CONSTANT CHANGE
The Ever-Evolving Personal Learning Environment

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There are several definitions for the term *personal learning environment* (PLE); in this article, PLE refers to a group of web technologies, with various degrees of integration and interaction, that helps users and learners manage the flow of information that relates to the learning process, the creation of knowledge, and the development of skills.

INTRODUCTION

In this article we examine the effect of technology transience on the development and use of personal learning environments (PLEs). To help us do so, we use the case of delicious, a popular online service used in the educational area, which came close to disappearing in 2010 after Yahoo, the owner of the tool, announced the company would be no longer continue support for the system. After deliberation, it was decided that Yahoo would put delicious up for sale, and the tool eventually was acquired by AVOS, whose aim was to improve the service while trying to maintain all the characteristics that made it such a success with previous users. In 2014, AVOS sold delicious to Science LLC.

Other tools have been less fortunate. Examples such as Google Reader, Twine, Flock, and Jaiku, have all experienced the effects of technology transience. What happens in such cases? What is the potential impact within our PLEs as a result? And what can be done to mitigate the effects of technology transience? After presenting some of the history surrounding the example of delicious as well as other tools, we conclude by developing some suggestions based on our own experiences working with users and helping them create their own PLEs and assist those who guide others in the construction of PLEs.

PERSONAL LEARNING ENVIRONMENTS AND TECHNOLOGY

Personal learning environments are a relatively new concept that entered the educational dis-

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course in the early 21st century. The first and most pronounced driver toward the PLE approach arose partly as a consequence of a shift in the focus of technology-supported learning from instructor-designed virtual learning environments toward a more learner-designed and learner-customized environment through the use of free Web 2.0-based Internet tools. There are different definitions for the term, probably because of the "personal" aspect of PLEs; a PLE may be described as the set of tools, data sources, connections, and activities that each person commonly uses in order to learn (Adell & Castaneda, 2010). Van Harmelen (2008) suggests that a PLE is composed of the computer-based parts of what he refers to as the "learning ecosystem." In this article we will discuss technology transience in the context of Web 2.0-based PLEs, that is, personal learning environments built using services and applications that follow the Web 2.0 approach (Torres, Edirisingha, & Monguet, 2012): a group of web technologies, with various degrees of integration and interaction, that learners use in order to manage the flow of information that relates to their learning process, the creation of knowledge and the development of skills.

The second main driver for interest in PLEs was the emergence and widespread use of Internet-based tools and services collectively known as Web 2.0 tools. The term "Web 2.0" was coined by O'Reilly and captures a "trend toward greater creativity, information sharing and collaboration amongst internet users" ("Innovation," 2008, May 3). As Mason and Rennie (2008) noted, podcasts, wikis, blogs, social networking sites, social bookmarking tools, and many other Web 2.0 services enable an increased participation of users in the creation and sharing of content, and the communication and interaction with others, and are thus of interest to a variety of educational efforts.

A third driver behind the growing interest in PLEs are the policy and pedagogical discourses surrounding "personalization" of learning and learning environments (DFES, 2005); this view is based on the idea that learn-

ing technologies should help learners manage their own learning—including content, mode of delivery, and access—according to their own preferences. Personalization of learning, it is argued, provides the learner with greater flexibility and options for learning. In a PLE, it is the learner, not the teacher, who is in the center of the learning process.

The majority of e-learning (electronic learning) efforts in higher education are based on virtual learning environments, computer software systems that help manage an online learning setting (e.g., Blackboard, WebCT, Moodle, Sakai, and PebblePad). In the last few years there has been, however, a growing trend toward e-learning environments that are based on the notion of the more learner-centric PLEs. Some organizations working with PLEs include the Manchester PLE Project (Hedtek, 2010) and the SAPO Campus project (University of Aveiro, 2010).

The evidence that current higher education learners are increasingly familiar with computers and the Internet is a further reason for the interest in PLEs. There appears to be a widespread belief that the current generation of learners—for which terms such as "Net Gen" learners, "millennials" (Oblinger & Oblinger, 2005) and "digital natives" (Prensky, 2001) are used to emphasise their technological know-how—are more capable of manipulating Web 2.0 technologies than are previous generations of computer users. While it is possible that a majority of these learners are familiar with technology tools, the evidence is not sufficiently strong to suggest that these learners are familiar with employing Web 2.0 tools for formal learning.

FROM E-LEARNING TO PERSONAL LEARNING ENVIRONMENTS

E-learning is a term that gained popularity in the 1980s. It is not easy to pinpoint the exact moment that technology started being used as an educational aid; however, it can be easily argued that paper, pencil, pens and black-

boards all represent technological innovations. In the 1960s, the University of Illinois implemented the use of computer terminals to provide students with resources that complemented recordings of lectures that were available via television or radio (Cuban, 1986); in the 1970s, other institutions tried this approach, and distance education courses were being delivered via television (Hilmes, 2011). By the 1980s, the world experienced a gradual convergence of media, computational and interactive capabilities into a single device, by means of technologies such as videodiscs and CD systems (Alpiste, Monguet, & Brigos, 1993). By the end of the 1990s, the Internet and the World Wide Web had started to dramatically change methods of learning and teaching.

Through the years, several different names have emerged to characterize innovative approaches and technology-supported initiatives: distance education, technology-enhanced learning, multimedia learning, computer-based training, computer-assisted instruction, Internet-based training, web-based training, online education, virtual education, virtual learning environments (VLEs), mobile-learning, distributed learning, computer-mediated communication, and more. The term *e-learning* encompasses all of these approaches, and the word can therefore be considered an umbrella term for this package of approaches.

One of the common characteristics of these technology-based approaches is that information and knowledge are distributed and transmitted following a one-to-many approach, using a combination of channels, devices, and infrastructures (Vaughan, 2010). In essence, the same content, transmitted via various technology sources, is available to all students, of all academic levels, and assists teachers with the delivery of new information. Most recently, the collaboration between educational peers within classes has gained momentum, particularly exemplified by the emergence of massive open online courses, where the number of students involved, as well as the nature of the learning experience, usu-

ally requires not only that participants collaborate and work together, but where, in some cases, massive open online courses may provide a more active role in the assessment of their coursemates' work.

The current nature of innovation cannot be described by considering any single technology or domain, but instead must consider the converging processes among technologies and domains. Quite often, unexpected innovations are the roots of the emergence of games, simulation environments. and creative resources in a "do-it-yourself" model, never before witnessed at its current scale.

Technologies are undergoing exponential growth patterns directly related to Moore's Law (Intel, n.d.), which states that computing power approximately doubles every 18 months, and is one reason why the pace of information and communications technology change is occurring so rapidly. The exponential improvement in digital technologies impacts the cost-performance of three core digital components: computing power, storage, and bandwidth (L. Downes, 2014). Innovations built on top of these core "exponential" technologies have been evolving, and are predicted to continue to advance at unprecedented rates during the upcoming years (Cabrera, 2014). When such "accelerated" technologies are introduced in educational ecosystems, learners interact with and through them, and many traditional educational processes are easily disrupted, resulting in a wide number of changes in the learning setting. Exponential technologies can also result in accelerated innovation, and increase the pressure on companies and organizations to repeatedly change and adapt. This "avalanche effect" amplifies and empowers the combination of technologies, products, and practices in new ways in an endless cyclical process. This is one way that the concept of "technology transience" may be visualized, with ever-shortened technology lifespans further affecting this effect for both users and producers of educational content.

The digital dimension is present in every new advanced development around us, from

3D printing to molecular biology, and is most obviously witnessed in hardware and software development. It is becoming much easier to create new tools and services based on and offered through the Internet, which may in turn be used to construct and enrich (without apparent limitations) the configuration of PLEs. Exponential technologies also have an important impact in the evolution of paradigms: the PLE is also becoming a personal creative space.

It is worth noting that many of the technologies that are eventually adopted for educational purposes were not originally designed with that objective in mind. The adoption of technology in the field of education follows a different pace than in other fields. A good resource for keeping up with trends in technology adoption is *The Horizon Report* (Horizon Report, n.d.). This report is published yearly by the New Media Consortium and is a widely quoted and respected resource. *The Horizon Report*'s main goal is to help individuals understand the impact of new technologies in the fields of higher education, K–12, and museums. First published in 2002, the report has become a useful resource that assists not only in identifying technology adoption trends, but also in describing the nature of these trends over the past decade or so.

The Horizon Report is structured into three "horizons," each based on time to adoption: the 1st adoption horizon—one year or less until adoption, the second horizon—two to three years until adoption, and 3rd horizon—three to five years until adoption. While we lack the opportunity to examine each of the reports in depth, it is worth noting some highlights regarding technologies related to Web 2.0-based PLEs:

- 2007: The first adoption horizon included social networking, while the second horizon included mobile phones.
- 2008: The first horizon included collaboration webs.
- 2009: The first mention of PLEs by *The Horizon Report* may be found in the 2009

edition: "Armed with tools for tagging, aggregating, updating, and keeping track of content, today's learners create and navigate a web that is increasingly tailored to their own needs and interests: this is the personal web" (Johnson, Levine, & Smith, 2009, p. 19). Mobile and cloud computing were in the first horizon.
- 2010: mobile computing appeared in the first horizon, and electronic books in the second horizon.
- 2011: electronic books and mobile technologies moved to the first horizon.
- 2012: mobile apps first appeared in the first horizon.
- 2013: massive open online courses and tablet computing appeared in the first horizon.
- 2014: The recently published 2014 report puts the flipped classroom concept in the first horizon; in this model of learning, the time spent in learning activities is rearranged so class time is spent in active learning activities, while students use the time outside class to go over the information and resources on which those activities are based on. This way, students learn by doing.

Do-it-yourself approaches, personalization, and an ever-growing range of options for learners mean that technology will continue to play a crucial role, not only in the delivery of instructional content, but also in learner communication, discovery, exchange, collaboration, and the sharing of information. In this scenario, reliability and stability of services and applications is a key component of the learning experience, and the issue of technology transience can therefore be seen as a key concern.

TRANSIENCE OF TECHNOLOGY AND ITS IMPACT ON LEARNING

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 Internet and the Web have simply accelerated this process.

The *long tail effect* also means that users have more to choose from. The term was first proposed by Anderson (2004) to describe the retailing sale strategy of offering a large number of unique items, but selling relatively small quantities of each. The concept has been applied to a variety of scenarios, such as online business, mass media, social networks and many others. In the context of online applications and services, application of the concept may demonstrate, for example, that although there are a few "big" players, such as Facebook and Twitter, there are also a large number of alternative services, each with a relatively small number of users [go2web20.net, an index of web applications, lists some 3000 registered tools registered, in categories such as communication, management, search, blogging, collaboration, design, and others]. In such an environment, it is without surprise that one sometimes visits an application that was in operation the prior week (or month, or year), only to discover that not only the application is gone, but also the data stored in it, information, references, and so on, which in the end means that a considerable time and effort have been lost.

A particular case that is linked to the "VLE vs PLE" debate (Conole, 2012) is what happens when the technology is still present, but the content has disappeared or is no longer accessible. Institutional learning management systems or VLEs, such as Moodle, are quite often "walled" environments, only accessible to those who are members of the community or institution. In many cases, as students graduate, their institutional e-mail account is closed, and access to the VLE is no longer available.

Although not directly a case of transience in technology, the availability of information and data are indeed affected by the access the individual has to such a repository or environment. In this sense, what is transient is not the technology as such, but the permissions the user has to access it—the availability of the information. There is evidence that some high education institutions are no longer issuing institutional e-mail addresses, allowing students to use their personal ones instead (Educause, n.d.). This way, their e-mails go with them, which is not always the case with institutional e-mail services.

TECHNOLOGY TRANSIENCE: THE DELICIOUS CASE

One of the authors (Torres) has been involved in PLE-related research since 2008, and in the process has explored different approaches to building both PLEs (Torres et al., 2009) and applications in the educational context (Torres, Martin, Ortiz, & Serra, 2010). In the last 6 years, his PLE has been continuously changing, reflecting the changing nature of the technology context of today's world. Some of Torres' PLE services have changed appearance, or even functions; some have completely disappeared; and a few have remained relatively stable during this time period. Services that once belonged to Torres' PLE but have since disappeared include Twine, Geocities, Flock, and Google Reader. Of these changes, the only one that caused major problems because of its disappearance was Google Reader; this service had become an integral part of Torres' PLE and served as both an aggregator of information and a discovery tool. A migration to Feedly (an RSS feeds aggregator) solved some of the issues, combined with Zite and Flipboard (which also aggregate information in a magazinelike format), and the adoption of Pinterest, which allows users to create boards and "pin" pictures on it, which are actually links to the original sources of information associated to these

Au: Add Torres et al 2009 to refs.

pictures. Lately, the Save function on Facebook has proved useful for saving resources for later use.

Other services were considered for addition to the PLE at various points, but fortunately were never included ("fortunately," because these tools have since stopped working; for example, Google Wave, which in 2010 was heralded as the best "new thing," only to fizzle out and never deliver on its promise). Ghost and Jooce, which were interesting interfaces that worked as virtual desks and allowed users to share information and files, have suffered similar outcomes.

Some of the services that have been a part of Torres' PLE and have not changed in a major way are Netvibes, Facebook, Twitter, Google Drive (before known as Google Docs) and delicious. Together, these support a wide range of actions and needs: among them, aggregation of content and sources, social networking, collaboration, information discovery and social bookmarking. Nevertheless, they are still a part of a changing technology setting, even when they remain in operation, because these tools continue to change and evolve over time.

Social bookmarking is a term that describes the actions of bookmarking web resources and sharing them with other users, and the category of online services that allow users to perform these. Delicious, one of the most popular social bookmarking services and perhaps the one most widely used in the educational area, has an interesting history, which is also a good example of the consequences and implications surrounding technology transience. Delicious (n.d.) was founded in 2003, and then acquired by Yahoo in 2005. In 2010, Yahoo announced their plans to close (or "sunset") delicious, which caused many users to abandon the site and look for alternatives, such as Pinboard and Google Bookmarks. Among all the complaints and protests (cf. "The Internet Freaks Out," 2010), there were also some initiatives to try to convince Yahoo to change their mind about closing the service, such as the one started by Allyson Kapin of WomenWhoTech.com.

Some bloggers have speculated that it is possible that all this attention was one of the reasons why Yahoo changed its mind and decided to sell delicious rather than shut it down (Softpedia, 2010). In 2011, Yahoo sold delicious to AVOS, and several changes were introduced, some of which were received with criticism by users (ZDNet, 2011), such as the introduction of Stacks, a function that allowed users to group tags and create categories of links, radically changing the previous approach based on tags, known as Bundles. There were also concerns about the changes in the terms of service and privacy policy that applied to the use of delicious. AVOS sold delicious to Science Inc. in 2014 ("Delicious Social," 2014). Since then, AVOS has gradually been introducing changes to the delicious system, and will probably continue to do so. To highlight a specific case of technology transience, the delicious service has changed hands three times in ten years, and each change has brought with it modifications of the terms of service, interface, functions, and overall user experience, sometimes with mixed results. This had led users to explore other options, sometimes in a concerted effort. In 2010, for example, Alec Couros created a shared Google Doc in order to brainstorm options and alternatives; the document is still available and provides an interesting glimpse on this event.

There are also other problems and implications of technology transience on PLEs that are built using Web-based tools and services. These issues extend beyond merely the time and effort that can be wasted or lost after one of these services ceases to exist: where does the associated data go when a service or tool is discontinued? Are those data truly lost forever? Or, even more worryingly, are those data still stored somewhere, accessible by someone else without knowledge or approval? And who takes responsibility for data protection in the case of a tool's data when the organization that owned the tool no longer exists?

And even further questions come to mind in this regard, many of which do not hold clear answers. If, for example, the tool or service

does not disappear, but is acquired by another organization, are the new owners required to honor previous terms of service and user agreements? Users struggle enough the first time in attempting to read and understand a company's terms of service agreement; to ask them to do this multiple times is even more challenging. The case of delicious might be considered a somewhat extreme example, but will users truly take the time to read and familiarize themselves with the terms they are repeatedly facing, or are they more likely to blindly enter each new contract without full awareness of the ramifications of these new terms of service? Today, privacy is becoming a luxury, and it can seem that newer generations have a more careless approach about the issue. Some research suggests that as few as 7% of users actually read a company's terms of service (Terms and Conditions," 2011), meaning that most users enter these contracts without fully knowing their details. There have been attempts to help users navigate what is often several pages of legal jargon; TOSDR (Terms of Service," n.d.) is such an initiative. The website attempts to highlight key elements from the terms of service of the most popular web services, such as Google, Facebook, Twitter, Wikipedia, and many others. They also show specific topics, such as "waiving your rights," "changes," "notice of changing terms," and "business transfer." The entry for delicious in the "business transfers" topic reads: "Your personal information are an asset for business transfers. delicious 'may sell, transfer or otherwise share some or all of its assets, including your Personal Information, in connection with a merger, acquisition, reorganization or sale of assets or in the event of bankruptcy.'" [The entry is found at https://tosdr.org/topics.html#business-transfer-lJG-sikCSEJ8]

This is quite relevant in light of delicious' history, but users would be required to read around 3,500 words (i.e., its terms of service) and another 2,000 words to cover the privacy policy where this is mentioned.

The case of delicious forces us to reflect on a transience aspect that appears especially relevant in the case of PLEs*:* sometimes it is not the technology itself that is transient, but the use of such technology that is transient in nature. Following the first announcement that delicious was being considered for sunsetting, users began analyzing options or leaving altogether, starting accounts on Diigo, Pinboard, MrWong, and other services, sometimes exporting their data with them. In a scenario where users choose the services they want or need to use, combining them in seemingly infinite combinations, perhaps it is not only a matter of technology transience, but of needs and requirements that are no longer being fulfilled, pushing users to search for other options.

MITIGATING THE EFFECTS

Transience is an inherent factor within technology evolution. It is important to understand its impact on our PLEs, and attempt to mitigate its effects. Based on our experience working with users and helping them create their own PLEs, we offer some tips and solutions for mitigating the effects of technology transience. These suggestions could be useful not only for users attempting to create and manage their own PLEs, but also when guiding and helping others in PLE development.

1. 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. If learners learn only how to use a specific tool, they will likely be lost when that tool is no longer available.

During the "Digital Orchard" (Torres et al., 2010) project (a project whose aim was to help teachers implement information and commu-

nications technologys in the classroom, and ran between 2009 and 2012), some of the participants created online communities using Ning. Ning phased out free networks in 2010, so the participants were forced to look for alternatives. Some chose Grou.ps (http://grou.ps/), which in turn switched to a paid-only option in 2011, others migrated to Posterous, which was closed in 2013. In almost all cases the transition between services was not a problem; the participants had been encouraged to explore the services on their own, choose which capabilities and functions were useful for them and which were not, and compare different approaches as they explored the options available. This suggestion leads to another:

2.   Expose learners to families of services and tools, not simply a single one.

For example, discuss the advantages of social bookmarking by comparing delicious, MrWong, StumbleUpon, Diigo, et cetera, so learners can make educated choices on the tools that are best suited to fit their needs, and not the other way around. In the previous example, the participants had been shown different options since the beginning of the project, and some of the options had been discovered or proposed by them, so the focus was never on a specific tool, but rather on the requirements they had and how they were achieving their objectives by means of the different applications. Some of the participants were looking specifically for a platform that allowed them to create a community, so they switched to Google+ Communities, while others decided to explore Facebook as an alternative.

3.   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 new 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. Again, the idea is to focus on needs and how they are fulfilled by the applications, and not on the applications themselves.

In the Digital Orchard project, for example, blogs were used in a variety of contexts. A group used Blogger to keep track of project development and management, so when it was time to transfer the coordination of the project to another group, they would have a log of all previous tasks and milestones. Another teacher created a blog so students could share personal stories around specific topics, similar to what one of the participants was also doing with their class, but through Twitter.

4.   Accept that change is something inherent to the nature of PLEs.

PLEs are dynamic, changing according to the needs of the learner, and also due to changes in technology. Change can be disruptive for users who are accustomed to a specific tool or application, but also opens 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 export/import options for the services they use, in case there is the need to switch between PLE tools at various points in time. Compatibility may also be an issue, and learning curves and available support varies among the different tools that can be part of a PLE. The nature of PLEs mean that users need to be learning continuously, and be flexible enough to switch to a new tool more or less seamlessly. This connects with the example discussed in Items 1 and 2, where the participants needed to move a whole community across different platforms.

5.   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. As mentioned in the discussion about delicious, the news of Yahoo sunsetting the application was almost immediately followed by initiatives such as the one led by Alec Couros, and the collaborative effort in searching for alternatives to the social bookmarking service, using a shared Google Doc.

The role of the Personal Learning Network (PLN) becomes crucial in the context of PLEs, and in many cases PLEs and PLNs are inextricably connected. This follows the connectivism theory, proposed by Siemens and Downes (2007). In Buchem, Attwell, and Torres, analysis of PLEs under the activity theory lens (2011) was carried out, and PLNs were included in the community aspect of the framework, representing the social context of learning. Learners share objects and support each other, and their learning experience becomes richer. The experience working with secondary education teachers in the Digital Orchard project demonstrated the value of support networks, which continue to this day, even after the project has ended.

Au: Add Siemens and Downes 2007 to refs.

Technology is constantly evolving, and affecting learners in new and different ways. Learning is increasingly the responsibility of learners, and it is learners' responsibility to keep up-to-date with technology changes, updates, and new developments. Now more than ever, change has become a constant. The specific care of the PLE provided in this article serves as an exemplar, both for how technology transience is affecting today's learners, and for how to best respond to and mitigate that transience.

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