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Full Length Research Paper

Factors influencing technology acceptance decisions

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This study proposes a causal model for investigating teacher acceptance of technology. We received 258 effective replies from teachers at public and private universities in Taiwan. A questionnaire survey was utilized to test the proposed model. The LISREL was applied to test the proposed hypotheses. The result shows that computer self-efficacy has a strongly positive effect on perceived ease of use and teacher intention to use. Overall, model and data fit was excellent and had satisfactory explanatory power. Most hypotheses were accepted.

Key words: Information technology, technology acceptance, structural equation modeling, computer self-efficacy, job relevance.

INTRODUCTION

Information technology (IT) plays an important role in contemporary education (Gilbert, 1996). Recently, visionary educators and IT professionals have proposed a technology-empowered teaching/learning paradigm. Those professionals have observed that the problem in accepting technology does not reside in technology software but in humans. Such a lack of acceptance hinders progress in that delivered systems are not used effectively (Keen, 1991).

Many studies explore issues of technology acceptance in the business sector; however, there is little research examining the technology acceptance in high schools and universities. Teaching is an occupation that differs considerably from staff in business companies. Teachers are relatively independent and have considerable autonomy over what and how they teach. These characteristics have lead to differences in technology acceptance among teachers compared to that of business employees. Conversely, schools and universities have different objectives that differ fundamentally from those of business organizations.

Thus, the consequences of technology acceptance among teachers likely differ from those in business.

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This study investigates the factors that influence technology acceptance of teachers at a university. This study also presents a novel causal model for testing the relationships between those factors that influence technology acceptance decisions. This study cooperated with the Union of University Professors in Taiwan in collecting data. Data were collected from 258 teachers at universities in Taiwan.

Literature review

Many studies have examined user technology acceptance and adoption in different fields (Muylle, Moenaert and Despontin, 2004; Compeau, Higgins and Huff, 1999; Igbaria and Tan, 1997; Karahanna and Straub, 1999; Sheppard, Harwick and Warshaw, 1988; Straub, Keil and Brenner, 1997). Based on literature review findings, most studies emphasize on cognitive/behavioral approaches and behavioral intention; that is, the decision to accept new technology can be explained by teacher subjective intention. These studies suggest that an individual's intention to accept a technology is likely affected by attitudinal, cognitive, and/or normative assessments of attributes or factors related to the technology, social system, target task, and implementation context (Wu and Wang, 2004; Goodhue and Thompson, 1995; Igbaria,

Zinatelli, Gragg and Cavaye, 1997).

Numerous theories have been utilized to explain user technology acceptance in different fields, including the theory of reasoned action (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975), the theory of planned behavior (Ajzen, 1991), and the technology acceptance model (TAM) (Davis, 1986). The TAM, a modification of the theory of reasoned action, explains individual technology acceptance decisions across a wide range of technologies.

Although the TAM has been widely applied in technology acceptance decision-making, it also has been criticized for its simplicity. Some researchers suggested identifying additional technology acceptance determinants (Chuttur, 2009) Venkatesh and Davis, 2000). To compensate the insufficiencies in the TAM, several studies have extended the TAM. Some studies combined critical factors or antecedents (Venkatesh, 2000), whereas others expanded the TAM by integrating variables from other theories or models (Magni and Pennarola, 2008; Hirschheim, 2007; Lin (2006); Riemenschneider, Harrison and Mykytn, 2003; Heijden, 2003; Muylle, Moenaert and Despontin, 2004; Wu and Wang, 2004). The dimensions of individual technology acceptance include target users (Nelson, 1990; Lucus and Spitler, 2000), technology attributes (Chang, 2001; Moon and Kim, 2001; Moore and Benbasat, 1991; Harrison and Datta, 2007) and implementation context (Hu, Chau, Sheng and Tam, 1999).

Studies have obtained different conclusions about an individual's technology acceptance decisions. Some researchers suggested that users discount the weight of perceived behavioral control when making a decision to accept technology (Taylor and Todd, 1995), whereas others noted that perceived ease of use might be overly stressed when an individual possesses little knowledge about or experience with new technology (Hu et al., 2002). This study attempts to re-integrate and reconsider these inconsistent conclusions.

Conceptual model and hypotheses

This study's causal model is a modification of the TAM. The construct of perceived usefulness is defined as the extent to which an overhead projector is considered useful by a teacher; conversely, the construct of perceived ease of use is the degree to which a teacher views use of a projector as easy. User acceptance of a projector is defined as intention to use. Based on the proposed model, teacher perception of a projector's usefulness and ease of use affect his decision to utilize the new teaching tool. Teachers are likely to accept a technology simply because it is easy to use and useful (Venkatesh and Davis, 2000). Conversely, a teacher is likely to regard the projector as useful when he believes that it is easy to use. Accordingly, we propose the following hypotheses:

H_1: The degree to which a teacher regards an overhead projector as useful has a positive effect on his intention to use the projector.

H_2: The degree to which a teacher regards an overhead projector as easy to use has a positive effect on his intention to use the projector.

H_3: The degree to which a teacher regards an overhead projector as easy to use has a positive effect on his perception of the technology's usefulness.

The Theory of Planned Behavior specified that a teacher's decision to accept projector will be affected by the opinions of their colleagues and school administrators. Within an academic system, university professors likely have strong psychological dependency on the academic community and have relatively close relationships with their colleagues. Many factors are at play in the construction of close relationships among instructors, including the non-profit nature of universities, the relatively closed community and minimal market competition among peers. These factors cause teachers to assign considerable weight to norms and their colleagues' opinions when deliberating about whether to accept a new technology as a supportive teaching tool. When teachers perceive a subjective norm favoring acceptance of an overhead projectors, they must also regard the new teaching tool as useful and attempt to use it. Thus, we propose the following hypotheses.

H_4: A teacher's perceived subjective norm concerning acceptance of overhead projector has a positive effect on his intention to use a projector

H_5: A teacher's perceived subjective norm concerning acceptance of overhead projector has a positive effect on his perception of the projector's usefulness.

The construct of job relevance is defined as the extent to which a teacher regards use of projector as relevant to his job. It is clear that a teacher's perception of job relevance will influence his perception of the technology's usefulness. Generally, teachers are relatively free in choosing their methods of teaching, content, grading and technology use. In this context, it is important for a teacher to evaluate a technology's relevance for routine classroom activities when choosing whether to accept a technology. Hong, Thong, Wong and Tam (2002) argued that perception of job relevance has a positive effect on perceived technology usefulness Therefore, we propose the following hypothesis.

H_6: The degree to which an overhead projector is perceived to be relevant to a teacher's job has a positive influence on his perception of the technology's usefulness.

Computer self-efficacy is defined as individual's

assessment of his capacity to use a computer (Compeau and Higgins, 1995). When teachers feel that they have the ability to use computers, they are likely to perceive a technology as easy to use and accept the new technology. Many studies have justified this effect in various fields (Heijden, 2003; Muylle, Moenaert and Despontin, 2004; Wu and Wang, 2004; Bandura, 1977). These studies concluded that computer self-efficacy has a positive effect on perceived ease of use and use intention (Johnson and Marakas, 2000; Agarwal, Sambamurthy and Stair, 2000). The overhead projector must be connected with a computer and teachers use the computer to present their teaching materials via the projector. Thus, computer self-efficacy has an important role in teacher intention to and perception of new technology.

H_7: A teacher's perception of computer self-efficacy has a positive effect on his intention to use an overhead projector.

H_8: A teacher's perception of computer self-efficacy has a positive effect on his perception of a projector's ease of use.

From the perspective of using technology, compatibility of hardware and software is considered significant and can affect teachers' decisions to accept a technology-supported teaching tool. Ramiller (1994) investigated compatibility in different fields and concluded that compatibility had a positive effect on perceived usefulness. Hence, the following hypothesis is proposed.

H_9: The degree to which an overhead projector is regarded by a teacher as compatible to the computer hardware and software has a positive effect on his perception of a projector's usefulness.

METHODOLOGY

Dependent variable

Although there are arguments about whether technology acceptance and intention to use are in fact the same concept, this study measured technology acceptance using the construct intention to use. Just as what Mathieson (1991) described, obvious strong relationships exist between use intention and actual behavior, their relationship is theoretically justifiable and empirically supported. Thus, this study adopts the construct of intention to use as a dependent variable.

Study subjects

This research selected professors teaching at public and private universities in Taiwan as study subjects. We cooperated with the largest university professor union in Taiwan, which provided a subject name list and helped this study investigate individual teachers' technology acceptance decision-making. Under pressure from the routine university performance assessment executed by the Education Department in Taiwan, public and private universities have been trying to improve their facilities and teaching tools; thus, the overhead projector has gradually become a popular technology among academics for it improves student's learning efficiency.

Measures

The constructs measured with scales employed in previous research (Muylle, Moenaert and Despontin, 2004; Wu and Wang, 2004; Davis, Bagozzi and Warshaw, 1989; Compeau, Higgins and Huff, 1999; Hartwick, H. Barki, 1994; Hu, Chau, Sheng and Tam, 1999; Taylor and Todd, 1995), that were modified to target new technology and an educational context. The perceived usefulness (PU) items were as follows: (1) Overhead projector enables me to accomplish tasks faster; (2) Using an overhead projector increases my productivity; (3) Using an overhead projector makes teaching easy; (4) Using an overhead projector increases my efficiency; and, (5) Using an overhead projector increases student comprehension. The perceived ease of use(PEU) items were as follows: (1) Learning to operate overhead projector was easy; (2) It was easy for me to become skilled at using an overhead projector; (3) I find it difficult to get overhead projector to do what I want it to do (R); (4) I find it easy to get overhead projector to do what I want it to do; and, (5) Overall, I find the overhead projector easy to use. The using intention (UI) items were as follows: (1) Whenever possible, I intend to use overhead projector while teaching; (2) To the extent possible, I would use overhead projector for different teaching tasks; (3) I would recommend using the projector to the other teachers; and, (4) I have no incentive to use overhead projector in the classroom (R). The computer self-efficacy(CSE) Items were as follows: (1) I could complete a job using a computer if I was able to watch someone else use it before trying it myself; (2) I could complete a job using a computer if someone else had helped me get started; (3) I could complete a job using a computer if I had a lot of time to complete the job for which the overhead projector was provided; and, (4) I could complete a job using a computer if I had used similar software package before to do the same job. The subjective norm (SN) items were as follows: (1) My friends think that I should use an overhead projector; (2) My colleagues think that I should use an overhead projector; (3) People who influence my behavior think that I should use an overhead projector; and, (4) People who are important to me do not think that I should use overhead projector (R). The compatibility (CO) items were as follows: (1) The overhead projector is a compatibility with the computer I use at school; (2) The overhead projector is a compatibility with the software I use at school; (3) The overhead projector is not a compatibility with the hardware I use in the classroom (R); and, (4) The overhead projector is a compatibility with the software I use in the classroom. The job relevance (JR) items were as follows: (1) I consider the overhead projector to be important to my job; (2) I consider the overhead projector needed in my job; (3) I consider an overhead projector to be essential to my job; and, (4) Using an overhead projector does not matter to my job (R). This study utilized a five-point Likert scale ranging from "strongly agree" to "strongly disagree" to measure responses to the constructs and items. To reduce the potential problem of a ceiling or floor effect, some items are in a negative format.

Data collection

This study selected 4 public universities and 5 private universities as the research sample. These schools have adopted the overhead projector as a teaching support tool and subjects have used a projector. Prior to data collection, subjects were informed of the study's purpose and were assured of response confidentiality.

Table 1. Summary of sample characteristics.

Demographic dimension	Percentage
Gender	
Male	58
Female	42
Average age	47
Average teaching years	16
School	
Public university	45
Private university	55
Academics	
College of science	24
College of social science	27
College of engineering	26
College of management	23
Faculty level	
Professor	29
Associate professor	36
Assistant professor	35

RESULTS AND ANALYSES

Respondent analysis

After eliminating partially completed questionnaires, 258 effective questionnaires were collected. Average respondent age was 47 years and average teaching experience at a university was 16 years. There were slightly more subjects from private (55%) than from those from public universities (45%). Gender distribution in the sample population was approximately 3:2 in favor of male professors. Distribution was balanced among disciplines: 24% from science; 27% from social sciences; 26% from engineering; and, 23% from management. The distribution of faculty was as follows: 29% were professors; 36% were associate professors; and, 35% were assistant professors as shown in Table 1.

Instrument validity

The reliability test utilized Cronbach's α-value and composite reliability. All constructs appeared had an α-value >0.8, which is acceptable (Nunnally and Bernstein, 1994). The composite reliabilities were all >0.6, also considered acceptable.

This research applied exploratory and confirmatory factor analysis to measure construct convergent and discriminant validity. Notably, all constructs demonstrated satisfactory convergent and discriminant validity when measurement items were loaded highly on the proposed construct. Seven constructs with Eigen values >1.00 were extracted (Table 2). Except for two items, all other item loading values were significantly >0.6, indicating satisfactory convergent and discriminant validity. Additionally, this study also examined the correlation coefficient matrix; except for two construct coefficients >0.7, all construct coefficients were <0.7, indicating that constructs have satisfactory discriminant validity. Confirmatory factor results also verified the measured validity of constructs. Loading values were 0.53–0.93, and considered acceptable.

Model testing results

This study utilized LISREL to test the proposed causal model. According to goodness-of-fit indices, the research model demonstrated a good fit with data. The ratio of χ^2 to d.f. is 2.12, which is acceptable with respect to the commonly recommended value of 3.0. Other fit indexes were also used to measure model fit, including GFI, AGFI, NFI, NNFI, CFI and SRMSR (Hoyle, 1995). The values of GFI, AGFI, NFI, NNFI, CFI were all close to 1,

Table 2. Evaluation of convergent/discriminant validity—using exploratory factor analysis.

Constructs and Items		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Subjective Norm	1	0.10	0.15	0.10	0.25	0.84	0.12	0.07
	2	0.11	0.19	0.07	0.25	0.82	0.14	0.05
	3	0.16	0.18	0.17	0.18	0.83	0.17	0.08
	4	0.19	0.16	0.10	0.19	0.82	0.16	0.11
Job Relevance	1	0.16	0.20	0.18	0.83	0.23	0.21	0.12
	2	0.23	0.20	0.11	0.86	0.22	0.14	0.15
	3	0.22	0.23	0.08	0.83	0.20	0.17	0.16
	4	0.26	0.28	0.13	0.77	0.24	0.12	0.14
Computer Self-Efficacy	1	-0.03	0.34	0.11	0.18	0.14	0.76	0.06
	2	0.07	0.18	0.17	0.07	0.17	0.87	0.08
	3	0.19	0.13	0.09	0.09	0.05	0.89	0.13
	4	0.26	0.07	0.12	0.19	0.02	0.81	0.12
compatibility	1	0.23	0.78	0.12	0.28	0.12	0.19	0.07
	2	0.15	0.77	0.23	0.24	0.12	0.09	0.22
	3	0.22	0.74	0.26	0.18	0.06	0.22	0.15
	4	0.31	0.69	0.26	0.29	0.12	0.14	0.08
Perceived Usefulness	1	0.66	0.34	0.30	0.38	0.14	0.16	0.11
	2	0.77	0.32	0.24	0.23	0.08	0.15	0.14
	3	0.87	0.33	0.21	0.19	0.10	0.15	0.03
	4	0.85	0.33	0.19	0.24	0.12	0.15	0.06
	5	0.74	0.29	0.28	0.22	0.14	0.14	0.06
Perceived Ease of Use	1	0.41	0.24	0.61	0.14	0.15	0.10	0.19
	2	0.43	0.26	0.55	0.17	0.17	0.13	0.15
	3	0.29	0.23	0.65	0.31	0.16	0.14	0.06
	4	0.19	0.29	0.77	0.20	0.13	0.20	0.10
	5	0.28	0.36	0.60	0.07	0.18	0.20	0.12
Using Intention	1	0.07	0.26	0.10	0.14	0.08	0.17	0.89
	2	0.10	0.06	0.06	0.09	0.05	0.15	0.92
	3	0.23	0.09	0.12	0.28	0.12	0.19	0.76
	4	0.15	0.24	0.23	0.24	0.12	0.09	0.75
Eigenvalues		4.43	4.43	3.70	3.62	3.61	3.09	1.81
Percent of Variance (%)		12.67	25.45	36.14	46.60	57.03	65.97	78.44

which is considered acceptable. The value of SRMSR was 0.06, less than the recommended value of 0.10.

Table 3 indicates that research model accounts for 66% of variance in Using Intention, 78% of variance for Subjective Norm, 82% of variance for Job Relevance, 30% of variance for Computer Self-Efficacy, 69% of variance for Compatibility, 80% of variance for Perceived Usefulness, and 69% of variance for Perceived Ease of Use. The variances explained justify the model's overall explanatory power. On the other hand, composite reliabilities were all larger than the recommended value of 0.6, indicating that those items are appropriate for measuring latent constructs.

This study examined the hypotheses in terms of statistical significance and strength of standardized path coefficients. Three hypotheses were rejected and 6 hypotheses were supported (Table 4).

Model test results (Figure 2) show that computer self-efficacy is the most powerful determinant of teacher use intention (0.57). Perceived usefulness had a significantly positive effect on teacher use intention (0.16); thus, H_1 is accepted. Perceived ease of use did not have a significant effect on teacher use intention; thus, H_2 is rejected. Perceived ease of use had a slight effect on perceived usefulness (0.16); thus, H_3 is accepted. Most results are coincident with those obtained by previous studies.

The effect of subjective norm on use intention and perceived usefulness were not significant; thus, H_4 and H_5 are rejected. The construct of job relevance had a slight effect on perceived usefulness, its path coefficient is 0.19; thus, H_6 is accepted.

Table 3. Construct loading, reliability and model fits.

	Lambda loading	Composite reliability	Variance extracted
Subjective Norm		0.93	0.78
SN1	0.86		
SN2	0.87		
SN3	0.92		
SN4	0.88		
Job Relevance		0.95	0.82
JR1	0.90		
JR2	0.90		
JR3	0.89		
JR4	0.93		
Computer Self-Efficacy		0.63	0.30
CSE1	0.53		
CSE2	0.55		
CSE3	0.55		
CSE4	0.56		
Compatibility		0.90	0.69
CO1	0.83		
CO2	0.82		
CO3	0.83		
CO4	0.85		
Perceived Usefulness		0.95	0.80
PU1	0.87		
PU2	0.90		
PU3	0.89		
PU4	0.92		
PU5	0.89		
Perceived Ease of Use		0.92	0.69
PEU1	0.86		
PEU2	0.89		
PEU3	0.83		
PEU4	0.80		
PEU5	0.77		
Using Intention		0.88	0.66
UI1	0.79		
UI2	0.84		
UI3	0.79		
UI4	0.82		
X^2	828		
df	390		
GFI	0.98		
AGFI	0.98		
NFI	1.0		
NNFI	1.0		
CFI	1.0		
Standard RMR	0.06		

*$p < 0.05$ **$p < 0.01$

Computer self-efficacy strongly affected teacher use intention; its path coefficient was 0.57. Computer self-efficacy also strongly impacted teacher perception of ease of use; its path coefficient was 0.81. Therefore, H_7

Table 4. Summary of causal path testing results—statistical significance and strength.

Hypothesis	Model path	Path coefficient	T value	Accept or reject
H1	PU→UI	0.16**	3.98	Accept
H2	PEU→UI	0.14	0.60	Reject
H3	PEU→PU	0.16**	4.30	Accept
H4	SN→UI	0.02	0.22	Reject
H5	SN→PU	-0.03	-0.45	Reject
H6	JR→PU	0.19**	2.08	Accept
H7	CSE→UI	0.57**	2.09	Accept
H8	CSE →PEU	0.81**	9.83	Accept
H9	CO→PU	0.28**	2.42	Accept

** represent P < 0.01.

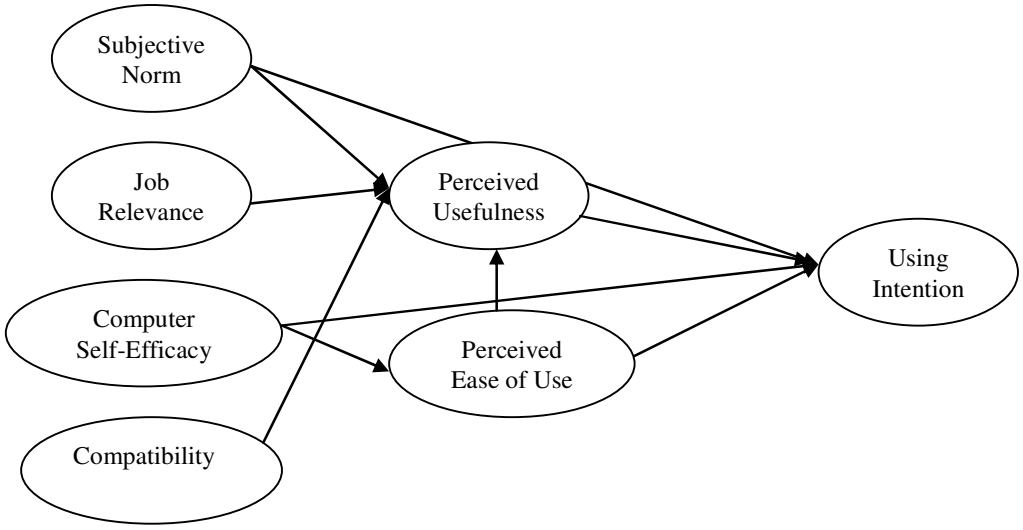

Figure 1. Conceptual model.

and H_8 are supported. The effect of compatibility on perceived usefulness was statistically significant (0.28); thus, H_9 was supported.

DISCUSSION AND CONCLUSION

This research demonstrates that job relevance significantly affects perceived usefulness. The universities teachers typically regard the projector as useful when it is relevant to the job. From the school management perspective, administrators and technology professionals must demonstrate the technology's relevance to routine teaching activities. Such demonstrations will likely enhance instructor use intention.

The perceived usefulness of the overhead projector also positively affects teacher use intention. Therefore, when teachers are inclined to be task oriented, they might try using or accepting new teaching tools when they feel they are useful to teaching activities. School administrators and government bodies need to present convincing evidence that informs teachers about a technology's usefulness for teaching activities, thereby fostering their acceptance of new technology.

The subjective norm was a non-significant driver for projector acceptance, suggesting that teachers are not influenced by their colleagues' opinions or suggestions. Thus, cultivating a positive community norm cannot increase teacher use intention. This result is contrary to that obtained by previous studies. Perhaps university professors are more independent of their colleagues than high school teachers. University instructors have relative autonomy when deciding whether they will use new teaching tool.

As the results show, perceived ease of use has no effect on teacher use intention, suggesting that teachers are unlikely to adopt the overhead projector just because

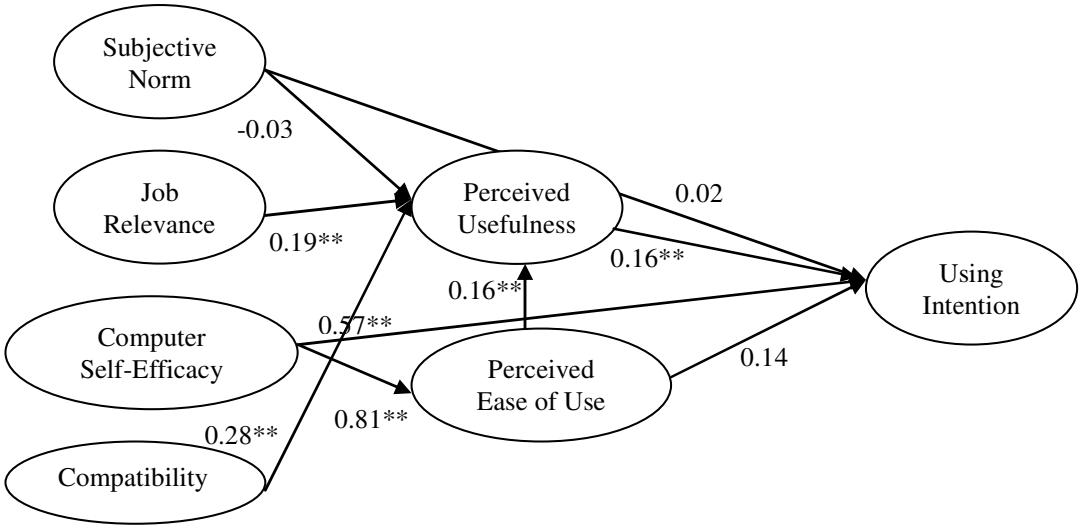

Figure 2. Model testing results.

it is easy to use. As the other researchers described, no amount of perceived ease of use can compensate for low use intention (Keil et al., 1995). Conversely, perceived ease of use has an effect on perceived usefulness. When teachers perceive ease in using the projector, they will further perceive that the projector is useful, implying that continued training and support should be available to foster teacher perception of usefulness. The computer or projector application in training can enhance teacher perception of use ease, and, in turn, enhance teacher perception of usefulness. In this study, teacher computer self-efficacy has a significant influence on perceived ease of use; thus, school administrators and government can improve teacher perception of use ease by enhancing their computer self-efficacy.

The observed effect of compatibility on perceived usefulness is justified—it moderately influences teacher perceived usefulness of projector. The new teaching technology has to have a compatibility with hardware or software already used in the classroom. School administrators or government agencies must consider fitness of technology when introducing new teaching tools, as compatibility strongly influences implementation policy.

In this study, the effect of computer self-efficacy on use intention was significant. Computer self- efficacy was the most important factor influencing teacher use intention. Teacher decisions about whether they will adopt the new technology-supported teaching tool depend on how they evaluate their own computer self-efficacy. Therefore, we recommend that administrators and government agencies attempt to enhance teacher perception of self-efficacy by holding technology training programs that to increase use intention.

This study established a model that fits with data and has explanatory power for teacher technology acceptance.

This model will help school administrators and government agencies understand why teachers accept new technology-supported teaching tools. Additionally, this study also helps school administrators and government agencies identify the factors that impede teacher acceptance of new technologies, allowing them to address these underlying obstacles.

Research limitations

This study has several limitations. First, conclusions are inferred from a single study; thus, generalizing result to the other schools should be done with care. Second, two construct coefficients were >0.7, it is considered to face the problem of collinearity. Thus, this study drew a factor correlation line with each construct prior to confirmatory factor analysis. This method could collect the collinear problem in the model. Third, research results inferred from a Taiwanese study should be carefully generalized to other countries that have different educational systems.

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