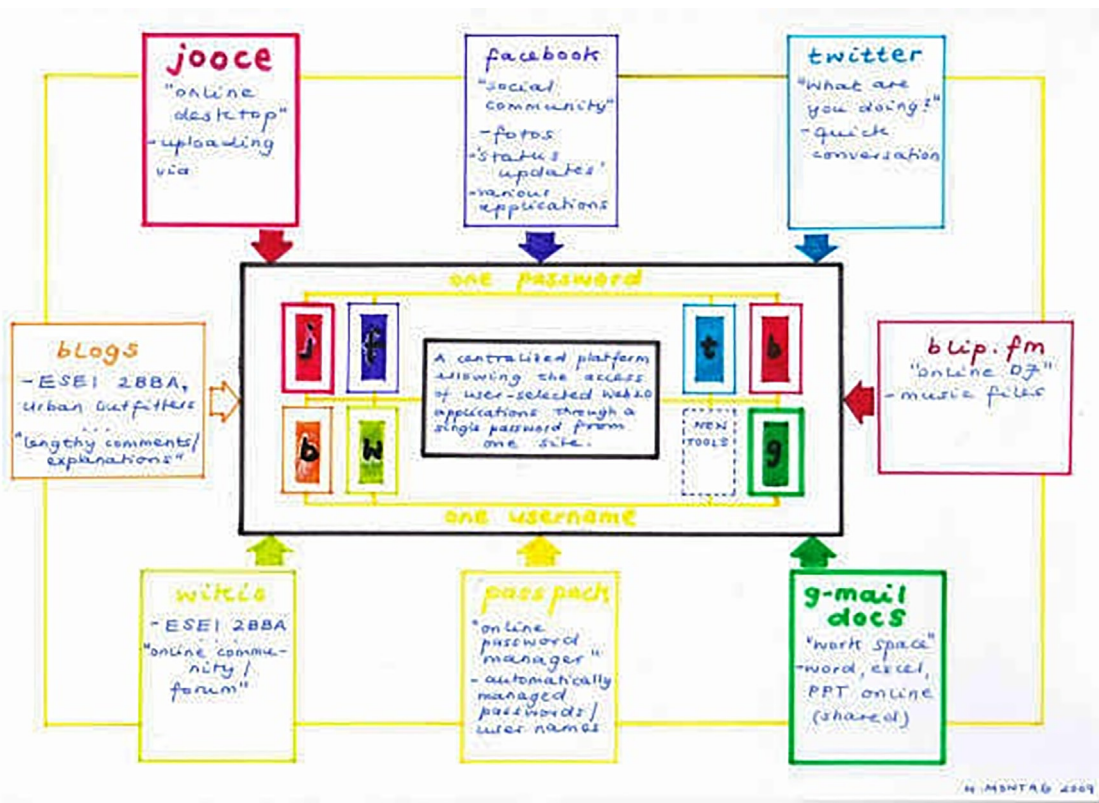


Fig. 2. One-point access, interconnected Web 2.0 tools. “A centralised platform allowing the access of user-selected Web 2.0 applications through a single password from one site”.

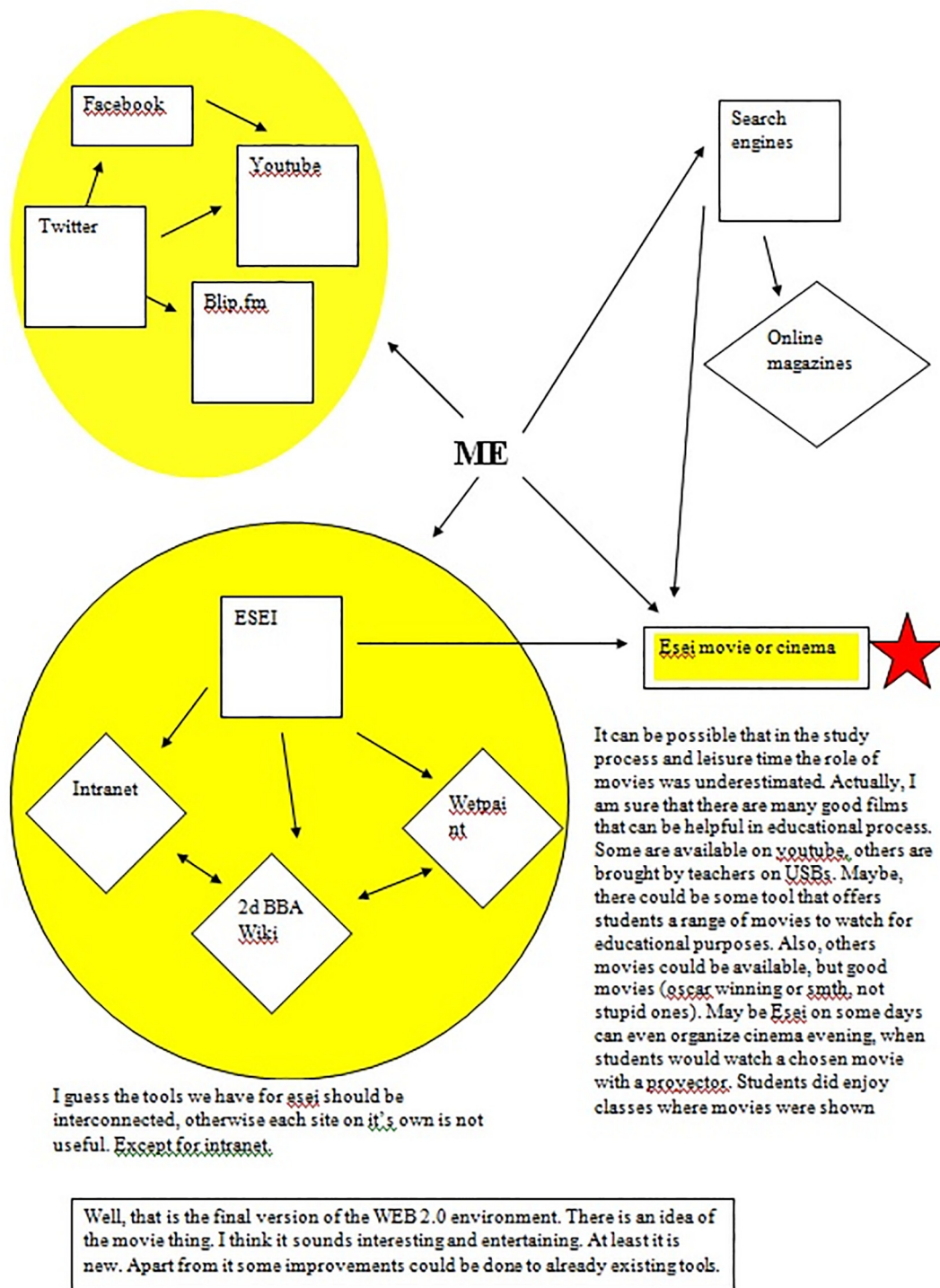


Fig. 3. A diagram showing how different environments are related (social media elements vs Intranet/VLE). The student puts herself at the center of her PLE.

Contrary to what we expected, given the increasing popularity of Facebook at the time of our study, the Social-network approach proposed in the framework was not considered by the class, and that not a single student thought of using Facebook (or any other social network) as a hub for their diagrams. Those were still early days for Facebook, which has now have a membership of 2.2 billion

users (as of January 2018) (Facebook, 2018). Several students who participated in the study did not have accounts on the social network, and there were a few that have not even heard of it. Some of them joined Facebook after it was mentioned by their classmates during the discussions, or because other tools provided access to it: “one thing I started using through Flock is Facebook [...] I started to have conversations with classmates, friends and even teachers“. To put this in perspective, all the new students enrolled during the Fall of 2017 semester (95 in total) had an account on Facebook, except five. Still, a survey revealed that around 60% of them regard it as not important in their learning process. So, even though Facebook has become one of the most popular social networks, there is still no clear evidence that it plays an important role in learning.

This part of the study was completed before introducing the concept of PLEs to the class; the purpose behind this was that they “designed” their PLEs before discussing the concept, and were not forced to follow a particular framework. In fact, one of the most interesting moments during the pilot study experience was when the students were explained the PLE concept and realised they had already built one. This also confirmed our decision to follow a bottom-up approach and not discuss the PLE concept prior to the students testing of Web 2.0 applications, and supports the view of PLEs as a framework rather than as objects. Here, the main outcome was not the PLE as such, but the learning process which led to the students’ discovery, testing, integration and adoption of a variety of Web 2.0 services which organically created their PLEs.

#### 4.3. Development of PLEs

During the last part of the study, the PLE concept was introduced and explained, as well as the proposed framework and the four approaches. Students were able to compare the “Web 2.0 diagrams” they had drawn with the framework approaches; at this point, they were asked to develop their PLEs, either based on the diagrams they had proposed, or following a particular approach presented by the teacher, or using a combinations of them. This process was later discussed and reflected on in their essays.

At the end of this phase, out of the 21 students, 17 had built or developed a PLE, while 4 students reported that they did not see the usefulness and chose to drop out of the study. Overall, the active participation rate was 50%.

#### 4.4. Reflections of learning – essays and interviews

The final stage of the study, at the end of the academic year, involved writing essays based on their learning experience of developing PLEs.

These essays were analysed and based on the initial coding of text, a first round of interviews and surveys were conducted both face-to-face and through e-mails, in order to go deeper into certain themes developing through the initial analysis of essays.

The analysis of this qualitative data was done through coding, a technique based on classifying the data items according to categories and topics (Bryman, 2012). In this study, the coding showed several common themes that emerged from the data collected. At the end of the process, four main categories were identified:

- **PLEs as organization and management tools.** This category groups items which were initially assigned to more general categories, such as “organization”, “classification”, “complexity”, “information” and “sources”.
- **PLEs’ role in strengthening of social interactions.** Includes items that were coded as “networking”, “group”, “relationships”, “teachers”, “discussions” and “social”.
- **PLEs in the learning process and development of skills.** Items that were coded as “abilities”, “skills”, “learning”, “knowledge” and “learning” were included in this category.
- **Problems, obstacles and suggestions.** A final category that groups items coded as “pros”, “cons”, “advantage”, “disadvantage” and “recommendations”.

A second round of coding showed evidence of the students’ awareness of the personal dimension of PLEs and their perception of PLEs as dynamic environments.

Following this preliminary analysis, the students were contacted twice for a follow-up interview, either face-to-face or by email. The questions were formulated in such a way that the evidence for the categories that emerged from the coding process could be verified and we could go deeper into points that were not clear in the essays, and to elicit new data from them.

The interviews were based on 4 questions, which were modified or complemented according to the responses:

1. How/What was your learning process using Web 2.0 tools and PLE? We want to know exactly how do you think PLEs and building them helped or changed your learning process/experience.
2. How did the PLE concept help working with so many different tools?
3. How did the PLE + Web 2.0 helped in the learning of the subjects contents? (as opposed to learning in general)
4. Do you still use: – Web 2.0 tools? – Your PLE?

#### 4.5. Next iterations

During the first iteration of the project, the IS09 class (the group that participated in the pilot study) was in their 3rd (and final) year of the degree. Two more groups were included in the second iteration of the project: the students that enrolled for their 1st year (IS11) and the students that were beginning their 2nd year (IS10). In order to do a follow-up, a survey was sent to the students that



participated in the pilot (IS09); 13 of them answered it. According to them, 10 students said that they still used their PLE, and rated it highly (4 out of 5) as a useful tool for organizing and managing content, learning new information and skills, supporting their interactions with other members of their network, and overall, as an important tool both in their learning process and their jobs and internships.

The IS10 group was introduced to the Web 2.0 concept, and explored some tools such as Flickr, [del.icio.us](http://del.icio.us) and [Blip.fm](http://Blip.fm). At the start of their second year, a wiki was created and used as a central resource point for the whole class. Most of the online subject-related discussions were held through the website; Twitter was also used, but less frequently than in the case of IS09. This seems to indicate that, regardless of the choice of application, the communication need is there, and that as long as it is channeled through at least one medium, it does not matter which one is being used.

The last group, IS11, was the only group to propose the use of a social network as a main “center of operations” for the class, through Ning. It seems that the more evident social aspect of this tool helped most of the students develop and strengthen the interactions with their classmates, with the whole class working in a collaborative fashion. It also helped that the group was much smaller (only 15 students) compared to the other groups that had participated in the study, such as IS09 and IS10 (both with 31 students each).

The experience from the project showed that the creation and use of a Web 2.0-based PLE was perceived by most of the students as positive, and added value to the learning process.

## 5. Results and discussion

The analysis is based on the data collected through surveys and interviews with the participants. The coding categories that emerged from the analysis are illustrated with extracts from the surveys and interviews.

### 5.1. Evidence of PLEs as organization and management tools

Most students reported a sense of chaos and confusion regarding the wide range of Web 2.0 tools and the need for some way of organizing them: “there is such an overload of tools today that we need some kind of organizer for them”. The PLE approaches discussed with them gave these students suggestions and ideas, and most of them came up with some way of managing the Web 2.0 applications and tools. In this sense, building a PLE gave them a way of structuring their digital identity and tools. As two students noted, “I really support the use of PLEs, because it can help me to share information and exchange many things through the Web 2.0 tools”, and “[a PLE] is an easy way to manage and organize all the information I get from online sources, and also offline ones”. Flock was repeatedly mentioned as a useful tool for centralizing the applications and offering a one-stop access to them, and at the same time a way of dealing with logins and passwords, as the following comment shows: “Flock has taken it to another level for me, by centralizing all my different [web] stops that I do in one page”.

Most students took into account non-digital components as part of their PLEs, and also noted that the tools included were not only academic. As one student noted, “this is not only my PLE but also my PEE (Personal Entertainment Environment) and PSE (Personal Socialization Environment)” which points to the fact that he did not see a clear division between academic and social activities, and was also evidence that his learning process went beyond the walls of the institution. Some of the advantages of developing a PLE mentioned by the participants were:

- The ability to organize and manage data and content, as well as the access to new sources of information, and the tools and applications they use to access them: “PLEs increased my level of learning opportunities, as I don’t miss anything in [the] news’ perspective”.
- An approach to integrate the tools they were more comfortable with and the new tools they were being introduced to, and that seemed to be potentially good resources.
- Help in filtering information, allowing them to pick out only the most valuable information.

### 5.2. Evidence of strengthening social interactions

The social element was one of the most important aspects of Web 2.0 tools. According to the students, the collaborative approach followed in this class through the use of the wiki and blog, together with microblogging and social bookmarking transformed the learning process, by increasing the learning opportunities and the availability of useful resources. By sharing information with their peers, they could help them in their learning process, and in return get additional resources and information on applications they did not know about, thus creating a network that would extend beyond the university and onto the professional world. Students’ comments such as “*I am developing a network that most probably will become extremely valuable in the near future*” reflects this fact. Other comments regarding the creation of a network and developing social interactions with their classmates and the teacher were: “*what I like the most about all these Web 2.0 tools is the ability to get inspiration, knowledge and to be able to interact with other people*”, and “*the social element has had a large impact in my learning process, helped me to create stronger links with classmates, friends and teacher because you interact more and put your opinions forward*”.

Two of the advantages that were highlighted regarding social interactions were:

- The ability to share and discuss different points of view, following the fact that Web 2.0 tools seem to be ideal tools to collaborate,

and share and create knowledge.

- Exchange of ideas with fellow students and teachers taking place in class, but also outside of the learning institution, through the discussion of concepts that was taking place online.

### 5.3. Evidence of learning and developing skills

Although some students were familiar with Web 2.0 applications, most of them did not realize they could use them in their learning process. A high percentage of them (about 65%) were Facebook users prior to the beginning of the study, but none of them had used Twitter or *Delicious* before, or any other microblogging or social bookmarking tools, as noted by one of the students: “I have been introduced to tools I do not think I would have been using already now, if it was not for this project”. They did use blogs as a source of news (mostly on entertainment, news or specific interests), but very few of them knew what RSS were or how to use them.

There were many comments regarding the effect PLEs had on their learning process, and the skills developed as a consequence of building a PLE: “a proper working PLE decreases the level of stress and increases the opportunities to learn”; “a well-developed PLE can lead to enhanced self-learning”, and “[PLE] has changed my personal learning process”. Some of the benefits they reported were:

- Web 2.0 tools made the learning process more dynamic and interesting
- It helped them in transforming information provided in class and course textbooks into knowledge, as discussions forced them to reflect on the concepts covered in class
- The fact that they could use their PLE not only in a formal context, but also outside the school, where –in their own words- “a lot of the learning takes place”.

### 5.4. Disadvantages and recommendations

The students were also asked about any particular problems and obstacles they might have found during the pilot study. Following is a summary of their main points and recommendations.

- The activities can sometimes be confusing – A “big picture” is required from the start. This is still a difficult issue to tackle; the discussion of PLEs as a concept at the beginning of the study was avoided on purpose, to avoid leading the students in choosing one of the framework approaches, thus limiting their creativity and options. More guidance and support might be useful during the initial phase of creating accounts and trying the tools.
- “Creating a PLE can be too time-consuming.” This of course depends on the approach and the applications chosen, and the student’s experience, but it might indeed be a complex task. It is important to explain the advantages of an organized environment, and that the benefits outweigh the disadvantages. Self-reflection exercises may help students realize the potential of their PLEs.
- “Some tools cannot be tailored to the users’ needs.” This comment was made with reference to Flock’s limitation for adding tools other than the ones already provided with the browser, as well as the limited tools found in Google sites. There is no easy solution to this, and although efforts are being made to develop widgets and applications that are more flexible and can “communicate” with each other, there is no “perfect” tool. The convergence phenomenon and smartphones could provide an answer to this issue.
- Interoperability. Some tools do not “speak” to each other, which makes it hard to integrate them into one environment. As with the previous comment, this is a technological issue that we hope will be solved in the near future. As of today, though, it is up to the students to find those tools they feel more comfortable with and that can be adapted to their needs.
- Adoption problems. These were mostly related to student’s experience with technology and Web 2.0 tools. Context helps and, whenever possible, the use of the tools and applications that make up the PLE should be related to their experience and environment.
- PLE might lead to distraction from academic work. This is, according to some of the students, a consequence of mixing academic and “fun” tools. Students still see a marked difference between these two environments, as reflected in one of the comments: “the Facebook approach [to PLEs] is ‘too social’.
- Technology issues. This was mainly mentioned in reference to system failure (down time) of some of the tools, like Twitter. They also mentioned the lack of support and the differences between the tools – while some of them are easy to learn and adopt, other tools require more time and practice. This, again, reflects their different backgrounds and experience with this kind of applications in the context of learning.

### 5.5. Personalisation

The students seemed to like the range of options available to them and the fact that they could choose the applications that better suited their needs, and adapt them to some degree: “I took the tools that I liked the most and the ones I thought would help me more while studying, and in that way now I think I know and I feel better when researching and learning from different topics.”. They also saw value in being able to take services that they were already using and integrating them with some of the new tools they had discovered: “By combining my already customized iGoogle with Flock, my PLE provided me with nearly everything I needed for private and study purposes.”

They also acknowledged the fact that the approach helped them learn in a more independent fashion: “What is nice with PLEs is that you can organize the tools after how you want them, and by that you can learn in your own way, the way you are structuring them.”

### 5.6. Dynamic nature of PLEs

The participants realized that PLEs are constantly changing, in the form of updates, addition of functions and tools, and removal of some features. This is a consequence of the continuous changes and transformation of the digital landscape: *“This conception of what I believe to be useful to me changes though, which means that every now and then I will remove an element from my PLE, or add one to it. This could be because I had a tool ‘on trial’ which turned out not to be to my liking, or because I learned about something new that would add real value to my PLE. Another possibility is that my view about a tool has changed since having heard about it.”*

During the study they discovered new tools, and sometimes adopt one just to stop using it later in favor of another service that better suited to their needs. They showed, for the most part, a remarkable ability to learn new tools without having to be guided through the learning curve. But it was the wider view of the PLE concept, the integration with other tools, the peer learning and collaboration and the teacher’s guidance what really helped them move through a range of applications without major obstacles: *“The huge part that has changed in the way we have done things during this course is how we communicate what we are learning, and how we discuss this among us. I believe this will become the future of how learning and most of all how teaching will be implemented. A larger wave of integration in the learning will come out of this PLE and Web 2.0, and I think the teacher will evolve into a facilitator more than an autocratic teacher telling us what to do.”*

A phrase that sums up their view of technology in today’s society and reflects our view of the role of technology in the classroom is the following: *“How can you not use Web 2.0 tools in the current Internet environment? That is really the question.”*

This reinforced the initial approach: introduce the students gradually to different Web 2.0 tools applications, guiding them in the creation of their PLEs while not discussing the concept until later in the year. This way, students do not feel the pressure to choose one of the framework approaches and are free to come up with their own solutions and combinations.

### 5.7. PLEs to support lifelong learning

The duration of the research allowed sufficient time to conduct follow-up interviews with some of the participants in the pilot study, now young professionals in diverse areas of work related to business, such as finances, marketing and management; these were carried out during 2016 and 2017. While the number of answers is not enough to draw conclusions (just 15% of the original participants), it does provide some empirical evidence to support the idea that PLEs could be used to support lifelong learning activities.

The semi-structured interviews were focused on three main questions:

- Did the introduction and use of the PLE concept and the activities around the creation of it had proven successful when carried on to their professional lives?
- If yes, could they provide specific examples related to skills, management of information, social interactions, any other? If no, why?
- Other comments about the applicability of their experience in their professional field and/or further learning.

The respondents were unanimous about the positive aspects of their learning experience around and using PLEs during their degree. According to one, “being an early adopter of these technologies helped me understand network dynamics and the motivations behind people’s use and sharing of information”. For another participant, the use of Web 2.0 tools and services in the context of the study allowed her to more easily transition “from using widely available applications to the corporate proprietary tools” and “was and still is a great help in building my knowledge and capability base”.

Professional environments seem to have somewhat limited the use of some of the components of their PLEs. As one of the interviewees explains, “I have not been able to apply the tools at work, due to the internal IT structure and system, [but] I have been able to apply those tools in my private life, mainly to save time and stay more organized. The awareness [about] and ability to create/use a PLE helped me immensely during my MBA studies.” He goes on to say that his PLE “[...] not only allowed me to stay connected with my study colleagues and enhanced the work with my team members across the globe, through collaborative work, but also eased research activities and simplified all administrative tasks.” These results point to the potential of PLEs for both lifelong learning and application on a professional level, and opens up avenues for future research.

Based on the results from this study, the following set of guidelines was proposed to help both learners and practitioners in the use of PLE to support their learning, and in the specific case of teachers, their practice. The guidelines are explained below:

Guidelines for helping learners develop a Web 2.0-based PLE

- **Focus on the What and Why, not the How.** Learners need to be encouraged to consider their individual needs and interests, to list these, and then attempt to find (and share) solutions for them. Well-designed online activities (e-tivities) can help participants practice with the tools and applications that are being explored-
- **Start with a safe space.** Start by creating a small community in which students feel safe and are not afraid to try applications and make mistakes. Once the space is established, use it to explore connections between the different applications and functions, between the tools themselves, and with other networks.
- **Put an emphasis on sharing.** Once a community is established, encourage the students to share information and interesting resources and links within it. New channels of communication and ways of applying what they are learning might thus be discovered. Take advantage of applications that allow users to share resources, such as *delicious* and *Diigo*. Common interests help

create bonds within the group and help in developing a Personal Learning Network (PLN).

- **Encourage and reward participation.** Do not limit information to what students find, but encourage them to share original contributions, either individual or in groups. These contributions can be focused on content, but can also include comments and suggestions about the tools and applications currently being used.
- **Let the students explore their own paths.** Be flexible with students as they build their own PLEs. The steps described here should not be considered sequential in nature, and will probably change based on each student's background and experience. It is useful to provide advice about “container” tools (such as the PLE hubs proposed in the framework), so participants can explore different options or develop their own ideas about connecting and managing the applications that make up their PLE.
- **A “learn to learn” approach works better than learning specific tools or services.** Learners should be guided as they test new tools, assisted in identifying common features, trained in how to obtain help when needed and to solve basic problems, and encouraged to find new ways of achieving their goals and objectives.
- **Expose learners to families of services and tools, not just a single one.** For example, discuss the advantages of social bookmarking by comparing *Delicious*, *MrWong*, *StumbleUpon* and *Diigo*, so learners can make informed choices on the tools that are best suited to fit their needs, and not the other way around.
- **Propose alternative solutions and uses for tools that they are currently using.** Even though some services have been developed with a specific purpose, most of these services share basic features. For example, Twitter could be used to save resources for later use via the Favorites option, even though its primary function is to support microblogging. The Save option on Facebook would achieve the same purpose. Facebook may also be used to create photo albums and share them with a community, but Flickr, Instagram and Pinterest serve similar purposes.
- **Accept that change is something inherent to the nature of PLEs.** Change can be disruptive for users who are accustomed to a specific tool or application, but can also open a new world of possibilities. Most services allow users to download the information and the content users have created and stored in them; learners should be aware of compatibility issues and Export/Import options for the services they use, in case there is the need to switch between PLE tools at various points in time.
- **Stress the importance of support networks.** We are not alone in the learning process, and as access to the Web and the Internet increases, it is easier than ever to connect with other users and become part of a network. Changes in technology affect not only individuals, but also whole groups, so we can help each other by sharing experiences, advice and tips.

## 6. Conclusions

This study has shown that PLEs have the potential to contribute to learning in general. The diversity of tools that make up a PLE allows for flexibility across a broad range of contexts and learners. Web 2.0-based PLEs have several specific advantages in the context of learning. In a PLE, reflection could take part in several ways, including blog posts, microblogging, collaborating on a wiki, and more.

Motivation may also be increased, because the student is actively involved in the learning process. Instead of being a receiver of information, the student becomes the protagonist of the learning experience: the Web 2.0 approach puts an emphasis on user-created content. The multiple channels of communication allow students to start and participate in dialogues, and to ask and answer questions. The result is an increase in participation and control over the learning process.

In such an environment, the systems being used provide access to a large pool of additional information that can be used to support and complement the material being covered. Although students may start at the same point using a common source of content, the learning process may then become divergent between learners, the PLEs being personalized according to the interests and learning styles of each learner.

Learners in a group seldom have a homogeneous profile. It makes sense to try and personalize the learning experience as much as possible. As this study showed, PLEs provide an excellent tool to meet this requirement. Although learners have access to the same content (hence ensuring that the quality of the material is constant and homogeneous for every participant), the actual processing of the information can be managed by each learner using a unique own set of tools, allowing each learner to tailor the learning process to their own needs and circumstances.

Regarding the approach used to introduce the services and applications to the learners, there were divided opinions on whether the PLE concept should have been presented earlier in the process. While some of them thought that they should have been given a “big picture” and a clear purpose of how can Web 2.0 tools be incorporated and integrated, others thought that the hands-on, do-it-yourself approach actually made them become more familiar and knowledgeable with the applications, and that the “chaotic” situation forced them to come up with solutions on their own. The social element was observed not only in the collaboration online and the increased communication, but also on a “network effect” with some of the tools: adoption of these was in some cases motivated by some of their peers; since they saw their classmates trying some of the applications, some of the students decided to join and try them too. Word of mouth and comments were also effective in bringing some of the students on board.

One of the main conclusions of the study was the fact that, in the end, the choice of hub for the PLE and the specific tools that the student adopts are not the end result nor the most important point in the experience: it is the journey itself, the way they discover and try new tools and applications, how they use them to share and collaborate, and how they take on a “prosumer” approach, learning together, even teaching each other. Teachers become guides in the learning experience. This represents an important transformation in the teaching and learning process, and puts an emphasis on the social aspects of it.

The proposed guidelines aim to help teachers in introducing ICTs in their practice, and at the same time help and guide their students in building, developing and maintaining their own PLEs as part of their learning process. They include different elements to

be considered, but the key message is to focus on needs and how they are fulfilled by various applications, but not on the applications themselves.

When building their PLE, learners also reclaim ownership of the learning process, and take on a more active role in the management of their learning. One of the participants in the project, when interviewed five years after participating in it, stated that when choosing amongst different options to create a discussion space for an ongoing project, “*my experience from what we had done in University and in class, working with different tools, helped in the evaluation phase and my analysis on how the users would or would not take advantage of the discussion space given*”.

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