

2007

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Recommended Citation

Mendoza, Antonette; Stern, Linda; and Carroll, Jennie, "Plateaus in Long-term Appropriation of an Information System" (2007). *ACIS 2007 Proceedings*. 67.

<http://aisel.aisnet.org/acis2007/67>

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Plateaus in Long-term Appropriation of an Information System

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Abstract

This paper examines the process of technology appropriation and the triggers that encourage and discourage longer term use of an Information System (IS). In a longitudinal study over 14 months, we examine use of a Learning Management System in an educational setting. Our findings suggest that the process of appropriation is incremental over time. Multiple plateaus of temporary stabilization occur during longer term use of a technology. In addition, findings from the study reveal that rejection of a technology may take place long after adoption. Localized IT support, peer-support and availability of ongoing training in the form of one-on-one contact with the trainer, at critical time periods, may be key factors in encouraging productive use and avoiding rejection of the technology in the long term.

Keywords

Technology appropriation, adoption, adaptation, stabilization, training

Introduction

Technologies are seen as productive tools when introduced in an organization, enabling individuals and the organization as a whole to achieve productive outcomes. This requires effective long term use of the technology persisting well after initial adoption. While there is much literature about the influences that affect the initial adoption and intentions to use ("acceptance") of a technology (Davis 1989; Rogers 1995; Karahanna, Straub and Chervany 1999; Venkatesh, Morris, Davis and Davis 2003) little is known about the triggers that encourage and discourage long term use.

There is much literature about the diffusion of an innovation in an organization and the related change processes that accompany it in the form of organizational behaviour using the Punctuated Equilibrium Model (Gersick 1991; Romaneli and Tushman 1994; Van de Ven and Poole 1995; Loch and Huberman 1999; Sabherwal, Hirschheim and Goles 2001) and at the individual level, how users adapt a technology to suit their needs (Leonard-Barton 1988; Tyre and Orlikowski 1994; Majchrzak, Rice, Malhotra and King 2000). However, the change process in technology use among users as they adopt a technology and then adapt it to suit their needs in different environments in the long term, has long been treated as a black-box in IS literature. Little is also known about why users reject a technology long after adoption and the role of support in encouraging long term use.

In this paper, we extend our previous work on the process of appropriation of a technology over time in an educational setting (Mendoza, Carroll and Stern 2005). We define technology appropriation as: "*the way that users evaluate and adopt, adapt and integrate a technology into their everyday practices*" (Carroll, Howard, Peck and Murphy 2002). User experiences are studied over time and the findings are viewed using the Punctuated Equilibrium Model (Gersick 1991) to gain deeper understanding of longer term use of a technology. This study extends our understanding of the triggers that encourage and discourage productive and long term use of a technology in an educational setting.

The underlying questions addressed in this paper are: *How do users in an educational environment adopt, explore and apply a technology to derive value from it in the long term? What triggers encourage and discourage long term use of a technology?*

We begin with a discussion of the theories relating to the process of technology adoption and use, followed by the research design and methodology. The research findings are then presented and their implications are discussed. The paper concludes by presenting some avenues for future research.

Theoretical Background

Technology usage and acceptance has long been an important topic for information systems researchers (Davis 1989; Moore and Benbasat 1991; Thompson, Higgins and Howell 1991; Taylor and Todd 1995; Venkatesh and Davis 2000; Brown and Perry 2002). The Technology Acceptance Model (TAM) has been one of the most prominent models to predict technology adoption and use. According to this model, adoption and usage of a technology are predicted by intentions to use the technology, which, in turn are influenced by perceptions and attitudes about the technology. Perceived usefulness and perceived ease of use are the main determinants of user acceptance (Davis 1989). Recent studies have revised TAM (Venkatesh and Davis 2000; Venkatesh et al. 2003) by including social influences and key moderators. However, one shortcoming of TAM is that user's perceptions are different before and after adoption (Karahanna et al. 1999; Carroll et al. 2003), therefore, it is necessary to study the process from adoption to long term use.

Another theoretical approach to technology use builds on the Diffusion of Innovation Theory. According to this theory, the innovation decision process takes place in sequential stages. It starts from a user gaining knowledge about the innovation, to forming an attitude towards it, to deciding to adopt or reject the innovation, to implementing the new idea and finally to confirming the decision (Rogers 1995). Like the TAM, the Diffusion of Innovation Theory emphasises more on the adoption of an innovation rather than the process of appropriation as users adapt and re-invent the technology to suit their needs in the long term. It is therefore necessary to study the process from adoption to long term use to better understand how and why users adopt and then use a technology over time.

Some studies have built on the Punctuated Equilibrium Model (PEM) developed by Gould and Eldridge (1972). According to the PEM, a long period of relatively unchanged form called "stasis" may exist among species followed by radical change over a short duration called "punctuation" when new species arise abruptly. This paradigm has been used to understand changes in organization behaviour as innovations are diffused in organizations (Romanelli and Tushman 1994; Gersick 1991; Van de Ven and Poole 1995; Loch and Hubermann 1999) and a way of examining the dynamics of alignment (Sabherwal et al. 2001). A few studies have focused on technology use (Tyre and Orlikowski 1994). According to Tyre and Orlikowski 1994, users modify a technology to suit their needs and most adaptations are episodic and discontinuous in nature. They take place following initial implementation – during a window of opportunity. The technology then stabilizes and the window of opportunity may close. More recent studies suggest that users, through recurrent interaction with the technology, ignore certain properties of the technology or invent new properties and attain "*stabilization-for-now*" (Orlikowski 2000). Orlikowski does not make mention of the PEM even though descriptions of her study resemble the PEM. At present, however, little is known about how and why technologies come to be stabilized at certain times and are further adapted at other times.

Carroll et al. in 2002 conducted field research on mobile technologies and developed a Model of Technology Appropriation (MTA). According to the MTA, a technology that is introduced into a work place (technology as designed) is changed over time. The technology shapes the users' practice and in turn, is shaped by users' needs. This changed technology (technology in use) is an outcome of the process of appropriation, which involves users' trialling, evaluating and adapting the technology to suit their personal needs based on their perceptions and various other influences. The model represents three levels: level 1- when users are introduced to the technology and they are faced with the decision to adopt or non-adopt the technology during this initial encounter with the ICT; level 2 - once users decide to adopt the technology, they enter into a deeper level of use, the process of appropriation where they trial, evaluate and adapt the technology to suit their needs and in some cases disappropriate the technology; level 3- users' persistent use of the technology is captured and the technology is considered to be stabilized. However, little is known about the ongoing process of appropriation of an ICT, beyond adoption and stabilization in the longer term of different technologies in different environments.

Research Methodology

This research examines the process through which a technology is adopted, explored and applied to derive value in the longer term. It is the second project in a program of research examining the process by which users in an educational environment trial, evaluate and adapt technologies over time (Mendoza, Carroll and Stern 2005). A longitudinal study was conducted. We studied users of the Learning Management System (LMS) between January 2006 and March 2007 at the University of Melbourne. We chose the LMS for the study because the university had introduced this new system to support teaching and learning among staff and students. After pilot studies in 2005, a rollout plan for 2006 and 2007 was set in place by the university, where all subjects would go active on the LMS and all staff would be faced with the decision to adopt and use the technology. Centralized training courses were set in place by the university, to aid academic staff interested in learning to use the LMS.

Ten different training courses were visited and participants were recruited by the first researcher. Twenty three participants (7 female and 16 male) agreed to participate in the study. None of the participants had prior experience with the LMS, but 15 out of the 23 participants had used technology-based learning systems such as WEBRAFT (9 participants) or had developed their own web pages as a communication tool in their teaching practice (6 participants).

A multi-method research design was used, similar to our previous study (Mendoza et al. 2005). Interviews, focus groups, participant observations and scrap books were used to capture and triangulate participants' perceptions and expectations with the technology and track their perceptions and actual experiences with the technology during continued use of the technology. Participants were studied from their initial encounter with the LMS after training through to 44 weeks of use. Not all of the 23 participants were available to be interviewed and observed at every time point but attempts were made to follow up on all participants. Some of the participants were not using the LMS in the second semester of 2006 as they were not teaching a subject or were busy at critical dates. Data were collected at 8 points over the following 44 weeks, as shown in Table 1:

Table 1: Data collection timelines and techniques

Timeline based on Technology use	Number of participants	Techniques
1- 2 weeks after initial encounter	23	Interview
3 – 4 weeks	Three groups of 3, 4 and 2	Focus group + scrap book Interview + scrap book
7 – 8 weeks	22	Participant observation + scrap book
16 – 20 weeks	22	Follow-up interview + participant observation + scrap book
24 weeks	22	Follow-up interview + participant observation + scrap book
32 weeks	8	Follow-up interview + scrap book
36 weeks	6	Follow-up interview + scrap book
44 weeks	11	Follow-up interview

Between 1 and 2 weeks after training, background information was collected about participants' teaching, their prior knowledge about LMS and their recollection of how they came to know of LMS and why they attended the training program. Issues such as their attitude and expectations during their initial encounter with the technology were explored - a time when they were faced with the decision whether to adopt the LMS.

Scrap books were given to all participants during the first interview with the aim of providing as an expressive channel, for adding a different view on participant's perceptions when the researcher was unable to be present (Carroll et al. 2002; Mendoza et al. 2005). However, the scrap book was used only in the first 2 months of use. With time, not all 23 participants used the scrap book even though attempts were made to remind them.

After 3 to 4 weeks, focus groups were conducted, in which users shared their experiences and expectations, likes and dislikes about the technology with each other (Vaughn, Schumm and Sinagub 1996).

At 7 to 8 weeks, participants were observed using LMS at work in their natural setting. They were actively probed about their actions, while actually using the technology. Issues such as the role the technology played in participants' teaching practices, their experience with the look and feel of the interface, the features they used to suit their needs and the reasons for selecting specific features were explored.

Between 16 and 20 weeks and at weeks 24, 32, 36 and 44 weeks, follow-up interviews were conducted with participants. The interview questions were related to how participants used the technology in their teaching practice and their likes and dislikes about the technology and its features. They were also asked why they continued using the technology and what influences them to continue using the technology.

All interviews and focus groups were audio-recorded with the consent of the participants. In addition, the first-named researcher made field notes at interviews, focus groups and observations. Descriptive codes were used to generate general and specific themes. Diagrams and a time ordered matrix were also used to display, analyze and refine the themes from the data (Miles and Hubermann 1994; Langley 1999).

Research Results

In this section we report our findings on how participants used the Learning Management System in their teaching practice at different time periods. The findings have been organised according to the time of data collection.

Decision to Adopt

All participants attended a centralized classroom-based training program, organized by the University, on how to use the LMS. They perceived that it was a requirement by the university that they adopt the technology, *"...whatever decision the University makes in terms of channel to teach, you have to use it"* and some of them perceived that they had no choice but to use the LMS because similar technologies may not be supported in the future, *"I have the opinion or the belief that WEBRAFT will be phased out at some point and that the LMS will be the one we use"*. Participants perceived that the LMS might be useful in their teaching practice as a communication tool for staff and students, *"For communication for students and staff and I'm thinking that going to be very useful"*. This reflects expected usefulness or the degree to which a person expects that using a particular system would enhance his or her job performance (adapted from Davis 1989; Mendoza et al. 2005).

In addition, participants perceived that peers in the department or people in an authority role expected them to use the LMS. This is reflected in comments such as: *"We were strongly encouraged in the department to go put our hands up"* or *"...being the Associate Dean, I felt the sort of responsibility of understanding the system"*. This is an example of the subjective norm, defined as a person's perception that most people that are important to him/her think that he/she should or should not perform the behaviour in question (Davis 1989; Viswanath et al. 2003).

Some of the participants perceived that using the LMS would be easier than their experience with prior practices such as WEBRAFT, *"It's just an on/off button...In WEBRAFT you had to make pages using DREAMWEAVER and then upload them"*. Expected ease of use is the degree to which a person believes that using a particular system would be free of effort (Davis 1989). Eight participants expressed the need for professionalism and change to some of their teaching methods, *"...there should be an internet presence and it's not right that we hadn't one for so long"*.

Technology Use During Weeks 1 and 2

During weeks 1 and 2, participants were trialling the technology in their everyday teaching environment, *"I've been starting to set up folders...and I've gone in and put in my profile...so it's just really playing"*. They were also changing their existing practices to suit the technology, *"At the moment, I've been taking the stuff from WEBRAFT and I've had to adapt it, as we begin to use the LMS"*. During this time, their expectations about using some of the features changed as they tried adapting it to suit their needs. For example, one participant commented that the logins available in the GRADE BOOK feature may not be useful in his department as they used localized logins among their students, *"Having the university logins is just a complete waste of time for us in the grade book...I was planning to use all that but I'm not going to now because it's just an extra hassle"*. Some of the participants called for assistance from IT support staff in their departments or contacted the trainer from the initial course when they ran into problems, *"I've had to get help...from [trainers] of LMS and the IT person in our department to work out that the problem"*.

Technology Use at 3 to 4 weeks

During weeks 3 and 4, most participants had adapted to the technology to suit their immediate needs. Participants used the LMS in a limited way, *"I've done a bit of configuring of the menus... and make some announcements, so the basics just for the moment"*. They chose features that best suited their teaching practices at the time and rejected other features, *"People have to sign a plagiarism document ...so I don't see using the online submission"*. Some participants integrated their prior practices by using locally-developed software as an addition to LMS, *"...assignments submission, we've already got our own system for doing that, yes, but it can operate within this environment"*.

Some participants were still in the process of learning to use the technology and were faced with problems. They resolved problems on their own, *"I kind of hit a bit of a wall...I wasn't making a connection between the content system and the subject page, anyway sorted that out"* or contacted the trainer to help them resolve it, *"...one quite inconvenient thing about that [grade book] is all of the student data is downloaded in a single field – when I tried to come up with a formula and could not, [trainer] sent me a spreadsheet"* and some contacted the local IT support staff and peers for help *"I wanted to have a banner up...I contacted the support for that"*. In some cases, they worked around the problems by substituting their prior practice for a task as a way of resolving problems faced with the new technology. For example a few participants used WEBRAFT when they were faced

with problems using the LMS to do a task, *"I'm also using the WEBRAFT for class list...that's a useful facility...it saves a lot of time and mucking around, it's quick and it's up-to-date"*. While learning to use the technology, the lack of peer support to resolve problems was an issue for a few participants, *"...it's not sort of working intuitively...there's no-one in my department I can have a word with, I'm just totally working on my own"*.

Technology Use at 7 to 8 Weeks

During weeks 7 and 8, it was observed that participants had mastered a limited sub-set of the technology. This is reflected in a comment such as: *"I'm comfortable because I have got used to it.... see I'm using it only in a few limited ways...it's very stable for me"*. They not only adapted the technology to suit their teaching practices, but they changed some of their teaching practices to suit the technology. This is reflected in a comment such as: *"I'm more willing in class to mention music and songs knowing that students can go down and download them rather than rushing everything in class. I have changed in the way I have made materials available to students"*. Use of LMS appeared to stabilize, they selected some of the features that suited their teaching practice and opted not to use other features in the technology, *"I'm not using anything new...I'm not using the quiz because it's not a part of my teaching"*.

Routinization was observed in the limited use of the LMS even though participants continued to face problems, *"I have not been doing anything new with it"*. Some participants did not explore new features provided by the LMS because of prior problems they faced, *"When I was using in the first 4 weeks, I really struggled... I think I have a pre-disposition at the moment against it. I have to fight it"*. Some others simply worked around problems that they encountered while using the technology. For example one participant had problems with the limitation of file sizes that could be uploaded on the LMS *"I have been putting stuff using power point...but because of the size of the files...so I have dropped the images... and I have not had any organization issues"*. During this time, it was interesting to observe that some participants continued using home-grown software along with the LMS, *"I don't use the grade book...history department has our own system...It seems irrational for me to do it twice"* and a few participants continued to switch back and forth between their old practice and the LMS when faced with problems. For example one participant said, *"I tend to post most things to LMS except when I can't get that happening then I put it on WEBRAFT"*.

During this time, it was observed that one participant stopped using the LMS because she did not see the benefit of using it, *"I'm not using it for my teaching...a simple 2 minute task which is all it should be, but for me it's not a two minute task...it's not intuitive for me to use...there is no reward for my investment in time to use it"* and did not have IT and peer support, *"We don't have any support-technical assistant to help us...if there were a group of us in the dept using it and say common let's do it together...that might be better...I'm isolated and with a reasonable teaching workload it's not happening"*.

Technology Use Between 16 and 20 Weeks

After 16-20 weeks, stable use of the technology was noted. Thirteen participants did not change the way they used the LMS at this time, *"I have not done anything more advanced than I first started"* as their immediate need were met, *"I have been using the technology to suit my needs"*. They continued to work around their existing dislikes and problems which they had faced earlier, while using the technology *"I'm reconciled to the strange format and I live with it...even though its kind a stupidly designed, I'm kind of used to it"*. Nine participants commented that they had used new features which they had not used earlier. Further use was triggered by events in their teaching practices that needed specific features to suit their immediate wants at the time, *"I had to create a syndicate group in this subject"*.

During this time, another three participants stopped using the LMS. The inability to resolve some of their problems even after contacting the trainer or help desk support, *"she did not know how to solve the problem, so I don't use the feature"* and the lack of time, *"I don't think I'm really using it to its full potential...primarily time is the reason"* were noted by the participants. In addition, they commented that the lack of a reward for using it either because *"Students are not using it..."* or some of the features were not useful, *"...where the system would be most useful for me is the grading, assessment...and what we require isn't part of this system. ... I don't think it's all that useful"* stopped them from using the LMS to its full potential.

Technology Use at 24 Weeks

At 24 weeks, it was noted that participants once again selected and integrated new features provided by the LMS, into their everyday teaching practice. For example one participant created a banner for her subject using the BANNER feature, *"I figured out how to use banner feature this semester"*. Most participants contacted the trainer or IT support person to learn to use the new features or to resolve problems they had encountered, instead of using the manual provided to them, *"I went to training on assessment and communications...because it wasn't*

at all clear whether to use pool or test manager". One participant commented that he did not want to use the GRADEBOOK because his peers had faced problems with it, *"I didn't use the grade book, I was planning to...I got that mail from my colleague...about the problems he had with it... grade book would obviously have been useful...except it isn't quite"*. Three participants continued to use the WEBRAFT system in parallel with the LMS to accomplish a few tasks., *"Its so much easier to go back to WEBRAFT when we want to contact students...It's probably familiarity...it is easier and quicker for me to go somewhere I knew where I could find the information quickly other than going to LMS, which is hard to find"*. Participants expressed frustration when the IT help-line could not provide support to them when they had problems using the LMS, *"I actually called IT helpline and it was a waste of time... I find that it is really frustrating there isn't expertise to support us"*.

Technology Use at 32 and 36 Weeks

At weeks 32 and 36, use of the technology appeared to stabilize once again. No extra features were used by participants due to the lack of time and need to change their use of the LMS, leading to a stable use of the LMS, *"It's as I used before in first semester. I've fallen into a pattern where I'm not doing anything new with it...I find that it is still rewarding...I don't feel like I have time or really the desire to take it to next level"*. While the initial training attended by participants was class-room based, they expressed preference for a further one-on-one training session, from a local IT support person rather than a centralised training approach, to further use the LMS *"Well, I have done the basic training...I found it was just much better to have one-on-one, ask particular things that I need to know rather than sitting through 3 hours of training and there are couple of people outside LMS-IT, local IT support...it's just been easy to have them here"*.

Technology Use at 44 Weeks

At 44 weeks use, some changes in usage pattern were once again noted. One participant said, *"I have incorporated internet research...I'm teaching around internet contact using the LMS"*. Participants continued to express need for further exploration of the technology, *"We should use the grade book because it gets results to students and they will be alerted when it comes up"*. Some of them expressed frustration about the lack of response from the trainer when called, *"LMS-IT help desk can't help"* and worked with colleagues to resolve their problems, *"I get help from the tutor because it's too annoying and time consuming to upload stuff"*. One participant suggested that he did not see benefit using the LMS, *"Convince me that the LMS works, nobody did that...I don't see a benefit in using the LMS ...its re-investing my time"*. A few participants wanted to attend advanced training and observe how some of the other users had adapted the LMS, *"I'd like to attend training and it would be good if they showed us what others have done with the LMS to get some creative ideas"*.

It was noted that, during each of the time periods of the study, participants continued to express the need to further change their use of the technology by using features they had not used earlier. One participant, for example, stated that *"I realize the increased capability or things we can do through this, I will slowly teach myself how to do it"*. While the manual was useful as a reference initially, most participants did not find it helpful in adapting the technology in their teaching practices *"...one of the good things about the manual is, it shows you the screen you should be looking at and that's always reassuring, but- I think you'd only need that for a short time"*. They found it to be detailed and not intuitive, *"...I think sometimes too much detail is worse than not having enough. When I got lost, I got overwhelmed by the manual"*. One participant commented *"I need a help manual, that comes on-line with me... because people like me don't have time...you've actually got to go page by page through a bunch of steps"*. The need to attend advanced training courses to learn to use new features was indicated by participants at every time period of the study, *"...I know there is an advanced course and now that I'm feeling a lot more confident in using it...I think it'd be nice to know...there are those features"*.

Based on the findings, Figure 1 illustrates how participants, trial, explore and adapt features of the LMS then use stabilizes. The X-axis in Figure 1 shows the actual use of the LMS at different time periods starting from 1-2 weeks use until 44 weeks of use. A plateau indicates stable use of the technology by participants. A new need or trigger leads to further exploration and learning, followed by another plateau. This reflects a discontinuous pattern in the way that users evaluate and adopt, adapt and integrate a technology into their everyday practices – a process we call appropriation. Note that the triggers for change varied over time, supporting earlier findings that different influences on use are apparent at different points in the appropriation process (Carroll et al. 2003; Mendoza et al. 2005).

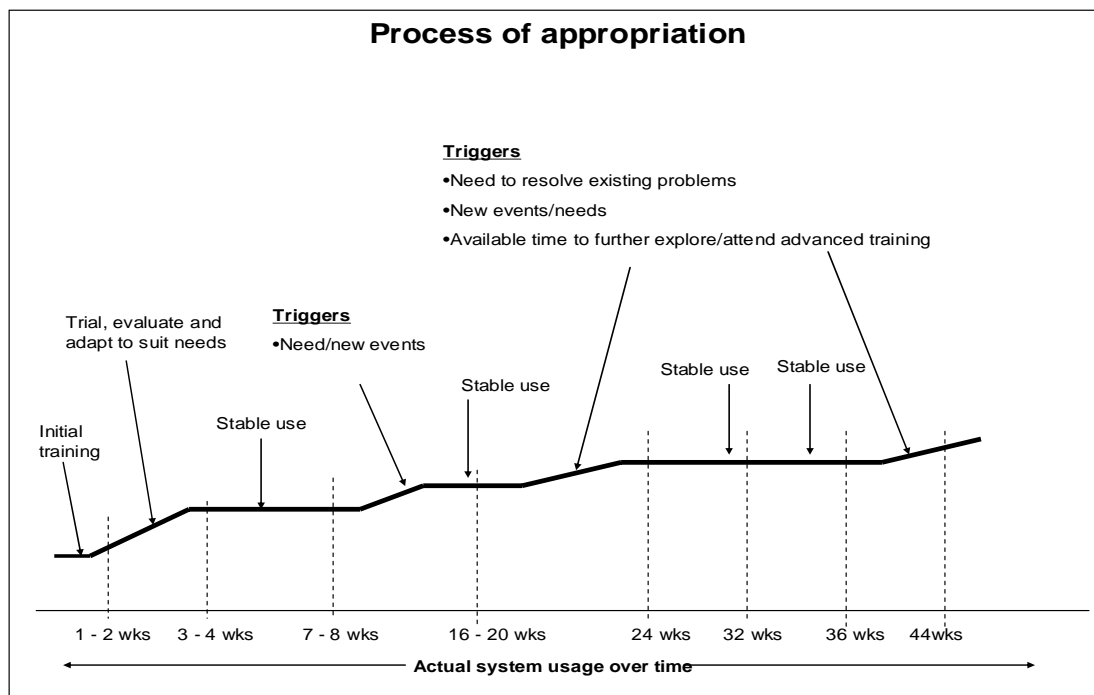


Figure 1: Process of appropriation over time
Plateaus - stable use of technology; Diagonal lines – further exploration and adaptation

Discussion

This research has addressed the question: How and why do users adopt, explore and apply a technology to derive value in the long term in an educational environment? One aspect of the findings, shown in Figure 1, is viewed through the lens of the Punctuated Equilibrium Model (PEM), to investigate more deeply the process of appropriation and stabilization in technology use.

In this study, users perceived use of the LMS as mandatory. Findings from this study support our previous findings (Mendoza et al. 2005) suggesting that users' decision to adopt a technology may not be sufficient to support productive and long-term use of a technology. Also, the need to change existing practices to improve professionalism in participants' teaching practice acted as a trigger that encouraged users in the decision to adopt, in addition to other, more well-established factors such as subjective norm, expected usefulness and expected ease of use (Davis 1989; Venkatesh et al. 2003).

Further, this study reveals that the process of appropriation incrementally evolves over time rather than being episodic in nature as suggested by some findings (Tyre and Orlikowski 1994; Holstrom 1999). While users trial and learn to use the technology during their initial encounter with it, adapting to the technology in their everyday practices (seen in weeks 1-2), a notion of a "window of opportunity" may exist when adaptation is most likely to occur (Tyre & Orlikowski 1994). However, findings from this study suggest that, with time, "multiple windows of opportunity" prevail, when users further adapt the technology into their everyday practices. As users gain experience and confidence with the technology, the need to explore and use new features provided by the technology or use the technology in new ways, act as a strong driver, in addition to new events and existing unresolved problems as suggested in some findings (Tyre and Orlikowski 1994; Majchrzak et al. 2000). In this study it was noted that during weeks 3-4, 16-20, at 24 and 44 weeks, users continued to explore and further appropriate the LMS by choosing new features provided by it. They also changed some of their existing teaching practices to suit the LMS (noted in weeks 7-8 and 44). In addition, they used prior practices – locally developed software or familiar technology in parallel with the new technology. They switched back and forth between their old technologies such as WEBRAFT when faced with problems with the LMS (weeks 3-4, 7-8). Therefore, findings from this study suggest that mutual adaptation may take place in different forms: users not only adapt to the technology and adapt the technology to suit needs but also combine prior practices involving other technologies along with the new technology into their everyday practices.

This study also reveals that the gradual process of appropriation of a technology similar to "punctuations" or "evolutionary period" (Gersick 1991; Sabherwal et al. 2001) is followed by multiple stabilization plateaus similar to "stasis" or "equilibrium periods" (Eldridge and Gould 1972; Gersick 1991; Tushman, Newman and Romanelli

1986) in the PEM. In this study we found stable technology use in weeks 7-8, 16-20, 32 and 36. If further appropriation is an incremental process then how can we explain the presence of multiple plateaus of temporary stabilization in longer term use of a technology?

Findings from this study suggest that stabilization may take place along-side existence of problems as users substitute their prior practice for a task as a way of resolving problems faced with the new technology. Familiarity with prior practices may pre-empt users from learning to use new features in a technology when time is an important commodity for a user. Stabilization may also take place as users work around problems (Tyre and Orlikowski 1994) by avoiding using features that cause the problem (observed in weeks 7-8). In addition we found that stabilization may be attained as users resolve some of the problems on their own or contact trainers, local IT support staff and peers for help in resolving problems. Findings from this study also suggest the lack of time and need to further appropriate the technology because of prior problems faced during earlier use of the technology may interrupt further exploration leading to stabilization (noted in weeks 7-8 and later in week 32, 36 and 44). Also, negative word of mouth from peers may discourage selection of unused features, triggering temporary stabilization. In this study, we found that a user did not want to use one of the features provided by the LMS because his peers had faced problems with it (noted in weeks 24).

This study reveals that rejection of a technology may take place long after adoption. Local IT and peer-support may resolve problems, help users see the benefit of using a technology and avoid rejection of the technology. In this study we found that one user stopped using the LMS due to lack of IT support staff and peers in her department using the LMS to motivate and help resolve problems faced during adaptation (noted in weeks 3-4). In addition, three users stopped using the LMS because their students were not using the LMS or some of the features could not be adapted to suit their needs (observed in weeks 3-4, 7-8 and 16-20). The inability to resolve some problems even after contacting the trainer or help desk support, had forced users not to use the features and work around them especially when they lacked time (noted in weeks 16-20). Therefore, we argue that it is important that we understand reasons for stabilization and its timing in longer term use of a technology, thereby supporting adaptation as a process of appropriation and avoiding stagnation or even rejection of a technology.

Conclusion

Studying users of a Learning Management System, we have found a number of ways in which long term use differs significantly from short term use as described in most studies. We have found that the process of appropriation is incremental over time. There exist multiple windows of opportunity, as users further explore and adapt a technology and choose to use a suite of technology-based solutions to suit their needs. Therefore, we suggest that studying an innovation in isolation may not be sufficient to understand adoption and long term use of a technology, when mutual adaptation takes place among a suite of technologies.

Multiple plateaus of stabilization in technology have been found in the longer term for varying reasons. We also found that rejection of a technology may take place long after adoption if localized IT and peer-support are not provided to users.

Given these findings, how can we support and nurture adaptation as a process of appropriation in the long term?

A variety of support mechanisms may be needed at critical time periods to encourage and support appropriation. Manuals may be useful as a reference document, but it may not always be the only way of helping users learn to use the technology, supporting previous findings (Mendoza et al. 2005; Calvert and Seddon 2006). On-line help within the technology may be more effective than manuals while learning to use the technology and adapting it over time especially when manuals are not easy to read or users do not have time to read them. In addition, findings from our study also suggest the ability to contact local IT support and peers to resolve problems, help see benefit of using the technology and share ideas on different ways of using the technology, may be important factors in encouraging further appropriation.

Designers, trainers and managers need to be aware that providing training for users during the implementation stage alone may not be sufficient to support and improve persistent and long term use of the technology. Ongoing training at critical time periods, in forms such as one-on-one contact sessions with the trainer or a local IT support staff, in addition to class-room based ongoing training courses may be a key factor in encouraging productivity and satisfaction among users. In future research, we plan to conduct case studies to investigate longer term use of a range of technologies in a variety of environments.

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