"Learnability" as a Positive Influence on Technology Use

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ABSTRACT

A number of different factors influence to a user's decision to adopt and continue using a technology. These include perceived ease of use (usability) and perceived usefulness (usefulness), among others. In this paper we examine another factor, ease of learning to use a technology, or "learnability". We discuss software design and social influences that can contribute to ease of learning, and discuss the importance of "learnability" for technology adoption and continued use.

Keywords: Adoption, technology use, learnability, ease of use, ease of learning to use

INTRODUCTION

Technologies are introduced into organizations in order to enable individuals and the organization as a whole to achieve productive outcomes. Of course, users must adopt the technology and continue using it if the desired outcomes are to be achieved. Adoption and acceptance of a technology has long been an important topic for information systems researchers [3,9,12,13].

In the Technology Acceptance Model (TAM), perceived usefulness and perceived ease of use have been identified as important determinants of intent to use a system, one of the first steps in technology adoption [3]. Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance [3]. Perceived ease of use is defined as the degree to which a person believes that using a particular system would be relatively free of effort [3]. In addition, TAM suggests that perceived ease of use may be a causal antecedent to perceived usefulness, another important factor in technology adoption. Recent revision of the TAM [13] includes some social influences and key moderators. It has also been suggested that an additional influence on technology adoption is the ease of *learning* to use a technology [1]. However, little is understood about the dynamic nature of perceptions of the ease of use and the ease of learning to use a technology during adoption and actual use.

We have conducted case studies on adoption and appropriation of software technology in the higher education context, with an emphasis on the influences that are important for adoption and continued use [6,8]. In these studies, we have confirmed the importance of the ease of *learning* to use a technology, in addition to the importance of perceived ease of use of the technology. We define *ease of learning to use* as the degree to which a person learns to use a particular technology and its features without undue difficulty. We identify from these case studies and report here on factors that contribute to ease of learning to use a technology or lack thereof.

METHODOLOGY

Case study 1: Algorithms in Action (AIA)

Algorithms in Action (AIA) is designed to support undergraduate students who are learning algorithms and data structure. The software provides a high level pseudocode description of an algorithm, which can be elaborated through a process of user-driven, step-wise refinement [11. The pseudo-code is accompanied by animation and textual explanation of various algorithms, at a level of detail consistent with the pseudocode. Multiple views of the algorithm are visible simultaneously. The software has many advanced features to support independent student learning, including speed control, backup to the first step in the session, step-wise refinement, breakpoints, and input of user-defined data. AIA was specifically designed to accommodate multiple modes of learning, and studies have shown that students use AIA according to their own learning style preferences and according to their needs at any given time, *e.g.* new learning *vs.* review for examinations [4,10].

In our case study of AIA adoption and use, 25 participants were recruited from a second-year level subject on algorithms and data structures. Data were collected soon after the initial encounter with the technology, at 1-2 weeks, and again later at 6-7 weeks of actual use, using interviews, focus groups, and direct observations of students using the software in the computer laboratory. Background information on students' prior knowledge and prior experiences with other software were collected, and their attitudes and expectations during their initial encounter with AIA were explored. Specific comments on using AIA were also recorded.

Case study 2: EndNote

EndNote is a bibliographic software package. It is an all-in-one tool that integrates tasks such as searching bibliographic databases on the internet, organizing references in a database and creating bibliographies automatically in word processors. While it has many features, use must follow a strict protocol and there is usually only one way to accomplish a given task.

In our case study of EndNote adoption and use, 14 postgraduate, participants were recruited from EndNote training courses conducted by the School of Graduate Studies at the University of

Melbourne. Twelve out of the 14 participants had no prior knowledge of the EndNote software. Participants were studied from the initial training course until 16 to 20 weeks of EndNote usage.

The research design used interviews, focus groups, scrap books and participant observations [6]. Data were collected at the initial encounter with the technology and 3 subsequent times over the following 20 weeks, using audio tapes and field notes. Descriptive codes were used to identify general and specific themes in the data. A time ordered matrix [5] was used to display and analyse the themes from the data collected at different times.

In both the AIA and the EndNote case study, several different influences on adoption were studied [6]. In this paper we report only on perceived ease of use and ease of learning to use.

RESULTS

User Background

The backgrounds of the students in the two studies were quite different. Participants in the AIA case study were second year computer science students and had prior experiences with other learning tools in their tertiary education. Their familiarity in using a technology in their education appeared to influence their decision to adopt AIA. For example, one of the participants commented, "*I have used MATLAB for another subject and I like using software"*. In addition, students were already positively disposed towards computers and learning tools, as expressed by such comments as "*For computer science, we have to use the computer, not sit and see the lecturer"*. They perceived that the information provided by the software would be complete and accurate, "*If a human being is teaching something, they could miss-out on something"*. Several students also expressed a liking for interactive tools in general and appreciated the pictorial representation of the algorithms provided by AIA, "*…it is cool…you can concentrate on all diagrams and pictures…I like it as they tell you how things work and we get a clear idea…It could be a good start".*

In contrast, users in the EndNote study were postgraduate students and researchers from non-technical disciplines, not necessarily experienced with software or positively predisposed to it. Participants uniformly replied in the negative in response to the questions *"Do you have prior knowledge of the software, its interface and services it offers?"* and *"Have you used a similar technology before?"*

Technology use – ease of use and learning to use

Based on the data collected in the AIA case study, it was noted that in weeks 1-2 and 7-8, aspects of ease of using AIA were noted as influences that encouraged use, while at the same time aspects of lack of ease of use were noted as influences that discouraged use.

Most participants commented that the technology was easy to use, "*It is very easy to use, the options and buttons are self-explanatory".* In weeks 1-2 and 7-8, lack of ease of use for AIA was expressed in terms of usability issues. One participant said, *"These multiple windows start popping up and it gets confusing, then going back and forth, they tend to disappear, the multiple windows don't really help …. These windows become a little confusing, I'm trying to look at the code and the graphical window but these windows pop up…It is a bit confusing. if it was one full screen its better",* and a few others expressed similar usability concerns.

Participants in the EndNote case study, in contrast, did not comment on ease of use and the lack of it, but did comment extensively on lack of ease of *learning* to use. As early as 1-2 weeks after training, EndNote users commented negatively on the lack of ease of learning to use the software, and continued expressing frustrations through 20 weeks each time they needed to learn to use a new feature. For example in weeks 1-2 they found EndNote to be unintuitive and not easy to learn to use: *"At the moment you feel like you have to look up and follow it step by step because it does not speak to you from the screen, it does not suggest where to go next"*. The help feature on the software did not help them because they were not familiar with the terminology used: *"…when I looked at the HELP to find a field, I don't know what they called it. I would call it field but I think they call it something else... it's the jargon that makes it difficult"*. If a technology is not easy to learn then it can stimulate users to start comparing it negatively with other technologies *"nothing seems intuitive…and I have found myself trying the help all the time… I can't recall any other software that I have ever pressed HELP as many times as this one and even then it didn't quite help me" (*noted in weeks 3-4). Lack of ease of learning continued to negatively influence further exploring and adapting the technology even in weeks 7-8. For example one of the participants said, *"The references were in upper case or lower case and then when I print…it would all be in lower case. It was really annoying me"*.

The influences observed are summarized in Table 1. As shown in the table, students using AIA commented solely on ease of use of the software, with both positive and negative perceptions, and did *not* comment on ease of learning to use the software, or lack thereof, while users of EndNote commented on the lack of ease of learning to use the software and did not mention ease of use or the lack of it.

In both case studies, support was available to participants and offset some of their frustrations with the negative influences. For example, one of the participants in AIA case study commented, *"It is pretty confusing, I don't understand what these functions are doing"* and contacted the lab demonstrator for help. In the EndNote case study, the availability of trainers and other on-line tutorials was noted as a positive influence expressed by participants. It helped them resolve issues and fix some of their problems. For example one participant had problems downloading information using EndNote, *"I got only the first reference from the ones I marked. That was a problem",* and contacted the trainer for help, "*The [trainer] said 'down load the additional filter from the university web site"*. Another participant used on-line tutorial to learn to use features, *"I found myself running back again to those on-line tutorials"*.

Lack of rejection of the technology – during adoption and continued use

It was observed that in neither the AIA case study nor in the EndNote case study was the technology rejected. In spite of expressing frustration with the lack of ease of learning to use EndNote, it was interesting to observe that at the same time participants were motivated to learn new features because they

	Weeks 1-2	Weeks 6-8	Weeks 16-20
Lack of ease of learning to use			
AIA	-	-	Study ended
EndNote	√	√	√
Ease of use and lack of ease of use			
AIA	√	√	Study ended
EndNote	-	-	-

Table 1: Influences noted during adoption and use in AIA and EndNote case studies

found the software increasingly useful. They expressed usefulness in terms of the features provided by it. For example participants suggested that the ability to search references through their EndNote library was useful, "*Being able to search and find through keywords, that's very useful for me I think"* and the ability to cite references as the write documents using Microsoft Word was useful, *"the Cite While You Write feature which I found very useful"* [6]. In addition, subjective norm was another positive influence that encouraged participants to adopt AIA and EndNote. For example, participants decided to adopt AIA because their lecturer had asked them to use it, "*…I would not like anything to learn from the tool, I prefer to read the book, it is not a tool that will automatically be suggested to me, it is because the lecturer said so".* In EndNote, they decided to adopt it because their supervisors and peers suggested they use it, *"My supervisor strongly suggested me to use it. Further more my colleagues found it useful and advised me to learn more about it"* [6].

It was also observed that easy access to ongoing training continued to encourage use of the technology over time. For example in the EndNote case study, easy access to ongoing training helped some participants resolve existing problems that arose while adapting the technology to suit their new needs, *"Things like these- the importing and exporting…with the training it made it easy. This filter thing is not something that I would have known if I had not gone for the training".* A few participants even attended additional on-going training sessions to help them further explore and use EndNote, *"I went for this course and asked her [trainer] a few things and then I clicked this one thing and it changed from lower case to upper case"* .

So, the negative influences of lack of ease of learning to use EndNote and the negative issues around lack of ease of use of AIA were offset by positive factors, such as perceived usefulness, subjective norm [3,13] and support.

DISCUSSION AND CONCLUSIONS

In these studies, we have noted that perceived ease of use of a software application does not always translate into ease of *learning* to use that application. Nor does perceived ease of use always translate into actual ease of use in the medium to long term. In fact learning to use is the step between perceived ease of use and actual use. If that learning is difficult, it can be a negative factor, as we have observed in our study of the bibliographic software. In the AIA case study, the lack of ease of learning to use did not appear to present a problem, leading to a seamless progression through perceived to actual use. In EndNote, however, lack of ease of learning to use presented a significant hurdle.

The data from these two case studies suggests that there are three basic categories of factors that contribute to ease of learning to use a piece of software (Figure 1). The first of these categories relates to the technological interests and previous technological experience of the user. In this category are factors such as previous experience with similar technologies and a predisposition to like using information technology, as noted in AIA case study. EndNote users came from non-technical backgrounds and did not have an experience with EndNote and any similar technologies. These factors are inherent in the user's background, and are not influenced by the software design. Because we did not compare these two different cohorts using the same software application, we cannot show a definite causal effect, but our data suggest that users' backgrounds may influence their perceptions of ease of learning to use a technology. Similar findings have been reported by others [2].

The second category of factors that contribute to ease of learning to use a piece of software relates to properties of the software itself. Within this category, we include the ability to use the software in different ways. For example, EndNote requires that the user follow a fairly rigid protocol. For example there are standard columns such as keywords, notes and title that hold information. The layout suggests that information may be

filtered based on a specific column for example. The filtered list is displayed on one page sequentially. A bibliographic tool *could*, however, show multiple views and allow multiple modes of use. For example, users' notes and keywords could be mapped visually. The fact that currently available bibliographic tools do not do visual mapping does not mean that they couldn't, and the extra view might very well improve ease of learning to use, thus enhancing adoption and continued use.

In contrast, AIA was deliberately designed to be useful to students with a variety of learning styles; students can use the software in a primarily visual mode, or they can use the software in a primarily textual mode [4]. This design framework probably means that students with a wide variety of different learning styles can find it easy to learn to use AIA.The presence of multiple simultaneous views and control of the speed of animation further enhances the ability of users to use AIA in the way that suits them best, and probably also enhances the ease with which they can learn to use the software.

The progression from perceived ease of use to actual use, through ease of learning to use, and the potential influences of user background, software design, and the availability of support are summarized in Figure 1.

The third category of factors that contribute to ease of learning to use a piece of software relates to the level of support available, which was seen in both case studies.

Negative influences may not stop users from using a technology, and rejection was not noted in this study. In the EndNote case study, there were a number of other positive influences, encouraging postgraduate students to continue using the technology, and this lack of ease of learning the system did not directly result in users rejecting the technology. Our previous work has shown that perceived usefulness, strong subjective norm, and appropriate support can be strong enough positive influences to overcome negative influences [6,7]. For example in the EndNote case study, all three of these positive influences were strong.

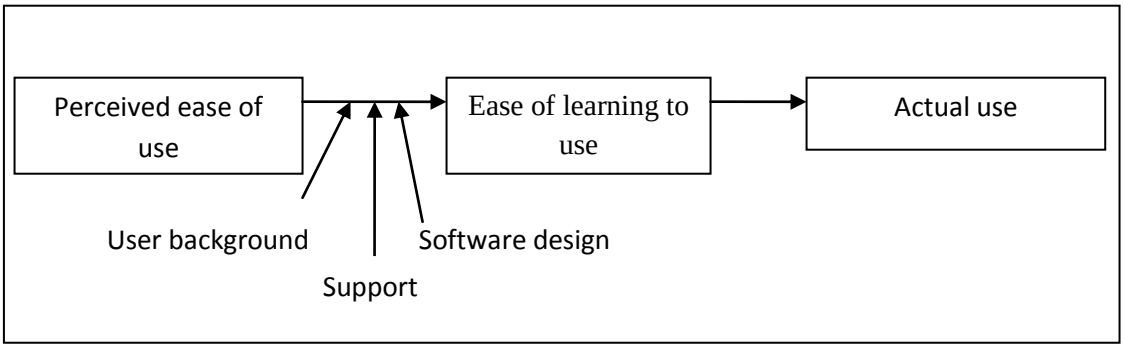

Figure 1: Progression of influences over time and potential influences.

But negative influences introduce additional hurdles to adoption and continued use. While rejection of technology was not noted in our case studies, in other cases, particularly where there are fewer positive influences, lack of ease of learning to use might tip the balance into rejecting the system in question. Therefore it is important to address this issue. Especially in the medium to long term, negative influences can lead a user to reject a technology as a whole or to rejecting some of its features, and it is desirable to minimize them where possible [8]. Bibliographic software is not usually designed to appeal to the visual part of a person's ability to process data, but it could be, and some people might find this improves ease of learning to use. We speculate that designing software with *learnability*, as well as *usability*, in mind may improve ease of learning to use, thereby eliminating an important negative influence on adoption and continued use of a new technology.

Another strategy might be to provide additional support where lack of ease of learning to use and the lack of ease of use of the technology are potential problems. Findings from our study suggest that quick access to trainers and peers help users to resolve existing problems while using a technology. A strong supportive mechanism could play a role in encouraging users to persist using and exploring new dimensions of a technology, helping in solving specific technology related obstacles and problems and finally help users perceive long-term benefits of using a specific technology. Designers, trainers and managers need to be aware that lack of ease of use and the lack of ease of learning to use may disrupt productive outcomes from technology use and sometimes may lead to rejection of a technology in the long-term. Therefore, we suggest that managers and team leaders provide a support mechanism to users at critical time periods to support and improve persistent and long-term use of the technology.

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