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Examining User Acceptance of Computer Technology: An Empirical Study of Student Teachers

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Examining user acceptance of computer technology: an empirical study of student teachers

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Abstract: The use of computer technology in schools has made slow progress since the mid-1980s even though governments have been generous in funding. It is therefore important to understand how and when teachers use computer technology in order to devise implementation strategies to encourage them. This study investigates student teachers' perceptions of computer technology in relation to their intention to use computers. The purpose is to shed light on more effective ways to motivate the use of computer technology in schools. Based on an expanded variation of the *Technology Acceptance Model*, 84 completed surveys of student teachers were collected at a local university in Sweden. Overall, the results indicated that (1) student teachers' perceived usefulness of computer technology had a direct significant effect on their *intention* to use it; (2) student teachers' perceived ease of use had only an indirect significant effect on *intention* to use; however, (3) student teachers' subjective norm, that is the possible influence of external expectations, did not have any direct or indirect significant effects on their *intention* to use computer technology. Theoretical and practical implications that follow from the results are discussed.

Keywords: computer technology acceptance, ease of use, student teacher, subjective norm, technology acceptance model, usefulness

Introduction

Recently, the pervasive influence of computer technology has made significant changes to the concept of school. With the help of computer technology, students are now able to be more proactive in the learning process in order to achieve learning goals better. The information students gather can be individually processed, evaluated, analysed and critically examined.

However, a recent survey has found that in comparison with the general public of the same age, teachers did not use computer technology to the same extent (Hylén 2003). Furthermore, the survey also revealed that teachers had a more skeptical and reserved attitude towards computer technology. The use of computer technology in Sweden has been a slow process since the mid-1980s (Jedeskog 1998) even though the Swedish government funded schools like many other countries in the world. It was therefore important to understand how and when teachers might use computer technology in order to devise implementation strategies to encourage them.

Several intention-based acceptance/adoption theories have been developed and empirically examined, including the theory of reasoned action (TRA) (e.g., Fishbein & Ajzen 1975; Davis *et al*. 1989); the theory of planned behaviour (TPB) (e.g., Ajzen 1988; Taylor & Todd 1995); the technology acceptance model (TAM) (e.g., Davis *et al*. 1989; Venkatesh & Davis 2000); and diffusion of innovations (DOI) (e.g., Rogers 1983; Moore & Benbasat 1991). Among them, TAM was specifically designed to explain individual technology acceptance/adoption decisions across a wide range of organizational contexts, computer technologies, and user populations (e.g., Davis 1986; Venkatesh & Davis 2000). However, TAM had only two constructs and was independent of the organizational context. It had been criticized for its parsimonies. To address this constraint, effort should be made on a model extension in order to provide a richer explanation for computer technology acceptance (e.g., Legris *et al*. 2003).

Therefore, the objectives of this study were (1) to explore teachers' acceptance of computer technology, (2) to identify key *intention* determinants of computer technology use, (3) to provide practical guidelines to school administration to devise steps towards computer technology implementation; and (4) to provide practical guidelines for system designers to satisfy expectations of individual computer technology users.

Literature review

Factors that affect computer technology's use

Computer technology use depends first of all on whether there are enough computers. Access to computer

technology at both workplace and at home influences whether an individual user uses the technology. Therefore, there has been tremendous investment in building computer technology infrastructure in order to ensure that there are enough hardware and software resources available in organizations. However, the sole availability of infrastructure does not guarantee actual usage in daily routines. It is also very important to understand key motivational variables in the computer technology use of individual end users.

Attitude

Attitude has been found to be a significant determinant of behavioural *intention* in prior social studies (e.g., Fishbein & Ajzen 1975; Ajzen 1988). It has also been empirically tested as a strong mediator for motivational variables to predict behavioural *intention* of computer technology use (e.g., Taylor & Todd 1995). However, as more and more key motivational determinants were found, the mediating effect of attitude towards behavioural *intention* to computer technology use diminished. In a recent review, it was found that nearly half of the studies being reviewed found attitude non-significant and did not include attitude in their model framework (e.g., Legris *et al*. 2003). It seemed that attitude was once actively used but had been excluded from more recent computer technology acceptance studies.

Subjective norm

A subjective norm refers to an individual user's perception about opinions or suggestions of the significant referents concerning his or her behaviour (e.g., Ajzen 1988). To put in other words, the subjective norm is the degree to which an individual perceives the demands of others on that individual's behaviour (Larsson & Lilja 2003). Individuals can choose to perform a specific behaviour even if they are not po- sitive towards the behaviour or its consequences. The choice depends on how important the individuals think that the important referents believe that they should act in a certain way (e.g., Fishbein & Ajzen 1975; Venkatesh & Davis 2000). Subjective norm was found as a strong determinant to behavioural *intention*, and to a wide range of social behaviours (e.g., Fishbein & Ajzen 1975). Subjective norm has been empirically tested and has had a significant direct (e.g., Ajzen 1988; Mathieson 1991; Taylor & Todd 1995) or in- direct effect (e.g., Venkatesh & Davis 2000) in predicting an individual's *intention* to use computer technology. However, subjective norm is not consistent in predicting computer technology use *intention*. Some studies found that it was not significant at all (e.g., Davis 1986). Other studies also pointed out the boundary limitation for subjective norm to be significant only in mandatory settings (e.g., Venkatesh & Davis 2000, p. 195).

Perceived usefulness and perceived ease of use

Perceived usefulness and perceived ease of use were two other fundamental determinants in predicting an individual user's *intention* to use computer technology (e.g., Davies 1989). A recent review found that these two variables received considerable attention in a great number of prior computer technology acceptance/adoption studies and were significant in both direct (perceived usefulness) and indirect (perceived ease of use) effects on *intention* to computer technology use (e.g., Legris *et al*. 2003).

Other factors

It was also found that computer technology experience, perceived computer technology competence, loyalty and perceived culture of organizations had a direct effect on teachers' *intention* to computer technology use (e.g., Jedeskog 1998; Ferndahl 2002).

Motivations and research questions

A review of the literature on computer technology use studies suggested that emergent factors might not be significant over time (e.g., attitude) and emergent factors might not be consistent in result significance (e.g., subjective norm). There was also doubt that the previous theoretical model (e.g., TAM) could be applied in the educational context. However, TAM could be expanded (e.g., subjective norm) to provide a richer model to predict and to explain computer technology acceptance/adoption. Therefore, the research questions of this study were (1) to explore teacher's acceptance of computer technology; and (2) to identify the key *intention* determinants of computer technology use.

Model and hypotheses development

According to our model as shown in Fig. 1, a teacher's *intention* to use computer technology could be predicted and explained by his or her subjective perception of computer technology usefulness and ease of use, in conjunction with his or her subjective norm.

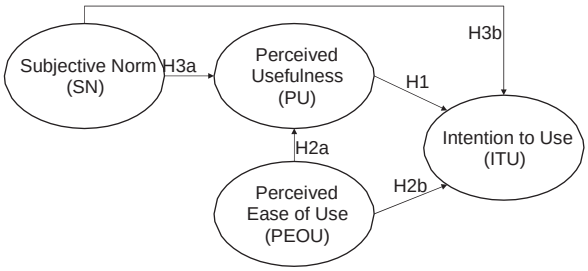

Fig. 1 Theoretical model framework

Perceived usefulness and perceived ease of use

As shown in Fig. 1, our model used TAM for its theoretical basis (e.g., Davis *et al*. 1989). Specifically, perceived usefulness was defined in this study as 'a teacher's subjective probability that using computer technology would increase his or her job performance within the school context' (p. 985) while perceived Fig. 1 Theoretical model framework. Ease of use was defined in this study as 'the degree to which a teacher expected computer technology to be free of effort' (p. 985). Teachers tended either to use or not to use computer technology to the extent that their subjective belief indicated it would help them perform their job better as the key agent to help students to achieve learning goals, conduct administrative duties and manage students in a class. Their main duty is to transfer knowledge to students to achieve learning goals. On the other hand, teachers also act as facilitators to help students learn by themselves through exploration or learning experiences. Teachers also keep track of students' progress through assess- ments. If teachers subjectively thought that computer technology would help their job performance in any way, it would be a motivation for them to tend to use computer technology. This has been well supported in prior studies in other organizational contexts (e.g., Venkatesh & Davis 2000; Mahmood & Swanberg 2001). Therefore, we posited that,

H1: A teacher's perceived usefulness of computer technology would directly influence his or her intention to use computer technology.

On the other hand, even if a teacher thought that computer technology was useful, he or she might at the same time believe that the system was too difficult to use and that the performance benefits of usage were outweighed by the effort of using computer technology (Davies 1989, p. 320). A recent survey found that teachers ranked 'a lack of computer technology competence' as the third most major problem or barrier in the use of computer technology in their teaching role (Ferndahl 2002). Furthermore, today, many young students seem far more skillful and competent in managing computer technology. Teachers perceived their lack of computer technology as a threat to their teaching role in the classroom (Jedeskog 1998). It was therefore expected that teachers' perceived ease of use of computer technology would have a direct effect on their *intention* to use computer technology. If teachers perceived computer technology as hard to use, it would be doubtful that computer technology could really improve their job performance. That is, it would also affect their subjective evaluation of the usefulness of computer technology. Therefore, we tested

H2a: A teacher's perceived ease of use of computer technology would directly influence his or her perceived usefulness of computer technology.
H2b: A teacher's perceived ease of use of computer technology would directly influence his or her intention to use computer technology.

Subjective norm

In this study, subjective norm refers to a teacher's perception about opinions or suggestions of the significant referents concerning his or her acceptance of computer technology (Ajzen 1988). Within a school setting, a teacher's decision on computer technology use might be influenced by the opinion or suggestions of their important others. This need not be an explicit statement or order from the administration of the school. The focus of the measurement was to examine how a teacher subjectively evaluated the thought of important others in their decision process. On the one hand, within the school setting, as it is not a profit- making organization in nature, there is no direct competition for resources or promotion among peers. Teaching, to a certain extent, is a long-term commitment career. The social circle in teaching is quite close. All these above factors favour the view that teachers work in a cooperative and close social circle in which strong influence exists among peers. However, in fact, the teaching profession has a flat organizational structure. There is a principal and a few administrative positions. All the others are teachers, with high autonomy in their teaching duties. Within a classroom, or even after class, teachers make decisions on most of their teaching tasks. Although they might be influenced by their peers, teachers are quite independent. Teaching experience also affects their behaviour as the more teaching experience is gained, the more teachers might have a stronger standpoint on their own. Prior studies also found inconsistent results of subjective norm to- wards computer technology acceptance/adoption (e.g., Venkatesh & Davis 2000). Both standpoints have their merits. In this study, we were inclined to the stand- point that teachers were close and would

be influenced by the thinking of important others both in making their decisions regarding computer technology acceptance, and in evaluating computer technology as useful. Therefore, we posited that

H3a: A teacher's subjective norm to computer technology use would directly influence his or her perceived usefulness of computer technology.
H3b: A teacher's subjective norm to computer technology use would directly influence his or her intention to computer technology use.

Methodology

Subjects

In order to test the model, we gathered data from 84 student teachers who were first year students at a teacher's education programme at a local university in Sweden. We selected student teachers because (1) the majority of the graduates would be practicing teachers (2) the education programme had provided training in computer technology and the student teachers would be able to utilize computer technology when they became practicing teachers and (3) student teachers studied full time but they practiced teaching 2 days per week during the year in normal schools. Therefore, student teachers would be a good proxy to practicing teachers and would be a good measurement of future teachers' opinion.

Among the 84 respondents, 33.5% were male while 66.5% were female. The ages ranged from 19 to 30 (34%), from 31 to 40 (40%) and over 41 (26%). Some of them started education much later than the younger ones. In Sweden, one can start education at any time. The respondents were of four different majors, including (1) *early ages*: student teachers who specialized in nursery school and the comprehensive schools early ages (33%), (2) *natural science and mathematics*: student teachers who specialized in mathematics and natural science in comprehensive school (21%), (3) *general education*: student teachers who had other major subject areas (18%) and (4) *education*: student teachers who studied pedagogy as their specialism (28%). Almost everyone had access to a computer at home (96.6%) and 86.2% had Internet connection. They reported weekly computer usage as 0-2 h (10%), 3–5 h (21%), 6–10 h (31%) and over 10 h (38%).

Method

A survey instrument was introduced to all the first year student teachers enrolled in a computer course at the middle of the semester. Eighty four (78.5%) completed questionnaires were collected. The instrument was composed of 24 statements on perceived useful- ness (PU) (seven items), perceived ease of use (PEOU) (seven items), subjective norm (SN) (six items) and behavioural *intention* to computer technology (ITU) (four items), asking respondents to identify their opinion of each statement on a seven-point Likert scale, ranging from 1 – strongly disagree to 7 – strongly agree. In a further analysis validity check, five items were cross-loaded and were removed. The resulting construct items are listed in Appendix I.

Data analysis

Descriptive statistics and validity of instrument

The means, standard deviations, Cronbach's a values and factor loadings are summarized and listed in Appendix II. The means were all over 4, ranging from 4.31 to 5.44, except for the subjective norm in which three out of the five items were below 4, ranging from 3.46 to 3.63. The validity of the instrument was examined in terms of internal consistency (i.e. reliability) and convergent and discriminant validity (Straub 1989). Internal consistency was examined using Cronbach's a values. All the constructs exhibited a values greater than 0.85, significantly higher than the threshold value of 0.8 (Nunnaly & Bernstein 1994). This shows that all the constructs exhibited a high internal consistency with their corresponding measurement indicators. Convergent and discriminant validities were examined by construct items' factor loadings. By using principal component analysis of Varimax with Kaiser normalization rotation, the factor loadings of each item and their corresponding components were found. The four constructs exhibited both convergent validity (high factor loadings among items of the same component) and discriminant validity (low factor loadings across components). The total variance explained by the four components was 75.14%.

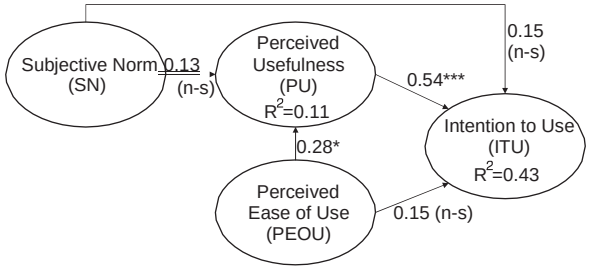

Fig. 2 Structural equation modeling testing results.

Model testing results

A Structural Equation Modeling technique was used to test the model. The LISREL 8.3 program was employed for this purpose (Jöreskog & Sörbom 1999). The model testing results are shown in Fig. 2.

It was found that perceived usefulness significantly influenced *intention* to computer technology use (β=0.54, p < .001), supporting hypothesis H1. Perceived ease of use was found to have significantly affected perceived usefulness (β=0.28, p < .05), supporting hypothesis H2a. However, perceived ease of use was found non-significant towards *intention* to computer technology use, showing that perceived usefulness was a full mediator between perceived ease of use and *intention* to computer technology use. Therefore, H2b was not supported. Furthermore, subjective norm was found non-significant toward both perceived useful- ness and *intention* to computer technology use, sup- porting neither hypothesis H3a nor H3b.

The model had two dependent variables, *intention* to computer technology use and perceived usefulness. Perceived usefulness was found to be significantly determined by perceived ease of use, resulting in an R^2- of 0.11. That is, perceived ease of use explained 11% of the variance of perceived usefulness. *Intention* to computer technology use was found to be jointly determined by the indirect effect of perceived ease of use and the direct effect of perceived usefulness resulting in an R^2- of 0.43. That is, the joint effect explained 43% of variance of *intention* to computer technology use. Hypotheses testing results are summarized in Table 1.

Table 1. Hypotheses testing results

Hypotheses	Path	Path coefficient	Results
H1	PU → ITU	0.54***	Supported
H2a	PEOU → PU	0.28*	Supported
H2b	PEOU → ITU	0.15 (n-s)	Not supported
H3a	SN → PU	0.13 (n-s)	Not supported
H3b	SN → ITU	0.15 (n-s)	Not supported

*$p < .05$; ***$p < .001$, n-s, non-significant

Discussion

Key findings

The research objectives of this study were (1) to explore teachers' acceptance of computer technology and (2) to identify the key *intention* determinants of computer technology use. It was found that teachers' perceived usefulness and perceived ease of use were two key *intention* determinants of their computer technology use. Teachers' perceived usefulness had a direct significant effect on their *intention* towards computer technology use. Teachers' perceived ease of use had an indirect significant effect on their *intention* to computer technology use, fully mediated by perceived usefulness. However, teacher's subjective norm did not have any direct or indirect significant effect on their *intention* towards computer technology use.

Contributions to research

Effects of perceived usefulness on intention to computer technology use

The results of this study found that teachers' perceived usefulness was significant and strong in determining *intention* to computer technology use. This finding is comparable with prior studies in other organizational contexts and technologies (e.g., Mahmood & Swan- berg 2001; Legris *et al*. 2003). This can be explained by the fact that teachers find computer technology useful in improving their instructional performance, and motivating their *intention* to use computer techno- logy in the future. This was also supported by a survey of the Swedish Teachers Union (Lärarförbundet och Lärarnas Riksförbund 1996). The study found that teachers who viewed computer technology as useful appeared to demonstrate an acceptance of computer technology and perceived their own role as evolving into guiding more teachers in the school in the or of the future.

Effects of perceived ease of use effects on perceived usefulness and intention to computer technology use

This study found that teachers' perceived ease of use did not have any significant effect on their *intention* to use computer technology. This empirical finding is supported in spite of the mixed results in prior studies (e.g., Davis *et al*. 1989; Subramanian 1994) in other organizational contexts and technologies under investigation. The logical relationship between these findings is that teachers would not have a higher *intention* to computer technology use, solely because computer technology was easy to use. But, if computer technology was perceived as easy to use, it would be perceived as more useful. A teacher restated this as, 'If I did not know how to use computer technology, it would be useless to me'!

Subjective norm

This study first showed that the means of the indicators of teachers' subjective norm ranged from 3.46 to 4.36 on a seven-point Likert scale. The low mean values implied that teachers did not perceive that their own behaviour would be highly affected by their important referents. In the model testing analysis, it was found that teachers' subjective norm did not have significant effects on their perceived usefulness and their *intention* to use computer technology. One explanation could be as Jedeskog (1998) suggested that it was the individual teacher who decided when computer technology became part of the curriculum. A teacher could work quite independently in a classroom, with little interference from the school administration. Prior studies supported this argument as they (e.g., Venkatesh & Davis 2000) empirically found that subjective norm had significant effect on *intention* to use in a mandatory setting, while it had no effect in a voluntary setting. The results of this study add empirical support to the study of computer technology acceptance/ adoption in the literature.

Contributions to practice

In the classroom, it is the teacher who decides when computer technology is appropriate in the curriculum. Within the classroom environment, when to use and how to use computer technology has to be guided by individual teachers. Teachers' *intention* to use computer technology is critical to the success of the utilization and implementation of computer technology. Supported by prior studies, this study empirically found that teachers'

perceived usefulness had direct significant effects on their *intention* to computer technology use while teachers' perceived ease of use had indirect significant effects on their *intention* to computer technology use fully mediated by their perceived usefulness on computer technology. Therefore, school administrations should devise implementation strategies to demonstrate how computer technology could improve instructional performance. For example, through best practices, administrators could showcase how learning goals could be more efficiently and effectively achieved through computer technology. Hylén (2003) re- ported that only 50% of teachers see computer technology as a pedagogical instrument.

On the other hand, teachers need the necessary knowledge and competence in order to use computer technology effectively. Encouragingly, more than half of all teachers in Sweden have participated in qualified computer technology competence development (Hylén 2003). This could be a good start. Despite this, teachers' computer technology knowledge and competence generally seems a serious problem. A survey found that (1) less than one-fifth (17%) of Swedish teachers' believed that they had sufficient computer technology knowledge and less than one-third (31%) believed that they had almost sufficient knowledge and (2) more than 70% (74%) teachers completing their degree in 1998 or after did not find the syllabus taught for computer technology satisfactory (Fowelin & Lind 2003). This could be a critical factor ex- plaining why teachers perceive they have low com- puter technology knowledge and competence and also explaining the low ranking of computer technology knowledge and competence as one of the most determining factors in their *intention* to use computer technology (Jedeskog 1998). This could also partly explain why the use of computer technology in schools has been a slow process (Jedeskog 1998). Effective training, teachers' computer technology experience and teacher's perceived computer competence would all affect teachers' perceived ease of use of computer technology. This would most probably be one of the top priorities that school administrations need to tackle in the future.

Limitations and future research

There were several limitations in this study that should be taken into consideration before the findings can be generalized. Firstly, student teachers were the subjects in this study. Although the majority of these student teachers would eventually be teachers and they also had 2 days per week practice experience in schools, their opinion would not be the same as practicing teachers. Yet, they serve as a good proxy and can help us project and understand the opinion of future teachers. However, the findings might not apply fully to practicing teachers. Future research could be designed to collect data from practicing teachers and compare the results. Furthermore, the opinion of these student teachers may have been affected by the operation of the schools where they did their practice teaching. There were some schools that allowed teachers full autonomy to decide their own teaching and their use of instructional instruments, while other schools were more prescriptive in school operations. Mandatory versus voluntary settings for computer technology use would probably provide different views of our understanding of the phenomenon. As a prior review pointed out (e.g., Legris *et al*. 2003), technology implementation depends also on the organizational con- text. It would also be more fruitful for future research to consider collecting data from different school set- tings to compare the differences of empirical findings.

Conclusion

This study attempted to explore teachers' computer technology acceptance/adoption and found that perceived usefulness and perceived ease of use were two determinants to teachers' computer technology use. In spite of the fact that these two determinants seem obvious, an in-depth analysis found that problems related to these two key factors have existed for a long time without effectively being tackled. The findings, the discussions and the implications of this study were definitely important to the study and implementation of computer technology in an educational context.

Appendix I. Measurement items

Constructs	Items
Perceived usefulness (PU) (adapted from Davies 1989)	*PU-1:* Using computers improves my job performance *PU-2:* Computers enable me to accomplish tasks more quickly *PU-3:* Using computers enhances my effectiveness on the job *PU-4:* Using computers improves the quality on the work I do *PU-5:* Using computers will make it easier to do my job
Perceived ease of use (PEOU) (adapted from Davies 1989)	*PEOU-1:* I seldom become confused when I use computers *PEOU-2:* I don't make frequent errors when using computers *PEOU-3:* I seldom need help when using computers *PEOU-4:* I don't find it cumbersome to use computers *PEOU-5:* Learning to operate computers is easy for me *PEOU-6:* It is easy for me to become skillful in using computers *PEOU-7:* Overall, I find computers easy to use
Subjective norm (SN) (adapted from Hu *et al*. 2003)	*SN-1:* My colleagues/classmates think that I should use computers *SN-2:* People who influence my behaviour think that I should use computers *SN-3:* My friends think that I should use computers in my future teaching *SN-4:* People who are important to me think that I should use computers in my future teaching *SN-5:* My teachers/instructors think that I should use computers in my future teaching
Intention to use (ITU) (adapted from Hu *et al*. 2003)	*ITU-1:* Whenever possible, I intend to use computers in my future teaching *ITU-2:* To the extent possible, I intend to use computers to do different teaching tasks

Appendix II. Summary of descriptive statistics and validity of instrument

	Mean	SD	α	Loadings
Perceived usefulness				
PU1	5.01	1.73	0.93	0.69
PU2	5.44	1.52		0.85
PU3	5.12	1.62		0.83
PU4	5.10	1.86		0.59
PU5	5.24	1.44		0.80
Perceived ease of use				
PEOU1	4.42	2.00	0.95	0.78
PEOU2	4.31	1.65		0.88
PEOU3	4.50	1.64		0.83
PEOU4	5.10	1.68		0.92
PEOU5	5.05	1.63		0.90
PEOU6	4.52	1.68		0.85
PEOU7	5.00	1.50		0.90
Subjective norm				
SN1	4.36	1.75	0.89	0.80
SN2	3.55	1.81		0.88
SN3	3.46	1.78		0.87
SN4	3.63	1.85		0.87
SN5	4.35	1.77		0.66
Intention to use				
ITU1	4.58	1.74	0.87	0.88
ITU2	4.79	1.72		0.84

Valid number of response: 84.

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