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THE USE OF TECHNOLOGY-ENABLED LEARNING TOOLS IN AN INTRODUCTORY INFORMATION SYSTEMS COURSE

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Abstract

Educators today are faced with the challenge of how to effectively use information technology to support learning objectives. With endless possibilities but limited time and funding, what technology-based tools should be developed and deployed? We begin to address this question by studying a large introductory information systems course, where students had a variety of face-to-face and autonomous, technology-based tools available to help them learn the software skills required in the course. All tools were available on a voluntary-use basis. The results show that two technology-based tools, a software practice test and a set of screen cams (interactive movie files), were used significantly more than the attendance-based, face-to-face tools such as tutorials or labs. Two factors consistently explained the usage of the practice test and screen cams—perceived usefulness and academic motivation. The results suggest that there may be some relatively simple ways to utilize technology in a way that provides value to students and is cost-effective from a resource point of view.

Introduction

Information technology (IT) creates opportunities for educators to support their courses in novel ways. For example, technology can enhance face-to-face learning in the classroom, or provide multimedia modules for students to use on their own. These opportunities also present challenges for educators. What content should be delivered using web-based courseware versus face-to-face classroom or lab settings? How many and which learning technologies should be employed and supported, given educators' limited time and funding? IT also creates opportunities and challenges for students. Students often have multiple resources or tools available to help them gain the requisite knowledge and skills. For example, a student needing to learn a software package might attend structured tutorial sessions led by an instructor, explore the package in a computer lab using the online help or on-site lab assistant, work through a software manual and CD-ROM tutorial from home, or some combination of these. The resources differ in terms of structure, human assistance, and learning strategy (e.g., trial-and-error or instruction-based). Which tools and resources should students use, given their learning objectives and time constraints? In an academic environment where the possibilities for supporting learning with IT are almost endless but the educators' and students' time and resources are not, an important question is which tools are used? Understanding students' usage of various learning tools can help educators decide where to focus their time and effort and can begin to address the effectiveness of the tools from a cost and learning perspective.

This paper describes an exploratory study of undergraduate students' usage of a variety of tools to help them learn Microsoft Word. Over 500 students enrolled in an introductory information systems (IS) course at a large New Zealand university. As part of this course, students were required to learn several software packages. They had to pass an online software test in each package as part of the requirements for passing the course. Each software test was administered in a supervised and time-constrained setting. Over the years, the number of software packages taught and the level of competency required in each one has risen. Enrollments have also risen. Not coincidentally, the number of learning tools to support the course has increased. One of the challenges for the course instructors is what tools to provide to help the large number of freshman students with diverse backgrounds master these packages in a twelve-week semester.

From the course's inception, weekly tutorials have been a primary resource provided to students. With increased enrollments, 20-30 tutorial sessions are now offered each week, with a team of tutors and a dedicated teaching lab to support them. Over the years, other tools or resources have been added in response to student requests for additional support. For instance, there are additional lab sessions targeted toward students needing extra help or a slower pace of instruction. A web-based learning and assessment system called *Cecil* (Gardner et al. 2001) is used to deliver two new learning tools to students. One is a practice software test and the other is a set of interactive movie files (screen cams) that can be "played" to demonstrate how to accomplish various software tasks. In essence, students have a variety of face-to-face and self-guided resources available for them to use in any combination they see fit. The course instructors were interested in which tools and resources were being used, why, and by whom (e.g., students with lower levels of computing confidence or students for whom English is a second language). Thus, the primary purpose of this study was to address some of the concerns of those managing and delivering the course by examining factors that could explain the usage of different learning tools.

Prior Research

Three streams of IS research were used as the foundation for the study: the Technology Acceptance Model (Davis 1989), Social Cognitive Theory (Bandura 1986), and End User Training effectiveness (Bostrom et al. 1990). Each of these theories is described briefly below.

The issue of technology acceptance and usage has been extensively examined in IS research, with models such as the Technology Acceptance Model (TAM) (Davis 1989). TAM is an adaptation of the Theory of Reasoned Action (Ajzen and Fishbein 1980) specifically tailored to explain the determinants of IT acceptance. Technology acceptance is defined as the voluntary use of a target system. The model emphasizes that an individual's attitude toward and subsequent use of a system are determined primarily by two factors, the **perceived usefulness** and **perceived ease of use** of the system. TAM is a parsimonious model that has been applied to technologies such as email, voice mail, word processing packages, spreadsheets, and computer labs (e.g., Agarwal and Prasad 1997; Mathieson 1991; Taylor and Todd 1995). In general, these studies have shown consistent support for the importance of perceived usefulness in explaining usage, and somewhat less consistent support for the importance of perceived ease of use.

Social cognitive theory (SCT) is a rich theory from social psychology that explains individual behavior as the result of the interactions between individual, situational, and environmental factors (Bandura 1986). Two contributions of this theory to research on IT acceptance and usage are self-efficacy and behavior modeling. **Self-efficacy** refers to an individual's belief in his ability to perform a task. This construct has been studied in a variety of settings and found to be an important factor in explaining technology usage, where higher levels of self-efficacy are associated with greater technology usage (Compeau and Higgins 1995). Self-efficacy is also important because it can be influenced by interventions such as training. According to SCT, a considerable amount of learning occurs vicariously by observing the behavior of others and its consequences for them (Bandura 1986). This observational learning is referred to as behavior modeling and is apparent in the training methods and approaches used in technology contexts, where an instructor demonstrates how to accomplish a task with the technology and the trainees then mimic what they saw. SCT suggests that behavior modeling can raise an individual's self-efficacy, which in turn may increase the individual's technology usage. While self-efficacy has been used to explain the acceptance of a target technology (e.g., a word processing package), it has not been used to study the acceptance of training tools for learning the target technology. In the current study, we measure students' self-efficacy with respect to the software package they are required to learn. We propose that higher levels of self-efficacy indicate lower levels of computer-related anxiety, and thus may lead to higher levels of acceptance of technology-based training tools.

In addition to self-efficacy, we were interested in another individual factor, namely academic motivation (Vallerand et al. 1992). Prior research has clearly linked academic motivation to overall academic performance (Eskew and Faley 1988). However, motivation has not often been studied in the context of technology acceptance. We included it in our study based on the instructors' perception that the more motivated students expend the effort to use non-required training resources.

TAM and SCT address our research question by suggesting that a learning tool's perceived usefulness and perceived ease of use and the individual's self-efficacy may be critical to explaining the usage of learning tools. The research on end user training contributes to this study by providing a framework for characterizing the different learning tools (Bostrom et al. 1990). Much of the literature on end user training examines the interaction of training methods with individual differences and the subsequent effect on training outcomes. Different types of training have been investigated, including behavior modeling, instruction-based training and exploration-based (e.g., Lim et al. 1997). **Behavior modeling** is typified by classroom settings where a tutor or instructor demonstrates how to use the software to accomplish a task, and then the students mimic or repeat the demonstrated behavior. **Instruction-based** training is typically deductive in that students learn the relevant rules, concepts, and/or model of a system and then apply this knowledge to specific examples. This type of training is highly structured and uses prepared materials

to explain the rules, concepts, etc. **Exploration-based** learning is a more inductive process, where students work through the system in a self-guided, trial-and-error manner. The results from studies in this area have been mixed, and complicated by the fact that many different training methods and materials, target systems, and individual differences have been investigated (see Olfman and Pitsatorn (2000) for a review). In short, we still know little about what type of training is most effective for which individuals learning a specific software application (Bostrom et al. 1990).

Model and Sample

The dependent variable in this study is the students' usage of the learning tools available to them. Six distinct tools or resources were examined: (1) a practice software test; (2) screen cams; (3) tutorials; (4) open problem clinics; (5) formal problem clinics; and (6) remedial workshops. Each of these is described briefly in Table 1. Usage of attendance-based resources (tutorials, problem clinics, and workshops) was measured by objective attendance reports kept by the tutors or lab instructors. For the technology-based tools (practice test and screen cams), students were asked a series of questions about whether and how frequently they used each tool.

The independent variables were drawn from the literature described earlier and the instructors' interest in certain individual characteristics of the students. The independent variables are described in Table 2.

Data was collected over a six-week period, using online questionnaires administered via *Cecil* in a supervised setting. The age, ESL, self-efficacy, and motivation data were collected in the first week of the course. The perceived usefulness, perceived ease of use, and usage data (actual and self-reported) were collected in the sixth week of the course, prior to the Word test on which students were assessed. Response rates to these questionnaires ranged from 65% to 89% (337 – 460 questionnaires) of the students enrolled in the class.

The same questionnaires were given to all students with one exception—the tool perceptions questionnaire. Due to time constraints, we did not ask students to complete a questionnaire covering the perceived usefulness and perceived ease of use for **all** six learning tools. Instead, six separate questionnaires were developed, each covering the perceived usefulness and perceived ease of use for a different tool. *Cecil* randomly distributed one of these questionnaires to each student to complete online. In total, 460 tool perceptions questionnaires were completed, with 72 to 86 questionnaires completed for each tool.

The final sample for each tool included only those students for whom we had a complete set of data (i.e., perceived usefulness and ease of use for one of the tools, age, ESL, self-efficacy, motivation, and usage of each tool). The final samples ranged from 36 to 46 students per tool, and 266 students overall. This represents 52% of the students enrolled in the class.

Table 1. Learning Tools

Tool	Description	Availability	Training Method
Practice Test	Electronic document, similar to the Word test on which students would be assessed.	Download anywhere/anytime via *Cecil*.*	Exploration-based.
Screen Cams	Interactive movie files that demonstrate the sequence of steps needed to complete the type of tasks required on the Word test.	Download anywhere/anytime via *Cecil*.*	Behavior modeling.
Tutorials	Tutor leads 20-30 students through structured exercises supported by textbook. Moderately-paced.	One hour/week in a teaching lab. Students sign up for one day/time slot for the semester.	Instruction-based & behavior modeling
Open Problem Clinics	Students work at computers on assignments, practice test, etc. and can ask help of an on-site tutor when needed.	Weekdays during lunch hours in computer lab. First-come, first-served basis.	Exploration-based.
Formal Problem Clinics	Tutor demonstrates how to accomplish tasks, similar to the tasks on the Word test. Slow-paced.	One day/week in computer lab. Students sign up ahead of time.	Behavior modeling.
Remedial Workshops	Tutor asks students how to complete tasks on the practice test and makes corrections as needed. Slow-paced.	Weekend workshops held in computer lab. Students sign up ahead of time.	Exploration-based.

**Cecil* is a web-based learning and assessment system used at the University of Auckland (Gardner et al. 2001).

Table 2. Independent Variables

I.V.	Description	Cite	Measurement
Perceived Usefulness	Degree to which a specific learning tool is perceived as helping the student successfully learn Word.	(Davis 1989)	6 questionnaire items, each item using a 7-point scale.
Perceived Ease of Use	Degree to which a specific learning tool is free from difficulty, or is easily available/accessible.	(Davis 1989)	6 questionnaire items, each item using a 7-point scale.
Academic Motivation	Degree to which student is intrinsically or extrinsically motivated with respect to university education.	(Vallerand et al. 1992)	Academic Motivation Index (AMI) calculated based on responses to 28 questionnaire items.
Self-Efficacy	Student's confidence in his/her ability to successfully learn Word.	(Compeau and Higgins 1995)	10 questionnaire items, each using a 10-point confidence scale.
ESL (English as a Second Language)	Whether English is student's first language or not.	N/A	Categorical variable.

Results

The median age of the students participating in this study was 20 (range 17-51, standard deviation 5.35). English was the first language for 53% of the students, with most of the ESL students (81%) having three or more years of English language training. The average self-efficacy score was 54.68 (standard deviation 15.65) on a scale of 0-100, implying that students were, on average, moderately confident in their ability to learn Word. The average academic motivation index (AMI) was 5.38 (range –2 to 12, standard deviation 2.94), which indicates that these students were, on average, more intrinsically than extrinsically motivated (Vallerand et al. 1992).

The results of the usage questionnaire are shown in Table 3. Almost all of the respondents reported using the practice software test and the screen cams (96% and 83%, respectively). On the other hand, the problem clinics and remedial workshops were used by very few of the respondents. These results indicate that the technology-based tools with anytime-anywhere access are more heavily utilized than the face-to-face, on-campus resources.

Table 3. Usage Results (n = 426)

Tool	Count	Percentage	Tool	Count	Percentage
Practice Test	408	96%	Open Problem Clinics	141	33%
Screen Cams	356	83%	Formal Problem Clinics	4	1%
Tutorials	332	78%	Remedial Workshops	26	6%

We used regression analysis to answer the question of what factors explain the usage of various learning tools. Table 4 summarizes the results for the practice test, screen cams, tutorials, and open problem clinics. Regression models were not run for the formal problem clinics or the remedial workshops because the usage of these tools was so low.

As shown in Table 4, the regression models for the practice test and the screen cams were statistically significant, explaining 35% and 44% of the variance in the data, respectively. Perceived usefulness and motivation are significant in both of these models, indicating that these tools were considered helpful, and were used by the more intrinsically motivated students. ESL is significant in direction that suggests native English speakers use the practice software test more than non-native English speakers.

These results suggest that a tool's perceived usefulness; that is, the degree to which the tool is perceived to help the student achieve a specific goal (e.g., passing a software test) is one of the most important drivers of the usage of that tool. This may well reflect students' desire to be efficient with their time and focus on the tools that will most clearly help them with their course grade. The online practice test and the screen cams were clearly related to the actual software test on which students would be assessed (see Table 1), and these were by far the most frequently used learning tools in the course. While the significance of perceived usefulness and motivation are understandable, the non-significance of other variables, particularly self-efficacy, was

somewhat surprising. This may suggest that the clear linkage between these tools and the actual Word test (i.e., their perceived usefulness) is so strong that it overrides other factors, such as the student's confidence using the target software.

As shown in Table 4, the regression model was unable to explain the variance in usage for the two attendance-based resources, tutorials and open problem clinics. The lack of significance for the tutorial model may be due to a perception that this resource was mandatory rather than voluntary. Although students were not assessed on tutorial work or attendance, they had to enroll in a tutorial section as part of the course, and were encouraged to attend. The lack of significance for the open problem clinics model may be related to the popularity and usefulness of the practice test and screen cams. These two tools may have been so useful that the students did not need, or see the benefit of, an open lab with an on-site tutor to answer questions.

Table 4. Results of Four Regression Analyses

D.V.	Overall Model	I.V.	Parameter Estimate	t-value
Practice Test Usage	F-value = 3.55** R^2 = 0.35	Perceived Usefulness	0.06	2.13*
		Perceived Ease of Use	-0.09	-1.58
		Self Efficacy	-0.01	-1.29
		Motivation	0.17	2.45*
		Age	-0.74	-1.41
		ESL	-0.94	-2.10*
Screen Cam Usage	F-value = 5.08*** R^2 = 0.44	Perceived Usefulness	0.11	3.86***
		Perceived Ease of Use	-0.05	0.21
		Self Efficacy	-0.005	-0.45
		Motivation	0.13	2.06*
		Age	-0.68	-1.38
		ESL	0.24	0.49
Tutorial Usage	F-value = 0.386 R^2 = 0.07			
Open Problem Clinics	F-value = 0.44 R^2 = 0.06			

* Significant at p = 0.05, ** p = 0.01, and *** p = 0.001.

A related explanation may be found in the cognitive psychology and decision-support literature on cognitive effort. This literature suggests that decision makers try to balance decision quality (effectiveness) with effort (efficiency), and that furthermore, individuals adapt their decision-making strategy in order to maintain a low level of effort (Payne et al. 1993; Todd and Benbasat 2000). In our study, the question driving students' tool-selection decisions may be been, "how can I get the highest reward (grade on the Word test) with the least amount of effort (least time-consuming training tool)?" Further study is needed to investigate the students' perceptions of effort associated with different training tools and the role this plays in their tool selection decisions.

Conclusions

The primary implication of this study is that technology-based learning tools such as the practice software test and the screen cams can be valuable resources for students learning end user software skills. The screen cams are particularly interesting in that they support a simplified form of behavior modeling (the video demonstrates how to accomplish a task) which may, in some cases, be a substitute for the more resource-intensive tools such as instructor-led tutorials in computer labs. Screen cams are also relatively easy to develop and deploy. In this study, the screen cams demonstrated how to correctly accomplish the tasks required for the software test. They could also be used to target students with different levels of self-efficacy, by illustrating common errors or problems encountered and how to resolve them.

To prepare for careers in business, students today must have a variety of IT-related skills. There are many resources and tools that can help them acquire and master these skills. The challenge facing educators is how to effectively use IT to enhance learning. We are still a long way from understanding what tools work best for which students, in which settings, or for which learning objectives. However, it seems clear that in some cases, IT may be used to complement or possibly replace some face-to-face resource-intensive learning tools. Educators are continually trying to find innovative ways to improve education while constrained by budget and time pressures. This study shows that an inexpensive and easy-to-use technology such as screen cams may create a powerful tool to support learning software skills.

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