Technology Acceptance within Informal Personal Learning Environments: A Qualitative Analysis

Completed Research Paper

Udayangi Perera Muthupoltotage **Lesley Gardner**

Abstract

Creating and using informal personal learning environments (IPLEs) enables personalisation of learning to individual needs. A comprehensive understanding of factors impacting technology selection and acceptance in IPLEs is still lacking. Drawing on 20 in-depth interviews with undergraduates and mind maps of their IPLEs, this paper presents a discussion of the factors effecting technology selection within IPLEs. Seven factors related to technical/operational capability and critical thinking ability, two key components of digital literacy are discussed. The paper suggests that existing models of technology acceptance need to be modified to include factors such as choice, individuals' tendency to exploit the social capital of the IPLE and digital literacy to understand technology acceptance within IPLEs. It proposes a conceptual framework of the factors which could be used to guide future research on appropriation of ubiquitous technologies for effective teaching and learning. It concludes with a discussion of the implications and future research opportunities.

Keywords: Informal personal learning environments, digital literacy, technology acceptance, qualitative analysis

Introduction

Winn (2002), stated that the new age of educational technology research focuses on learning environments "… in which the student has unprecedented freedom to act." (Winn, 2002, p. 335). Subsequently, Dede (2013) claimed that learners are improvising what they need to support their learning from the large number of tools accessible in their everyday experiences such as social networks, cloud computing tools, mobile applications, and other emerging resources. Hence, there is a need for education systems to holistically account for learning both inside and outside formal academic environments and give prominence to personalised learning (Childress & Benson, 2014), which is the ability to take ownership of learning and adapt learning processes and content including when, where, how, and what students learn to the individual student's needs, skills, interests, and preferences. This has led researchers to discuss the significant influence of personal learning environments (PLE) on teaching and learning in higher education institutions around the world by changing the landscape of both formal and informal learning through making it more accessible and personalised.

PLE components and content are changed to fit individual learning needs, rarely limiting to a single technology or even device (Espinosa, Castañeda, Gutiérrez, and del Mar Román, 2016). PLEs provide an opportunity for learners to develop the skills and literacies needed to effectively use emerging

technologies in a rapidly changing society (Oliveira and Morgado 2016). They stress the shift of control and ownership to the learner, where the learners make decisions and have a choice on the content, the sequence of learning steps, and most importantly, the learning tools and use of these tools to support individual learning (Buchem, Tur, and Hoelterhof, 2014).

Thus, giving rise to the concept of an informal personal learning environment (IPLE). IPLEs are multidimensional systems which enable learners to control the content and process of learning by selecting digital resources, applications, and activities which best serve their individual learning needs. The core concepts of these dynamic learning spaces are self-regulation and adaptation to personal needs. It is an inherently individual environment where no universal model is possible and consists not only of the technological tools, but also individuals' digital identity, relationships and multiple interactions with other individuals. Thus, the strength of these environments is that they can bring together the previously separate sources and contexts of learning. By including frequently used technologies and tools for taking responsibility of own learning and providing a natural connection between formal and informal learning (Muthupoltotage and Gardner, 2018a).

Regrettably, however, our understanding of technology use for learning from the students' perspective is still quite limited (Corrin, Bennett, & Lockyer, 2010). There is a lot of research which discusses how technology should and could be used by students but little attention paid to how students are actually using technology for learning, this prompted Selwyn (2010) to point out that research on the educational use of technology has worked itself into an analytical corner.

Current research suggests that while students do use technologies for learning, there is much variety in the frequency of technology use, the different kinds of technologies embraced, and the students' inclination to incorporate technology into learning (Bullen, Morgan, & Qayyum, 2011). It has been suggested that students' acceptance of technology for academic study is a matter of 'digital choice' (Lai, Wang, & Lei, 2012). Research has investigated the factors affecting students' acceptance of particular technology-enhanced learning (TEL) platforms (El-Gayar, Moran, & Hawkes, 2011) or specific suites of technologies (Alajmi, 2011), and many different theoretical models of technology acceptance have been applied to understand factors affecting acceptance of technology by students (see Chen, 2011).

The generalisability of the findings of studies such as the above; which were conducted within formal classrooms to the factors affecting technology acceptance within learner created and managed IPLEs used both in formal and informal learning contexts is limited. Therefore, an understanding of what factors drive learners' choices on whether to incorporate technology for learning within their IPLEs is an essential research concern. It enables identification of possible areas of support and integration that learning facilitators must provide. But, a comprehensive conceptualisation of these factors and how they influence the choice of technology for IPLEs is still lacking.

This paper reports the findings of an exploratory study framed by the research question "W*hat factors influence technology selection and acceptance when undergraduate students are creating and using IPLEs?*" The objective of this paper is to conduct an in-depth analysis of and explain the factors which will drive the technology acceptance choices of undergraduates when constructing IPLEs. Data was collected from first-year and second-year undergraduates in the Business School of a top university in the Asia-Pacific region, via face-to-face interviews in order to fulfil this objective.

Even the well-established models of technology acceptance such as the technology acceptance model (TAM), unified theory of acceptance and use of technology (UTAUT) or theories such as theory of reasoned action (TRA) had rarely been applied to the study of technology acceptance within the PLE and, specifically, the IPLE arena previously, hence making their applicability questionable in the context of IPLEs. In view of these current gaps in the literature, this study makes significant contribution to theory by providing an understanding of the factors affecting technology acceptance decisions within IPLEs from the perspective of learners.

A discussion of the theoretical background, research method employed in this study, and results of the investigation follows. The paper concludes with its contributions and directions for future research.

Technology Acceptance within IPLEs

Many studies have been conducted on student adoption of technology for learning in general. Some of these prior studies were focused on specific TEL platforms or applications (see El-Gayar et al., 2011) and others focused on exploring the adoption of a suite of technologies for learning (see Alajmi, 2011).

There have been attempts to understand the factors that drive and influence students' use of technology for learning from the perspective of technology acceptance by applying classic models such as the technology acceptance model (TAM) (Davis 1989). For example, Yi and Hwang (2003) extended the TAM by incorporating the motivational variables of self-efficacy, enjoyment, and learning goal orientation in order to predict undergraduates' use of the Blackboard web-based information systems. They found that enjoyment, learning goal orientation, and application-specific self-efficacy positively influenced the decision to use Blackboard, as well as its actual use for their sample. Similarly, Saadé and Galloway (2005) investigated the viability of the TAM model to predict acceptance of a multimedia learning tool specially developed and imposed within a University course offering for the purpose of the study. They found the TAM model to be a reliable predictor of technology acceptance within this context and concluded that attitude was a significant predictor of technology acceptance within this context. Later, Teo and Zhou (2014) established that perceived usefulness, perceived ease of use, and attitude towards technology use were significant predictors of university students' intention to use technology for learning.

Other information systems (IS) acceptance theories have also been applied to the area of students' acceptance of technology for learning. For example, the unified theory of acceptance and use of technology (UTAUT) model was used to understand undergraduate students' perceptions about using the web-based virtual learning environment, Moodle, by Šumak, Polancic, and Hericko (2010). The researchers concluded that performance expectancy and social influence significantly influenced attitudes towards using Moodle and behavioural intention.

Another example is the study of Chen (2011) where a new theoretical model which extended the UTAUT model was proposed and tested to explain the e-learning acceptance of Taiwanese students enrolled in a cyber-university system. It was seen that educational compatibility was the most important motivator of a student's behavioural intention and subsequently on e-learning acceptance. They defined educational compatibility as the degree to which the e-learning system complied with the overall learning expectancy of students within the learning situation, their learning style, and the preference of conducting learning activities.

An alternative example is the study conducted by Limayem and Cheung (2011) to investigate undergraduate students' decision to continue using the Blackboard system by extending the IS continuance model (Bhattacherjee 2001). Using a longitudinal survey these researchers established that habit significantly moderated the relationship between IS continuance intention and IS continuance usage.

Other researchers have refrained from using established models and alternatively used established theories for developing models consisting of constructs which could predict students' acceptance of technology. The study of Lai et al. (2012) is an example where the theory of reasoned action (Fishbein and Ajzen 1975) and the theory of planned behaviour (Ajzen 1985) were used together with other general literature on technology adoption to conceptualise a model for undergraduate student decision-making for technology adoption in learning. They found that educational compatibility, facilitating condition, and attitude to technology use were the most significant indirect or direct determinants of students' technology use for learning. Other factors which have been identified as significant predictors of university students' technology acceptance using various theoretical underpinnings include learning styles (Ames, 2003), and the scaffolding available in supporting the TEL experience (Lee & McLoughlin, 2011)

Furthermore, some other factors have also been identified as important predictors of technology use in contexts outside of higher education. Clark, Logan, Luckin, Mee, and Oliver (2009) explored students' in and out-of-school use of Web 2.0 and related technologies. This study, conducted among secondary school students, identified that an awareness of the wider educational potential of the technology

increased the students' use of technology. Gu, Zhu, and Guo (2013) investigated the difference between teachers and students when accepting technology for learning in secondary schools. They compiled and tested a model consisting of four factors, based on previous literature, as affecting technology acceptance: outcome expectancy, task-technology fit, social influence, and personal factors. Their analysis revealed that personal factors such as computer self-efficacy and willingness to try out new technology together with the influence of peers were significant predictors of technology acceptance.

Thus, literature is abundant on the factors which impact learners' acceptance of technology within contexts such as e-learning and specific technological tools and platforms imposed on learners. There is a significant dearth of research within this topic area regarding personal learning environments in general and even personal learning environments constructed as mash-up environments on a single platform. What is also lacking are empirical validations of exactly what factors would impact technology acceptance of students who construct and manage their own IPLE using a combination of technologies and tools and platforms outside of the formal classroom.

One of few studies in this informal area, to the knowledge of the researchers, is the study of Wild, Ullmann, Scott, Rebedea, and Hoisl (2011) which investigated the applicability of the UTAUT model for widget based personal learning environments and due to conflicting findings in two studies and a small sample concluded that the UTAUT could not be mapped directly to the domain of personal learning environments (Wild et al., 2011).

The study of Castañeda and Soto (2010) is another of the few studies which have attempted to investigate the personal learning environment construction process. Their study, however, was embedded within a course offered to students in a Spanish university where students were offered scaffolding for various Web 2.0 tools and they were explicitly encouraged to use those tools within their personal learning environments. While the context of their study is different from this study they concluded usefulness to be an important factor in selecting technology for students' personal learning environments.

In summary, while a model of technology acceptance within informal PLEs could be constructed taking into consideration the findings of all of the other studies within the TEL domain, such a model would contain a vast multitude of factors as identified in prior literature with little or no basis for their exclusion from consideration in an empirical investigation. Furthermore, such a model, if constructed, may not be applicable within the context of informal PLEs. Indeed Wild et al. (2011) warn that even though technology acceptance studies are extensively used, studies from one domain cannot be likened with a specific domain under examination without some limitations. Thus, a significant gap exists in the current literature regarding the factors which impact technology acceptance of learners within informal PLEs.

Method

Individual interviews were used to explore the undergraduate student's point of view regarding use of tools for constructing IPLEs. To ensure a reliable representation of interview participants, prior to issuing invitations for interviews, quantitative data was collected on students attitudes towards technology use for learning and the number and frequency of tools used to construct their IPLEs, using an online survey. Hierarchical clustering was conducted on this quantitative data obtained from 202 respondents, before randomly inviting an equal number of participants from each of the four emergent clusters for interviews.

Data Collection

Face to face interviews were conducted with 20 students. 11 were females while the rest were males. Their age ranged from 18-29 with the average age of 20. 12 of the interviewees identified with the main ethnicity of Asian, while the rest identified with the main ethnicity of European.

The interview duration was approximately one hour. Before starting the interview each participant was requested to spend 15 minutes on visualizing and drawing on paper, a mind map of their IPLE consisting of all the physical and/or digital tools and various technologies they used to support their learning.

These mind maps provided supplementary information about the tools and their organization within IPLEs.

An interview protocol was formulated to ensure consistency in structure and format of each interview session. Two main sections of this interview protocol are relevant to this study. They are 1) learning resource acquisition and selection – to investigate how and why students chose to add the particular tools and technologies noted in their mind maps to their IPLE; and 2) the past and future of the IPLE – to explore how students' IPLE had evolved over time in high school to arriving and spending one/ two semesters at university and how they envisioned the future of their IPLE.

With the permission of the participants, all interviews were audio-recorded. Written notes were also taken during the interviews to record participants' key responses and researcher observations. All interviews were conducted in English and were transcribed verbatim by a third party. Transcripts were emailed back to participants to ensure their agreement with the recorded data, then, coded and analysed using Nvivo 11 for sense-making. During the interviews, the participants explicitly discussed their approach towards selecting and continuously using the components of their IPLE. These discussions were examined to identify the aspects considered by participants when they engage in the process of accepting and using tools for creating their IPLEs. Codes elicited from participant responses regarding tool selection and acceptance were categorised into broad themes based on the context within which they were discussed. The coding process used in the study is discussed in detail in a prior publication (Muthupoltotage and Gardner, 2018b). Themes elicited from participant responses using thematic analysis in this manner were categorised into two interrelated and broad factors as (1) perception of operational capability, and (2) critical thinking and evaluation of educational potential. The themes were examined for differences between participants in the different clusters but none were apparent.

Discussions of the themes with the sub-themes within each of these categories, the key findings relevant to each category and a brief narrative of each category follows.

Findings and Discussion of Factors Influencing Technology Acceptance within IPLEs

Perception of Operational Ability

When asked how interviewees selected tools to be integrated into their IPLEs, their answers, were related to the operational ability to use technology. "*How do I pick a tool? (Laughter) well if I can work it, I will pick it*" (Participant 2).

Thus, operational ability or the ability to 'properly' use a tool was one of the key determinants of accepting a tool into the IPLE. It must be noted that possessing the required operational ability to use technology is the core component of the technical literacy dimension of digital literacy (Ng, 2012). Several aspects mentioned by the interview participants were categorised into themes which appeared to determine their operational ability. These included prior exposure, experiences and habits, support and scaffolding received from trusted parties, and individual beliefs of technical ability. Based on participant narratives, beliefs of technical ability also influenced the related theme of individuals' willingness to experiment with different tools when selecting and integrating tools to their IPLEs.

Prior Exposure, Experiences, and Habit

Having obtained prior exposure to a tool was a key determinant when participants chose to persistently integrate tools to their IPLE. Tools such as search engines, YouTube, components of the Microsoft office suite, and Facebook were mentioned by all the participants as tools which they had "*used always*" (Participant 11). As they already "*know how to use it*" (Participant 6) these tools became a part of their IPLE by default. Thus "habit" (Participant 5) appeared to be a determinant of whether individuals continued to use these technologies in their IPLEs.

Sometimes, "*having positive experiences before*" with using tools was a reason for persistently using tools. For example, Participant 9 considered the Prezi application to be her "*first choice*" for preparing multimedia presentations. This was due to having used the application successfully for presentations while in high school as a member of the school media club.

Prior experience was also a reason for the persistent adoption of some tools which were not very commonly cited as IPLE components. For example, Participant 14 (high technical, cognitive, and social-emotional literacies) mentioned how he "*found*" himself trying to use Khan Academy "*quite a lot*" because in high school he had experienced difficulty grasping mathematical concepts and "*Khan Academy saved [him] then*".

Even in situations where tools had not previously been used in an academic context, the prior familiarity with the tool made it easier for the participants to integrate them into their IPLEs for persistent use. For example Participant 7 was receptive to the notion of having group meetings regarding assignments on Facebook because she was "*on Facebook anyway a lot.*"

Early research in behavioural science and psychology, has suggested that holistic experiences with technology resulting in enjoyment, flow, and social image are potentially important in explaining technology acceptance (see Fishbein & Ajzen, 1975). Positive prior experiences with technology could lead to the enjoyment of technology and thus a willingness to integrate the technology within the IPLE for sustained use. Further, in a longitudinal investigation of student's continued use of the Internet-based learning technologies in formal classroom environment, habit was found to significantly moderate the relationship between information systems continuance intention and information systems continuance usage (Limayem and Cheung 2011). In light of this, the finding that positive prior experiences and exposure will influence the students' perception of their operational skills in using technology is not surprising.

Availability of Support and Scaffolding from Trusted Parties

Another main factor which determined users' operational skill levels when tools were integrated into their IPLE for consistent use was the amount of support and scaffolding that they received regarding the tool. Tools were introduced to users by three main groups of people who interacted with the users IPLE and provided support and scaffolding. They were 1) formal learning facilitators (lecturers, tutors), 2) peers and friends, and 3) family members.

It was seen that three main factors determined continued tool usage by IPLE users in this regard. First, recommendations of the learning potential from trusted parties was a key determinant. Recommendations appeared to foster a positive attitude towards the acceptance of technology. For example, Participant 6 detailed how he enjoyed listening to podcasts frequently since starting university but had previously been unaware of their value until "*podcasts were recommended*" by a family member who had started university education before him and had found them to be "*useful for him*". For Participant 6 this recommendation made him "*think that it should be tried and always he (the recommender) can be contacted for questions on where to find the best Podcast if needed, I can trust him*".

Tools were also frequently added to the IPLE for consistent use if the users had been provided comprehensive formal training on the effective use of the tool leading to the realisation of its potential. Participant 16 consistently used Repl.it as a tool for teaching himself Web application development principles and programming languages. He had only started using the platform himself after "*receiving training from tutors*" who were demonstrating the tool for a course he took at university. For Participant 16 the formal training made him "*realise what a cool tool it was*" and "*how easy it was to actually use it*". This realisation then encouraged him to investigate its "*match*" for his personal use especially as "*the tutor could be asked if there was a problem*".

Another factor originating in the external environment which determined continued tool usage within an IPLE was the availability of a means of going back for clarifications and advice when users encountered problems which led to higher levels of experimentation with the tool. For example, Participant 15 used mind maps as a consistent study technique and used the tool LucidChart for the purpose of creating these mind maps. She was exposed to the tool by a lecturer who "*used it only during the lecture*", she detailed how she then "*experimented and learnt it*" by herself for personal use thereafter but found the process to be "*very easy*" and "*great*" because there was a "*very active user community in LucidChart who will always answer questions very soon and clearly, and should know what they are saying*" and she could "*always quickly go there whenever needed*".

The last factor which affected continued tool usage was encouragement and exposure provided by peers which again led to experimentation. For example, Participant 3mentioned: "*I do not ever really just try out any apps, but I get encouraged by my friend to go to try things out all the time, just messaging, and Facebook*".

In a previous quantitative study conducted among undergraduate students in Hong Kong where the voluntary adoption of various types of digital technologies was investigated (Lai et al., 2012), it was seen that the social resource facilitating conditions for students had a positive relationship with the degree to which an innovation is perceived as being compatible with the existing values, educational needs, and past experiences of potential adopters. The finding within this study that the social structure of support and scaffolding for tools enhances the operational skills demonstrated by students and their acceptance of tools in to their IPLE, could add a further level of detail into the above interpretation of educational compatibility. The technical ability to use a technological innovation effectively could influence the perception of educational compatibility. In essence the support and scaffolding received from the social structure of the IPLE, can remove barriers to technology use at the perception level (Venkatesh et al. 2003), not only by increased realization of the tools relevance or compatibility with the learning goals of the IPLE but also by increasing individual perceived technical ability.

Another finding which emerged from this aspect of the analysis was the manner in which the IPLE users were mobilising the resources of their social networks when selecting and integrating tools into their IPLEs. There was a very clear element of choice and purpose visible within the comments of the participants in this regard. They realised that there was a number of resources available to them embedded in their social relations and social structure with friends, peers, faculty, and family. But there was no element of conformance to social influence from these parties visible. IPLE users were evidently going to mobilise the social capital when they wished to increase the likelihood of completing their own learning activities.

This finding is inconsistent with the prior established idea that contemporary students follow their peers when adopting technology (Gu et al. 2013). While, it has been noted that there are few empirical tests of social capital and technology adoption in general, it has been stressed that social interaction effects individuals' perception about the acceptance of new technology in contexts other than higher education (see Lee, Cho, & Hwang, 2013). Thus, the manner in which choice moderates the individuals' action of turning to the social structure to gain information, and, thereafter use the information they need when faced with difficulties related to using technology, warrants further investigation

Individual Beliefs of High or Low Technical Ability and Individual Willingness to Experiment with Technology

The two themes are elaborated in conjunction as the participant responses indicated a relationship between the two themes. Analysis of participant discussions indicated that they possessed various beliefs of their "*level*" of individual technical capability. These beliefs then appeared to influence the cognitive skill they demonstrated when making decisions to include technology into their IPLE. For example, Participant 10 said:

> *But like, I can still use it, but I don't know every tool, I'm not as, like, tech savvy as some people are. So I feel like I'm not as extreme as like the people who are very good at using technology. I am low level. So I just stick to the few apps and stuff that I already know."*

This evaluation of technical ability was usually superficially based on factors such as a surface comparison with others (i.e. Participant 10 above). Some participants had negative experiences previously and formed their opinion of individual skills based on these experiences such as Participant 4 who said "*I am always breaking things, everything just freezes, and that's me, so it's better to just do as little as possible with those (tools)*". Some others appeared to have too high expectations of their technical skills such as Participant 19 who said "*well I can't write computer code or anything, so I really don't have much skills with using technology. I just stick to what I know*".

It is seen from the above excerpts that the beliefs about individual ability colour the individual's willingness to critically evaluate tools for their usefulness for learning tasks and to experiment with different, or a variety of tools when the beliefs are negative.

On the other hand, when individuals believed themselves to be highly skilled at using technology, they demonstrated the ability to evaluate tools well for their usability and compatibility with the tasks and they demonstrated a willingness to experiment. For example, Participant 1 (high overall digital literacy) believed that he "*knew the way around technology*", "*could solve problems when they came up*" and was "*comfortable*". During his interview, he discussed at length how he had used Wix to build a web site for an assignment when all of his other classmates were keen to use the tool already demonstrated by their teacher. While Wix needed more technical skills it also had more features and he was "*willing to try it*" because he knew he could "*do it*". He now considered Wix as part of his IPLE because it was used to create a website prototype at his part-time workplace.

The individual belief in their technical ability as expressed by the interview respondents, upon consideration is quite similar to the concept of computer or technology self-efficacy, defined as the belief in one's ability to use technology by some researchers (see Lai et al., 2012). A prior study conducted among secondary school students in China revealed that willingness to try new technology did significantly influence technology acceptance (Gu et al. 2013). It appears that this same behaviour is replicated within their IPLEs by the sample of higher education students used in this study. It has been argued that with contemporary learners who are perceived to already possess basic technological skills, what is most important is their evaluation and confidence in individual ability to benefit from technology enhanced learning by mapping individual technologies to learning tasks effectively (Jones et al. 2010). Our findings support this argument where interviewees who experimented with technology also reported the realization of potential, resulting from their confidence in individual ability.

Critical Thinking and Evaluation of Educational Potential

According to participant responses another key part of determining if a tool would be integrated for persistent use within the IPLE was "*critically thinking about and judging the apps*" (Participant 16) or thinking if the tool was "*actually fitting*" (Participant 9) individual needs and wants. As pointed out by Participant 6: "*Well, of course, I wouldn't even consider anything I don't think I can, I know to use properly. But I do kind of carefully think about say is this really matching my need*".

Thus, it was seen that most participants considered critically thinking about the tool and evaluating its educational potential as a key part of the process of accepting a tool into the IPLE. Critical thinking is considered to be a key component of digital literacy (Eshet-Alkalai, 2012). Through probing further to elaborate participant answers, and analysing those answers together with resultant themes it was seen that three key factors emerged as interrelated themes which were key considerations in the critical thinking process leading to tool acceptance.

Mandated Use Consideration

Participants admitted to temporarily integrating tools into their informal learning environment simply because it was compulsory to use the tool. Twenty-six references across 14 interview participants were coded where they reported: "*just integrating*" (Participant 3) tools into their IPLEs as there was a "*requirement to use the tool*" imposed on them via the university courses they were reading for. They appeared, however, to be doubtful of its continued usage after the mandated usage period ended. For example, Participant 2 said who had integrated the tool Quizlet as part of her IPLE mentioned "*I don't know if I will keep using it. Not if I don't have to, I guess*."

Some participants (5) also mentioned instances where they chose not to include a tool within their IPLE even if they did foresee its benefit because they were not required to use the tool, as shown by the comment of Participant 13:

> *"For some of my assignments, I have to use references a lot and Mendeley is ok I guess for that, generating it, the reference. But I don't use it. We are not required to. I just get the website to generate it. I find that way is easier and quicker for me."*

The interesting factor to note in the above quotes and most of the comments made by other participants regarding this mandatory vs optional use of technology was the explanatory statements provided by participants for adoption/non-adoption. These statements referred to not being aware of the educational potential or needing confirmation/clarification of the potential, "*Do you think I should, I mean are they*

any good?" (Participant 19) or a perceived mismatch between the technology and their individual preferences for performing a task. "*I don't see how it works for me for studying*" (Participant 2, also mentioned above) or a perceived mismatch between the technology and the effort required for adopting it for learning "I find that way is easier and quicker for me" (Participant 13, also mentioned above). These statements indicate that persistent adoption of a mandated tool would vary based on the perception of educational potential as well as the individual perception of the task, tool, and effort mismatch.

In summary, mandated use of a tool appeared to influence participants' ability to critically evaluate tools for the IPLE in two ways. First, the mandate encouraged participants to think about the potential benefits of using the tool. Next, the mandate encouraged participants to think about how well the tool would fit their individual preferences for performing tasks and the amount of effort they were prepared to expend on using the tool for performing tasks.

Acceptance of technology is an area which has been studied quite extensively within formal organizations where technology use is mandated. But researchers have argued that the concept of technology acceptance may indeed change in environments where the users have a choice whether to accept or reject a technology (Straub, 2017). The finding that IPLE users will include tools in to their IPLE temporarily because they are required to use it, but express doubt or question the need for continued usage and will exclude tools from the IPLE as there is no mandated requirement supports this argument. However, the mandate itself or the realisation of educational potential was not enough to generate acceptance. The mandate succeeded in generating satisficing behaviour, while educational potential appeared to have less priority than other considerations as seen in the discussion below.

Individual Perception of Learning Style

Based on participants' responses it was seen that they demonstrated a knowledge or perception of their own learning styles, and based on these perceptions would accept or reject tools from their IPLE.

> *"I'd definitely say I'm a visual learner. I can't really listen to the lecture recordings without having to look at the lecture slides, cos then I sort of just wander off and not really pay attention. And I use stuff like mind maps quite often, especially when I'm studying, just so I can get all the key points out and then I can look at it. I also, like if I need to memorise stuff I'll make cue cards or charts or something, yeah, so I'm definitely a visual learner. Even when I am looking for tools to help me, I guess I think about it in that way."* (Participant 12)

When looking at the mind map of the IPLE for the above participant it was seen that it included among others, the following three tools. Evernote "*for recording lectures and some tutorials*" where the application allows tagging on lecture slides directly, Lucid chart for mind maps, and Tiny cards for making cue cards. Thus, a direct alignment was seen between the above comments regarding learning style and how the participant had actually included tools in her IPLE. This indicated a potential task to tool fit based on the perception of individual learning style.

Similarly, Participant 1 explaining why he frequently used the technical forum Stack Overflow, stated "*well my learning style is to just question, everything. So, Stack [Stack Overflow] is really a good resource for me. I can do just that and get the answers I want not just for uni work but even for work [part-time job]*". Other participants (eight references across six sources) resonated with this finding.

It was seen that even in situations where the potential educational benefit of the tool was high, tools could be rejected from the IPLE due to a perceived task to tool mismatch influenced by the perception of individual learning style. For example, Participant 14 expressed his aversion to using collaborative tools such as Google Drive with the following comment:

> *"At the moment, I'm finding, like, working more on my own, is my sort of study style. So just, yeah, it's quite like, I guess it's quite a bit more like individual sort of work, rather than like doing like, I don't know, group, I don't know. Sort of like working with others on the same sort of thing, I don't really do that."*

Thus, the perception of an individual participant's learning style is seen to change the perception of how well tools may fit the task that needs to be performed, influencing participants' ability to critically evaluate tools for their IPLE.

Previously within the e-learning arena researchers have investigated the degree to which an e-learning system matched individual learning style as the concept of educational compatibility. For example, it was seen that Taiwan university students' use of a virtual learning management system varied based on educational compatibility based on learning style (Chen, 2011). Earlier research has shown that learning styles can affect University students' preference for and confidence in technology use in classrooms (Ames, 2003), thus, indicating that learning style could impact attitude towards technology.

In this study it was evident that perception of learning style fostered both positive and negative attitudes prompting acceptance and rejection of tools within the IPLE. For example, the use of 'Stack overflow' within the IPLE was admitted by a learner who thought his learning style was '*just question, everything*', whereas, a learner who felt her learning style was more inclined toward individual study also reported an aversion towards using the online collaborative tool 'Google Drive'.

It is surmised, then, that in an environment such as the IPLE where a multitude of tools are involved, the awareness of the compatibility between the tools and one's learning style per se may not be adequate in driving students' continued successful use of technology for learning. This awareness needs to be transformed in to a belief in the usefulness of the tools to serve numerous personalized learning functions, generating more positive attitudes towards the perceived match between the tool and the individuals learning style. Formal training provided for tools where the focus is on how well tool functionality could be adopted for individual learning styles would be a useful strategy for educators to use here, when they are interested in adopting IPLEs for formal classroom usage. The growing research interest in recommender systems (Khribi et al. 2015) would also be practically useful in this regard.

Individual Perception of Effort Requirement for Tool

Participants' responses indicated that tools which were perceived to require less effort to use were readily accepted as components of the IPLE, whereas tools which were perceived to require "*too much effort*" would be rejected unless it was mandatory to use the tool.

For example, Participant 1 explained why he preferred to use Notability as a tool for note-taking as opposed to OneNote, which he had already tried, by elaborating on the lack of usability of OneNote and saying "*whereas Notability is a whole lot nicer and you've got the palm rejection and that sort of thing so takes so little effort.*"

Participant 13 mentioned that generating the reference from the websites took "*no effort*", whereas Mendeley was "*comparatively more effort*" when discussing why she did not use Mendeley as a tool for referencing even though it is recommended by her teachers. Thus, while the fact that the tool was not compulsory for use had been considered by her, as discussed previously, it was clear that she had also considered the effort required for usage before rejecting the tool.

While the study participants did not mention ease of use directly, when considering the context of discussing effort required for specific tools, it was seen that the code 'less effort' appeared to be synonymous with 'ease of use'. For example, Participant 2, discussed an instance where she had "*thought*" of using MindMeister because she liked to "*make graphics to organise thoughts*", but after looking at the tool a few times decided that "*it was just much easier to draw them by hand*", because "*It (MindMeister) was just too complicated and way too much effort to use*".

An interesting fact to note, however, was that participants appeared to prioritise effort required as a more important consideration than the learning gain or expected performance improvement when accepting a tool into their IPLE. For example, Participant 13, was certainly aware that the use of Mendeley as a referencing tool was "*going to be good, less chance of mistakes and so on*" and that if she wished to continue to higher studies, she would probably be able to "*use that then, and it would really be useful to learn how to use it properly now*". But had still decided that "*this ways (using websites to generate references) just easier*".

Thus, it can be seen that when creating an IPLE the individual perception of effort required to use a tool would dictate prioritising ease of use over usefulness. This finding that participants prioritize ease of use over the usefulness of the tools when adding them to their IPLEs, is quite surprising. The perception of usefulness has previously been seen to be a key determinant of online and blended learning technology acceptance (Alsabawy et al. 2016) and of similar importance to ease of use (Juhary 2014).

Castañeda and Soto (2010) after investigating university students personal learning environment construction process explicitly for a single university course, concluded that students extremely value, useful tools which help them to plan their tasks, save time, simplify complicated tasks and, definitively, have fun' (p. 24). However, when migrating towards the use of technology for informal learning where choice is not mandated, it has been seen that ease of use is a more important consideration for university students than usefulness (Elkaseh et al. 2016). Thus, it could be that in informal contexts where the students are provided a choice of technology, they would migrate towards using the most easy to use tools even at the cost of not reaping the full learning benefit.

A previous study of young learners' adoption of Web 2.0 technologies in and outside of school (Clark et al. 2009b) showed that awareness of the educational possibilities of technological resources was a key determinant of students use of technology for informal learning. The findings of this study, however are contradictory to these previous findings in the technology acceptance arena. They indicate that IPLE users did not always accept technology in to their IPLE even if they were aware of a potential educational benefit. Tools which are perceived to match an individual's learning style and required less effort were prioritized. There is some research which has found similar results in a voluntary virtual learning environment (Lai et al., 2012), which those researchers tried to justify by generalizing to non-western university students. That explanation would not hold for the interview sample of this study, which consisted of both western and non-western IPLE users.

But when diverting from technology acceptance literature and looking at characteristics of modern learners' for an explanation, it is seen that the findings of this study can certainly boost other claims that ease of use and convenience will determine the selection of technology for academic use for modern learners (Bullen et al. 2011). From an educational practice perspective, therefore, increasing the learners' operational skill levels, perhaps by providing more exposure as well as support could be a good strategy here. Thus, ensuring that the perception of a tool being easy to use and requiring less effort is generated, creating a receptive environment for accepting the tool in to the learning environment. This also has implications for tool designers where a priority should be to design digital educational tools which are less complex and easily learnt and handled with the least amount of time and effort required from the user.

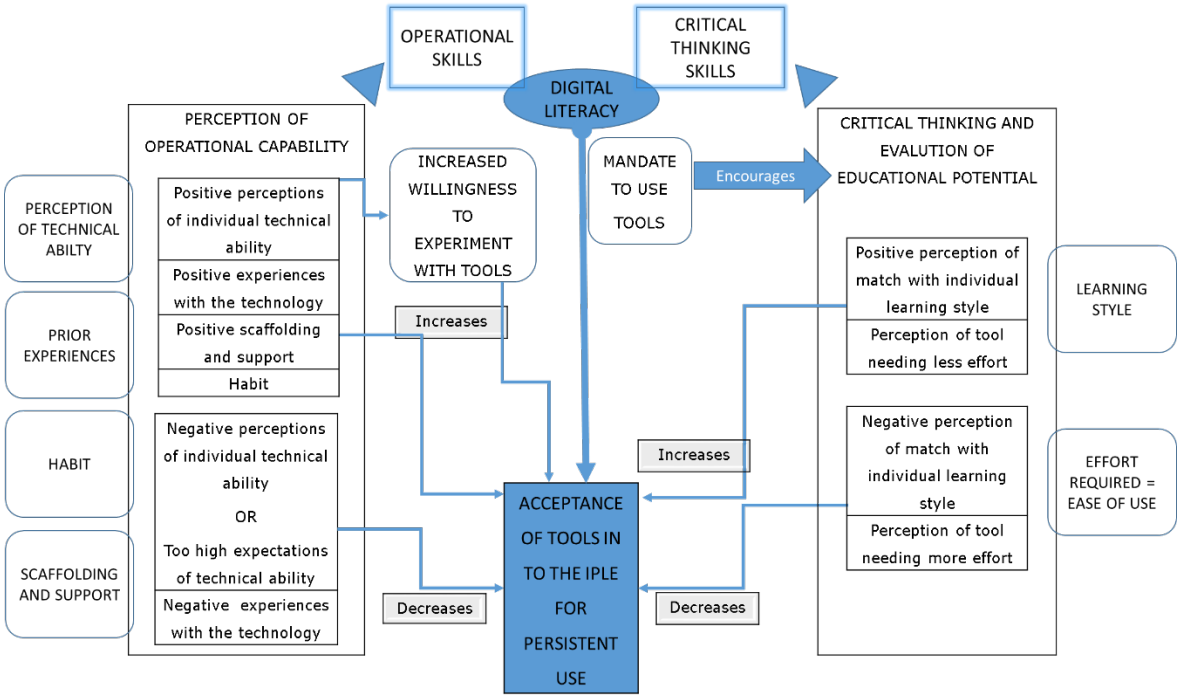

Figure 1. Conceptual Framework of Factors Influencing Technology Acceptance within IPLEs

Considered in their entirety the factors uncovered in this study are depicted in the conceptual framework in Figure 1. It is seen that the important determinants of technology acceptance are indirectly related to

component parts of digital literacy. Technical/operational capability and critical thinking ability are seen to be key component skills of digital literacy (Eshet-Alkalai, 2012). Digital literacy however has rarely been studied as a determinant of technology acceptance. In a study conducted among organizational e-learners which attempted to quantitatively clarify the effect of digital literacy on the intention to continue using e-learning, Mohammadyari and Singh, (2015) integrated the concept of digital literacy with the UTAUT model and saw that digital literacy was a key determinant of effort expectancy. While digital literacy there was operationalized as the capability to use technology and critical thinking was not incorporated, the findings of this study among university students, indicate digital literacy in the form of technical capability and critical thinking ability and their influence on previously established constructs such as effort expectancy for technology acceptance should be further investigated within IPLEs.

Conclusion

Technology acceptance is an area which has been studied extensively in the IS research arena. PLEs have been studied extensively within the TEL research arena but not much from the perspective of technology acceptance. To our knowledge, tool selection and acceptance processes for user created IPLEs has not been empirically investigated before.

Hence, the qualitative findings of this study regarding factors influencing technology acceptance for IPLEs, contributes to knowledge in this area in several ways. First, this study indicates that in conjunction with other studies which investigate technology acceptance in various other contexts such as e-learning, prior exposure, scaffolding and individual perceptions of technical ability are key determinants of individuals' functional skill related to technology. Thus, indicating that factors considered in most prior models of technology acceptance such as UTAUT (Venkatesh et al., 2003), which consider some similar constructs may be applicable for understanding technology acceptance in the IPLE context.

Next, given that choice, individuals tendency to exploit the social capital of the IPLE and the individual learning styles also appeared to be important factors in determining acceptance of support and scaffolding, this study indicates that models such as the UTAUT cannot be applied to understand IPLE technology acceptance as they are, and may need to be modified to consider these factors in depth in future research. More research in the nature of the study conducted by Mohammadyari and Singh, (2015) should be conducted by operationalizing these constructs and investigating the nature of magnitude of their influence.

Finally, this study indicated that ease of use of tools was more important than usefulness in the IPLE technology acceptance context. Well established models such as TAM (Davis, 1989) does consider these two concepts to be important in determining attitude and behavioural intention to use technology. But when constructing IPLEs usefulness appears to be a construct of lesser import, again, indicating that further research should be conducted to validate and clarify this phenomenon.

The factors identified in this study could now be used to further inform the application of established models such as UTAUT and TRA within the IPLE arena or suggest alternate models which incorporate them guided by the conceptual framework proposed in this study (see Figure 1), and particularly considering the impact of digital literacy as an influencer of technology acceptance. Due to the lack of validated measures and models which investigated the factors affecting technology acceptance within an IPLE, this study used a mostly qualitative approach to address its second research question. This could be viewed as a limitation of the study. But the aforementioned theoretical implications now provide ample justification for proposing a modified technology acceptance model based on previously established models and constructs identified in other studies to further investigate the phenomenon of technology acceptance within IPLEs by particularly considering the impact of digital literacy.

References

Ajzen, I. 1985. "From Intentions to Actions: A Theory of Planned Behavior," in *Action Control: From Cognition to Behavior*, SSSP Springer Series in Social Psychology, J. Kuhl and J. Beckmann (eds.), Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 11–39.

Alajmi, M. 2011. "Modeling Student Perception of Web 2.0 Technologies Adoption in Kuwait," *Digital Library*, , May. (https://digital.library.unt.edu/ark:/67531/metadc67955/, accessed December 2, 2018).

Alsabawy, A. Y., Cater-Steel, A., and Soar, J. 2016. "Determinants of Perceived Usefulness of E-Learning Systems," *Computers in Human Behavior* (64), pp. 843–858.

Ames, P. C. 2003. "Gender and Learning Style Interactions in Students' Computer Attitudes," *Journal of Educational Computing Research* (28:3), pp. 231–244.

Bhattacherjee, A. 2001. "Understanding Information Systems Continuance: An Expectation-Confirmation Model," *MIS Quarterly* (25:3), pp. 351–370.

Buchem, I., Tur, G., and Hoelterhof, T. 2014. "Learner Control in Personal Learning Environments: A Cross-Cultural Study," *Learning and Diversity in the Cities of the Future*, p. 13.

Bullen, M., Morgan, T., and Qayyum, A. 2011. "Digital Learners in Higher Education: Generation Is Not the Issue," *Canadian Journal of Learning and Technology/La Revue Canadienne de l'apprentissage et de La Technologie* (37:1). (http://www.editlib.org/p/42755/article_42755.pdf).

Castañeda, L., and Soto, J. 2010. "Building Personal Learning Environments by Using and Mixing ICT Tools in a Professional Way.," *Digital Education Review* (18), pp. 9–25.

Chen, J. L. 2011. "The Effects of Education Compatibility and Technological Expectancy on E-Learning Acceptance," *Computers & Education* (57:2), pp. 1501–1511.

Childress, S., and Benson, S. 2014. "Personalized Learning for Every Student Every Day: The Best Hope for Accelerating Student Achievement Is by Using a Range of Pedagogical and Technological Innovations That Deliver Personalized Learning to Each Student," *Phi Delta Kappan* (95:8), p. 33.

Clark, W., Logan, K., Luckin, R., Mee, A., and Oliver, M. 2009a. "Beyond Web 2.0: Mapping the Technology Landscapes of Young Learners," *Journal of Computer Assisted Learning* (25:1), pp. 56–69.

Clark, W., Logan, K., Luckin, R., Mee, A., and Oliver, M. 2009b. "Beyond Web 2.0: Mapping the Technology Landscapes of Young Learners: Beyond Web 2.0," *Journal of Computer Assisted Learning* (25:1), pp. 56–69.

Corrin, L., Bennett, S., and Lockyer, L. 2010. "Digital Natives: Everyday Life versus Academic Study," in *Proceedings of the 7th International Conference on Networked Learning*, , January 1, pp. 643–650.

Davis, F. D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3), pp. 319–340.

Dede, C. 2013. "Connecting the Dots," *EDUCAUSE Review*. (http://www.webmail.sacscoc.org/institute/2014/2014SIHANDOUTS/Plenaries/Dede2Mon.pdf).

El-Gayar, O., Moran, M., and Hawkes, M. 2011. "Students' Acceptance of Tablet PCs and Implications for Educational Institutions," *Educational Technology & Society* (14:2), pp. 58–70.

Elkaseh, A. M., Wong, K. W., and Fung, C. C. 2016. "Perceived Ease of Use and Perceived Usefulness of Social Media for E-Learning in Libyan Higher Education: A Structural Equation Modeling Analysis," *International Journal of Information and Education Technology* (6:3), pp. 192–199.

Eshet-Alkalai, Y. 2012. "Thinking in the Digital Era: A Revised Model for Digital Literacy," *Issues in Informing Science and Information Technology* (9:2), pp. 267–276.

Espinosa, M. P. P., Castañeda, L., Gutiérrez, I., and del Mar Román, M. 2016. "Still Far from Personal Learning: Key Aspects and Emergent Topics about How Future Professionals' PLEs Are," *Digital Education Review* (29), pp. 15–30.

Fishbein, M., and Ajzen, I. 1975. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*, Addison-Wesley Series in Social Psychology, Reading, Mass.: Addison-Wesley PubCo.

Gu, X., Zhu, Y., and Guo, X. 2013. "Meeting the 'Digital Natives': Understanding the Acceptance of Technology in Classrooms," *Journal of Educational Technology & Society* (16:1), pp. 392–402.

Johnson, M. W., and Sherlock, D. 2014. "Beyond the Personal Learning Environment: Attachment and Control in the Classroom of the Future," *Interactive Learning Environments* (22:2), pp. 146–164.

Jones, C., and Healing, G. 2010. "Net Generation Students: Agency and Choice and the New Technologies," *Journal of Computer Assisted Learning* (26:5), pp. 344–356.

Jones, C., Ramanau, R., Cross, S., and Healing, G. 2010. "Net Generation or Digital Natives: Is There a Distinct New Generation Entering University?," *Computers & Education* (54:3), Learning in Digital Worlds: Selected Contributions from the CAL 09 Conference, pp. 722–732.

Juhary, J. 2014. "Perceived Usefulness and Ease of Use of the Learning Management System as a Learning Tool," *International Education Studies* (7:8).

Khribi, M. K., Jemni, M., and Nasraoui, O. 2015. "Recommendation Systems for Personalized Technology-Enhanced Learning," in *Ubiquitous Learning Environments and Technologies*, Lecture Notes in Educational Technology, Kinshuk and R. Huang (eds.), Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 159–180.

Lai, C., Wang, Q., and Lei, J. 2012. "What Factors Predict Undergraduate Students' Use of Technology for Learning? A Case from Hong Kong," *Computers & Education* (59:2), pp. 569–579.

Lee, B. C., Cho, J., and Hwang, D. 2013. "An Integration of Social Capital and Tourism Technology Adoption—A Case of Convention and Visitors Bureaus," *Tourism and Hospitality Research* (13:3), pp. 149–165.

Lee, M. J. W., and McLoughlin, C. 2011. "Pedagogy 2.0: Critical Challenges and Responses to Web 2.0 and Social Software in Tertiary Teaching," in *Web 2.0-Based E-Learning: Applying Social Informatics for Tertiary Teaching*, Hershey PA: Information Science Reference.

Limayem, M., and Cheung, C. M. K. 2011. "Predicting the Continued Use of Internet-Based Learning Technologies: The Role of Habit," *Behaviour & Information Technology* (30:1), pp. 91–99.

Muthupoltotage, U. P., and Gardner, L. 2018a. "Analyzing the Relationships between Digital Literacy and Self-Regulated Learning of Undergraduates – A Preliminary Investigation," in *Lecture Notes in Information Systems and Organisation*, Springer.

Muthupoltotage, U. P., and Gardner, L. 2018b. "Rules Governing the Use of Personal Learning Environments for Self-Regulated Learning: An Activity Theory Approach," in *European Conference on Information Systems*, University of Portsmouth, Portsmouth, United Kingdom.

Ng, W. 2012. "Can We Teach Digital Natives Digital Literacy?," *Computers & Education* (59:3), pp. 1065–1078.

Oliveira, N. R., and Morgado, L. 2016. "Personal Learning Environments: Research Environments and Lifelong Informal Learning," in *Handbook of Research on Applied E-Learning in Engineering and Architecture Education*, pp. 32–54.

Saadé, R. G., and Galloway, I. 2005. "Understanding Intention to Use Multimedia Information Systems for Learning," *Issues in Informing Science and Information Technology*, pp. 287–296.

Selwyn, N. 2010. "Looking beyond Learning: Notes towards the Critical Study of Educational Technology," *Journal of Computer Assisted Learning* (26:1), pp. 65–73.

Straub, E. T. 2017. "Understanding Technology Adoption: Theory and Future Directions for Informal Learning," *Review of Educational Research* (79:2), pp. 625–649.

Šumak, B., Polancic, G., and Hericko, M. 2010. "An Empirical Study of Virtual Learning Environment Adoption Using UTAUT," in *2010 Second International Conference on Mobile, Hybrid, and On-Line Learning*, , February, pp. 17–22.

Teo, T., and Zhou, M. 2014. "Explaining the Intention to Use Technology among University Students: A Structural Equation Modeling Approach," *Journal of Computing in Higher Education* (26:2), pp. 124–142.

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. 2003. "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, pp. 425–478.

Wild, F., Ullmann, T., Scott, P., Rebedea, T., and Hoisl, B. 2011. "Applicability of the Technology Acceptance Model for Widget-Based Personal Learning Environments," *1st Workshop on Exploring Fitness and Evolvability of Personal Learning Environments (EFEPLE'11)*, p. 10.

Winn, W. 2002. "Research into Practice: Current Trends in Educational Technology Research: The Study of Learning Environments," *Educational Psychology Review* (14:3), pp. 331–351.

Yi, M. Y., and Hwang, Y. 2003. "Predicting the Use of Web-Based Information Systems: Self-Efficacy, Enjoyment, Learning Goal Orientation, and the Technology Acceptance Model," *International Journal of Human-Computer Studies* (59:4), Zhang and Dillon Special Issue on HCI and MIS, pp. 431–449.