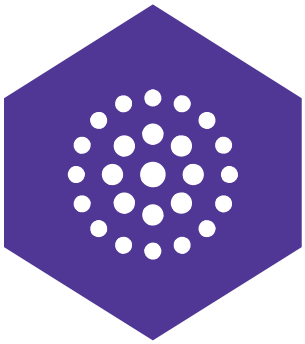

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Considerations for a Professional Development Program to Support iPads in Higher Education Teaching

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Abstract: The purpose of this paper is to examine the scholarly literature on the adoption of technology in education in order to identify the key considerations for designing, delivering, and evaluating a professional development (PD) program to support the use of Apple Inc.'s iPad technology by higher education teachers. Scholars who have studied the adoption of technology in educational settings indicate the need for PD in order for success. Even with hyped technology, such as the iPad, providing access alone is not enough for successful adoption. I begin by examining the literature on the use of the Technology Acceptance Model (TAM) in educational contexts and how it might influence a PD program. In the following five sections of the paper, I examine five elements that I have identified as crucial to successful technology adoption: technology, time, individual beliefs, organizational structures, and evaluation. Finally, I summarize the key considerations identified throughout the literature review. Based upon my review, a professional development program should: 1. Benefit both pre-adoption and post-adoption learners. 2. Include a learning intervention that aims to increase pre-adoption learners' perceptions on usefulness and ease-of-use. 3. Integrate both product technology and idea technology. 4. Demonstrate useful apps with workflow in a context that learners understand. 5. Begin with familiar activity before challenging beliefs. 6. Seek out stakeholders and idea leaders to provide context and champion the program. 7. Provide ways to share the re-inventions of idea technology at regular intervals. 8. Provide multiple training interventions spread out over time. 9. Use post-adoption learners to encourage change in beliefs of pre-adoption learners. 10. Mitigate pro-adoption bias by evaluating individual's perceptions using the TAM. 11. Evaluate impact by measuring the individual's impact of a lost device. 12. Repeat evaluations over various time frames to measure the change in the organization.

Keywords: Professional Development, Technology Adoption, iPad, Higher Education, Teacher Education, Faculty Development

Introduction

The purpose of this paper is to examine the scholarly literature on the adoption of technology in education in order to determine the key considerations for designing, delivering, and evaluating a professional development (PD) program to support the use of Apple's iPad technology by higher education teachers.

Technology adoption refers to an individual's acceptance of a technology, while *diffusion* refers to the adoption of a technology across an organization (Rogers 2003; Straub 2009). As is common with most adoption and diffusion researchers, I have a pro-adoption bias. Rogers (2003) describes a pro-adoption bias as the assumption that "an innovation should be diffused and adopted by all members of a social system" (p.106). In other words, I believe that it is beneficial for teachers in higher education to adopt the iPad into their teaching practice. By *higher education*, I mean post-secondary education, such as college or university regardless of subjects being taught, and *teaching practice* refers to all activities performed by teachers in the administration, preparation, delivery, and evaluation of instruction.

Scholars who have studied the adoption of technology in educational settings, believe that professional development is necessary for its successful adoption (Keengwe and Kang, 2012; Schneckenberg, 2009). Even with hyped technology, such as the iPad, providing access alone has not proven to be sufficient for successful adoption (Georgina and Hosford 2009; King 2002; van Oostveen, Muirhead, and Goodman 2011). Moreover, if early adopters of a technology have negative experiences, their experiences "may lead to skepticism among the early majority" (Moser 2007, 67).

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To determine the key considerations in the technology adoption literature, I created a framework to organize the different themes in the literature (see Figure 1), which I call the iPDP framework. The iPDP framework begins with the Technology Acceptance Model (TAM), which forms the foundation of quantitative technology adoption literature. Following the exploration of TAM, I established five themes that I have identified as crucial to successful technology adoption: technology, time, individual beliefs, organizational structures, and evaluation. These themes were influenced by Rogers' (2003) themes in technology diffusion theory: innovation, time, communication channels, and social system.

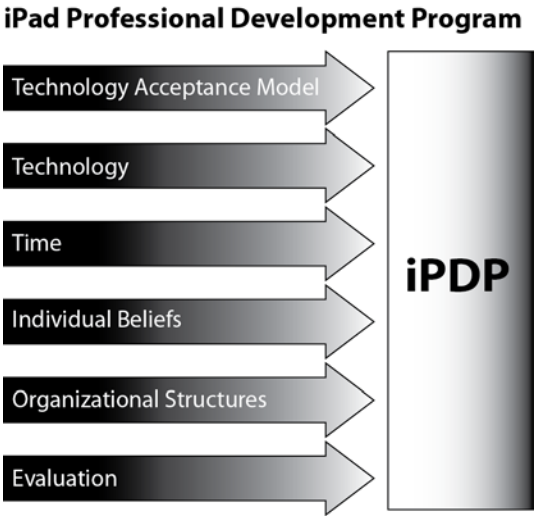

Figure 1 The iPDP framework for the determination of key considerations in an iPad technology adoption program. ©2012 Rebecca Hogue.

For brevity, I use the term "iPDP" to refer to a professional development program that supports higher education teachers' adoption of iPad technology, that is, an iPad Professional Development Program. I also define the ways in which I use the words teacher, instructor, student, and learner (see Table 1). For the purposes of an iPDP, I classify two levels of learners: *pre-adoption learners* and *post-adoption learners*, categories that only refer to using the iPad for teaching practice. Learners who use their iPad for entertainment might belong to either category.

I begin this paper by examining the TAM and each of the themes in the framework. Then, I summarize the key considerations for technology adoption that I identify throughout the literature review. These considerations are organized into three parts: design, delivery, and evaluation.

Table 1 Definition of Roles

Term	Definition
Learner	Participant in the iPDP, that is, higher education teachers.
Student	Person who is taught by a teacher. Because the participants in the iPDP (learners) are also teachers, the people the learners teach are students.
Teacher	A professional who teaches students, that is, a person who participates in teaching practice.
Instructor	Person who facilitates the classroom portion of the iPDP.
Pre-adoption learner	Participant in the iPDP who has not yet used his or her iPad for professional purposes.
Post-adoption learner	Participant in the iPDP who uses his or her iPad for professional purposes.

Technology Acceptance Model

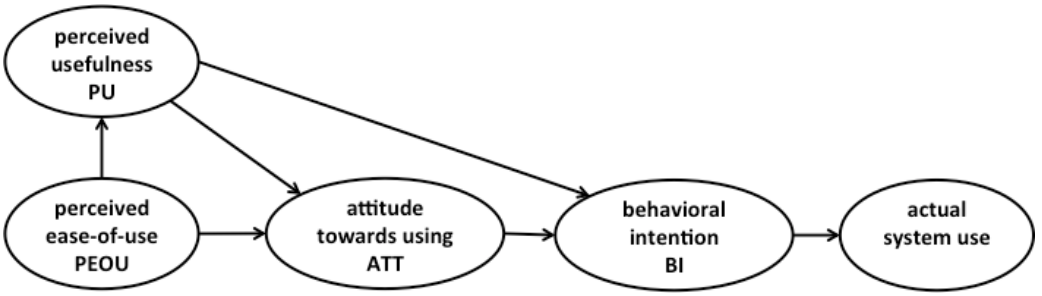

Figure 2 Technology Acceptance Model, adapted from Davis et al. (1989).

The TAM is a quantitative structural equation model created by Davis (1980), as part of his PhD dissertation and updated by Davis, Bagozzi, and Warshaw (1989) as a result of critical reviews, illustrated in Figure 2. The TAM is based upon the social psychology Theory of Reasoned Action (Davis, Bagozzi, and Warshaw, 1989), i.e., the TAM helps to predict whether an individual will adopt a new technology based upon his or her perception of the technology. It has since been reviewed and critiqued by hundreds of scholars (Bagozzi 2007) and remains a commonly used measure for technology adoption in information systems research (Wu 2012).

Since its inception in 1980, scholars have been examining and extending the TAM to help predict adoption of various technologies within specific contexts. Davis et al. (1989) posit that the two perceptions that influence an individual's adoption of a particular technology are *perceived usefulness* and *perceived ease of use*, where perceived usefulness is "the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context," and perceived ease of use is "the degree to which the prospective user expects the target system to be free of effort" (p.985). In terms of mobile technologies, however, the variables are less clear. Lui, Li, and Carlsson (2010) found that the biggest indicator of successful adoption was long-term usefulness, that is, the user's belief that the device would be usable over a long time period. Ease of use was no longer a consistent indicator. They suggest this is likely due to the efforts made by mobile manufacturers and learning content designers to address ease of use concerns. In summary, learners are more likely

to adopt a new technology if they find it to be useful, especially over the long-term, and easy to use.

The TAM points out two important elements in technology adoption: (1) the importance of increasing a learner's perception of the usefulness of the device, and (2) how easy the device is to use. It is likely that one or both of these elements is lacking in pre-adoption learners. Therefore, an iPDP should provide a learning intervention that helps to increase the pre-adoption learner's perceptions of the usefulness of the iPad and that demonstrates how easy it is to use.

Technology

Professional development in educational technology often focuses on the hardware or software aspects of the technology rather than the usefulness of the technology. Hooper and Rieber (1995) refer to the software and hardware focus as *product technology* and the usefulness aspect as *idea technology*. Unfortunately, idea technology is often missing in PD programs. Scholars highlight the need for professional development to include both product technology and idea technology (Georgina and Olson 2008; Hooper and Rieber 1995). In the following sections, I elaborate on the product technology and idea technology considerations for an iPDP.

Product Technology

In an iPDP, the product technology refers to the iPad hardware, iOS operating system, and the various software applications that run on the device. For the iPad, the term used to describe the software applications is *apps*, which are available over the Internet and accessible directly from the device through an application called the *App Store*. In Table 2, I list the characteristics of the iPad product and summarize a few ways in which the features of the iPad have been shown to impact teaching and learning. As the iPad is still an emerging technology, the primary focus in the literature has been on the effect of the iPad on student learning (Henderson and Yeow 2012; Tanaka, Paulo, Hawrylyshyn, and Marcario 2012) rather than teaching practice. An iPDP must address product features that support teaching practice with special focus on the usefulness and ease of use aspects.

Table 2 iPad Product Technology Description and Impact on Teaching Practice

Characteristic and Description[1]	**Impact on teaching practice**
Slate form factor Height: 241.2 mm Width: 185.7 mm Depth: 8.8 mm Weight: 601 g	• The device is light and small compared to laptops and textbooks. The small size allows the device to be used for learning in context, and makes it easier for learners to take the content with them (Henderson and Yeow 2012; Tanaka et al. 2012). • The mobile slate form factor encourages collaboration among students (Henderson and Yeow 2012). • The small form factor also allows the device to be easily passed between students and between the teacher and student (Henderson and Yeow 2012; Melhuish and Falloon 2010).
Display 9.7-inch (diagonal) LED-backlit glossy widescreen Multi-Touch display with IPS technology	• Multi-touch screen provides users with options on how they interact with the device: fingers, stylus (special pen), or on-screen keyboard. Multi-touch also allows multiple people to interact with the device at the same time, increasing collaboration (Henderson and Yeow 2012). • The screen size is similar to a storybook, making it more appealing to read than smaller mobile devices (Henderson and Yeow 2012). • Unlike laptops, which are often designed to provide private interactions with the device, the iPad has a wide viewing angle, which in a learning setting promotes sharing (Henderson and Yeow 2012). In addition, a laptop screen provides a physical barrier between teacher and student, which is not an issue with an iPad. • High-resolution screen allows for interactive pictures, which can replace the need for bulky props in teaching (Murray and Olcese 2011).
Memory 16 GB, 32GB and 64GB options available	The storage capacity on the device allows students to create an electronic repository of relevant content that they can access anytime anywhere (Tanaka et al. 2012), this also extends to teachers access to reference material.
Internet access WiFi connection when available. A cellular (3G) model is also available.	• The device provides immediate access to Internet resources wherever a Wireless network is available (Henderson and Yeow 2012). • Allows geographically dispersed learners the ability to interact while learning in workplace settings (Tanaka et al. 2012).
Operating System iOS mobile operating system	Unlike desktop operating systems, mobile operating systems turn on instantly. This time saver makes the device more usable. (Henderson and Yeow 2012)
Applications Over 25,000 educational apps available on the Apple App Store	• The App Store provides a very convenient central hub for acquiring software for the device (Henderson and Yeow 2012). • With easy access to so many application, it can be time consuming and difficult for teachers to keep up with the latest capabilities (Henderson and Yeow 2012).

1: Descriptions based upon the iPad2 Wi-Fi 16GB configuration as listed on the Apple website (April 15, 2012): http//www.apple.com.

Idea Technology

Idea technology is directly related to how much a learner perceives the usefulness of the device. A learner who has been presented with different idea technologies, that is, specific contextual ways in which the device can be used, is likely to have an increased perception of the usefulness of the device (Hooper and Rieber 1995). This aspect of an iPDP addresses the purpose for the technology within the learner's specific context.

The literature on the *Tablet PC*, an older Microsoft Windows technology that shares the touch- or pen-based interface and the slate form with the iPad (van Oostveen, Muirhead, and Goodman 2011), examines ways the Tablet PC could improve teacher practice and student learning. Scholars found that, when teachers used a digital pen to make annotations while presenting, student retention was increased (Neal and Davidson 2008). In addition, teachers found the devices convenient for marking electronically submitted assignments, especially those where comments were not keyboard friendly, for example, the marking of physics assignments where the teacher needs to add comments regarding equations (Freake 2008). Many of the barriers to adoption mentioned in the Tablet PC literature are mitigated by the iPad technology because, in comparison, the iPad has lower cost, longer battery life, a less bulky and lighter form, and easy-to-access, inexpensive applications. Even though there are differences between the Tablet PC and iPad technology, the literature on the Tablet PC indicates useful idea technologies that also apply to the iPad when used in conjunction with a stylus (special pen to replace the finger as an input device for the iPad).

Annotating while presenting information and marking papers represent two *workflows* for the iPad that support teaching practice. Workflows are descriptions of processes that include a detailed sequence of steps indicating how to perform a specific task. Workflows describe how to use the technology in a specific context rather than describing the product features. An iPDP needs to contextualize useful applications by providing detailed workflow descriptions in a context that the learners understand.

Finally, idea technology is not static because technology use must be adapted to different contexts. This adaptation is critical to technology adoption (Hooper and Rieber 1995; Rogers 2003) especially with the iPad, whose capability is enhanced by frequent introduction of new and improved apps. An iPDP needs to consider ways to share the adaptation of idea technology at regular intervals.

Time

Technology adoption does not happen overnight. Calendar time (that is, a period of elapsed time as opposed to a specified number of hours) must be allowed in order for an individual to absorb information about the new technology and reflect upon how it can be adapted to his or her workflow (Brown, Benson, and Uhde 2004; Rogers 2003). Spotts (1999) points out that a predominance of low-level users (pre-adoption learners) in an organization might simply mean that not enough time has passed for the new technology to be adopted. The need for calendar time to support adoption also aligns with Lawless and Pellegrino's (2007) comment that "the best professional development activities are spread out over time with opportunities for follow-up learning and feedback" (p.594). This indicates that an iPDP single half-day workshop would not provide adequate time to support technology adoption.

Individual Beliefs

Technology adoption is an individual choice and, as such, individual beliefs play a key role in the rate of adoption (Straub 2009). Rogers (2003) points out that "an important factor regarding the adoption rate of an innovation is its compatibility with the values, beliefs, and past experiences of individuals in the social system" (p.4). Pedagogical beliefs and values would impact how a learner perceives the iPDP. Ertmer (2005) cautions that PD programs should avoid associating

technology directly with a single teaching strategy. Teachers who do not believe in a specific teaching strategy will not see value in the technology because it does not align with their beliefs. Both Ertmer (2005) and Brown, Benson, and Uhde (2004) recommend that technology adoption programs begin by using the technology to support familiar activities before introducing changes that challenge belief systems. As a result, an iPDP should begin with activities that use the iPad to do things that teachers would normally do using a computer (such as sending email and researching course content) before addressing activities that require more of a shift in beliefs such as integrating the iPad into a lecture or activity.

In addition to beginning with familiar activities, Ertmer (2005) and Georgina and Olson (2008) emphasize the importance of peers in the adoption process. In order to encourage use of the iPad into teaching practice, teachers need to see how other teachers are using the devices. Thus, changing a teacher's beliefs is more likely to occur if peers socialize the ideas (Ertmer 2005; Rogers 2003). The same applies to learners; hence, an iPDP should integrate post-adoption learners into professional development activities in order to influence a change in pre-adoption learners. In addition, an iPDP should benefit both pre-adoption learners and post-adoption learners.

Organizational Structures

The success of technology adoption is strongly influenced by organizational structures and culture. The organization can have policies and practices that either help or hinder with adoption. For example, Schneckenberg (2009) warns that the culture of academic institutions is rather conservative and resistant to change. Adding to this culture is the "high degree of autonomy of professorate" (Schneckenberg 2009, 419), as demonstrated by the policies that accord higher education teachers the freedom to teach in any way that they wish. As a result, technology adoption cannot easily be a policy that is proclaimed by the institution. In this way the organization structures of higher education differ from that of the K-12 school system, where change can be legislated or pushed down from the school's administration. Within higher education institutions, change will come quicker if the professors themselves initiate it.

Another structural barrier to adoption is the need for higher education teachers to achieve high scores on their teaching so that they can gain tenure. This is especially the case for newer professors, who are often also the most energetic and creative when it comes to use of new technologies (Hagner and Schneebeck 2001). However, the need for good teaching scores causes creative professors to use tried-and-true ways of teaching rather than risking an innovative teaching strategy that may fail. Keengwe, Kidd, and Kyei-Blankson (2008) suggest that most faculty "were more likely to use technology if they had departmental and peer support, cross-collaboration with other faculty using technology, and if there was a rewards program in place to attract and motivate them" (p.25). If feasible, an iPDP should work with university administration to find ways to reward professors who are willing to try innovative ways of using technology in teaching.

In order to better understand the organizational context, researchers should seek out key stakeholders and idea leaders. *Stakeholders* are those people in the organization who have a vested interest in the success of the project, and *idea leaders* are the people in the organization who are respected by their colleagues and have influence over how these peers adopt new ideas. Baker et al. (2010), in their framework on faculty development, show that identifying and garnering support from key individuals is critical to the success of any faculty development program.

Evaluation

Evaluation is a process that determines whether or not a PD program was a success (Williams et al. 2011). Unfortunately, the literature tends to focus on describing PD programs, rather than researching their effectiveness (Steinert et al. 2006, 497). In addition, Scanlon and Issroff (2005)

highlight that "evaluations based solely on maximizing learning outcomes are too limited to help us to fully appreciate the impact of technology on learning" (p.431).

One goal of evaluation in an iPDP is to measure whether or not the organization's adoption of iPad technology has increased, that is, are higher education teachers using iPads to support more aspects of their teaching practice? This can only be determined by measuring the adoption by individuals within the organization (Rogers 2003; Straub 2009). Not only does this point to a need to measure individual adoption rates, it also means that measurement cannot be undertaken in a single instance of time, as "diffusion [of new technology] is a process that occurs over time, so there is no way to avoid including time when one studies diffusion" (Rogers 2003, 126). The researcher must study an individual's use of technology over time.

The question then arises: how can increased use of the iPad be measured? Counting the number of apps installed on an iPad is not an effective measure of use because learners can easily install but not use apps (especially with the large number of free apps available). Asking learners to report on the number of hours per week they use the device for professional practice is a useful measure, but alone it may speak more to the efficiency of the learner rather than the learner's adoption of the technology. I propose that a more useful measure would be to determine the impact of the device on a learner's specific teaching practice. One way to measure this is to ask learners what the impact on their teaching practice would be if they lost the device. Asking this question to an individual at various instances in time throughout the lifespan of an iPDP as well as comparing the changing responses could provide a useful measure of adoption.

In addition to addressing individual learner adoption, any evaluation should mitigate for the pro-adoption bias of the researcher. Rogers (2003) suggests, "taking into account the people's perceptions of an innovation, rather than the technologists', is essential in overcoming the pro-innovation bias" (p.109). One way to measure perceptions of the learner regarding technology adoption is through the TAM; however, the TAM only captures perceptions at a particular instant in time. An iPDP is intended to improve adoption over the duration of the program. Using the TAM at various time intervals (before program start, after each intervention, and after specified period of time) and comparing the results across time intervals could provide a useful measure of the change in attitudes. The TAM together with the change in impact of a lost device provides a useful measure of the success of an iPDP.

Summary: Applying Key Considerations in an iPDP

In the previous sections of this paper, I examined the technology adoption literature and identified key considerations for the design, delivery, and evaluation of an iPDP. Table 3 summarizes these considerations, categorized by design, delivery, and evaluation, where: (1) *design* indicates the considerations that affect the structure of the program; (2) *delivery* indicates the considerations that affect the implementation of the program; and, (3) *evaluation* indicates the considerations that affect how to measure the program's success.

Table 3 Key Considerations in Designing, Delivering, and Evaluating iPDP.

Design	The iPDP design should: 1. Benefit both pre-adoption and post-adoption learners. 2. Include a learning intervention (e.g., workshop) that aims to increase pre-adoption learner's perceptions on usefulness and ease of use. 3. Integrate both product technology and idea technology. 4. Demonstrate useful apps with workflow in a context that learners understand. 5. Begin with familiar activity before challenging beliefs. 6. Address technology adoption in a bottom-up fashion. 7. Include rewards for learners who are willing to try innovative ways of using technology in teaching. 8. Seek out stakeholders and idea leaders to provide context and champion the program.
Delivery	The iPDP delivery should: 1. Provide ways to share the re-inventions of idea technology at regular intervals. 2. Provide multiple training interventions spread out over time. 3. Use post-adoption learners to encourage change in beliefs of pre-adoption learners.
Evaluation	The iPDP evaluation should: 1. Mitigate pro-adoption bias; evaluate individual's perceptions using the TAM. 2. Evaluate impact by measuring the individual's impact of a lost device. 3. Repeat evaluations over various time frames (at the beginning, after each intervention, and at the 3- and 6- month marks) to measure the change in the organization.

Conclusion

In this paper, I used the iPDP framework (Figure 1) to examine the literature on the adoption of technology in education in order to identify key considerations for designing, delivering, and evaluating an iPDP. Regardless of the usefulness of the technology, Rogers (2003) cautions: "superior technological innovations do not necessarily diffuse themselves" (p.10). Thus, professional development promotes technology adoption. In order for individuals to successfully adopt a new technology, they must first be convinced that the technology has a useful purpose and they must perceive that the technology is easy to use. An iPDP program that takes into account the TAM, technology, time, individual beliefs, organizational structures, and evaluation has the potential to increase technology adoption.

The focus of this paper was limited to the literature relating to technology adoption in education. An additional investigation into the literature on learning theories, higher education professional development, and evaluation will provide insight into additional considerations for the design, delivery, and evaluation of an iPDP.

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