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An elaboration likelihood model based longitudinal analysis of attitude change during the process of IT acceptance via education program

Woong-Kyu Lee*

Department of Business Administration, Daegu University, Gyeongbuk, Republic of Korea

The principal objective of this study was to gain insight into attitude changes occurring during IT acceptance from the perspective of elaboration likelihood model (ELM). In particular, the primary target of this study was the process of IT acceptance through an education program. Although the Internet and computers are now quite ubiquitous, and thus many people can come to an acceptance of IT organically – including acceptance of such products as new released online services or software, some software – most notably programming languages and spreadsheets – may require education programs, and the efficacy of that education may determine the rate of acceptance. Thus, education programs for such IT may be regarded as not only teaching and training how to use the product from a technical standpoint, but also as a process by which program participants are persuaded to have a positive attitude towards accepting the new IT. This study adopted an ELM based longitudinal approach to capture the changes in the roles of persuasion routes and attitude during IT acceptance – in this case, the education program. To validate empirically the suggested model, junior students majoring in business administration, all of whom were taking an Excel class, were surveyed twice – just after mid-term and just after their final exam. These data were analysed via partial least-square method to deduce some possible implications. Our results supported all the hypotheses put forward.

Keywords: attitude change; ELM; IT acceptance; longitudinal approach; education program

1. Introduction

The attitude construct continues to be a major focus of theory and research, and one of the core conceptions in social and behavioural sciences, and is related to a broad range of diverse issues – including behavioural prediction, attitude changes, judgement and decision-making, social perception and emotion, as well as intra- and inter-group attitudes (Ajzen 2001). Including the technology acceptance model (TAM) (Davis 1989, Davis *et al*. 1989) and its modified or extended versions, many information technology (IT) adoption studies, which can be regarded essentially as studies of behaviour prediction and explanation, have also been predicated on attitude theory based social psychological frameworks. In addition to understanding and predicting users' acceptance of IT, the goals of these studies include lowering barriers for the adoption or the usage of IT by shaping or changing positive attitude towards IT itself or the use of IT (Davis *et al*. 1989, Venkatesh and Davis 2000, Venkatesh and Bala 2008). However, the majority of these studies have focused on beliefs such as perceived usefulness rather than attitude or attitude change (Lee *et al*. 2003, Legris *et al*. 2003, King and He 2006).

Some recent studies have attempted to elucidate attitude changes during IT acceptance using the elaboration likelihood model (ELM) (Sussman and Siegal 2003, Bhattacherjee and Sanford 2006, Lee 2008, Angst and Agarwal 2009). ELM accounts for the persuasion process on the basis of dual-processing modes, in order to change or shape attitudes towards psychological objects. According to ELM, when messages are sent for the purpose of persuasion, they are processed via both a central and a peripheral route; the central route involves the comprehension and learning of the message via cognitive efforts, and the peripheral route depends on specific cues that are readily obtainable from a source, message or situation. The elaboration likelihood – that is, the ability and motivation to elaborate on the issues within a message – determines the primary path of persuasion between the central and peripheral routes for the formation of attitudes (Cacioppo and Petty 1984, Petty and Cacioppo 1986, Petty *et al*. 1995, Wood 2000, Petty 2001).

What the studies of IT acceptance using ELM have in common is that they have all explored the relationship between two routes of persuasion and usefulness.

One of their principal emphases is the analysis, in these relationships, of the moderating effects of job relevance, issue involvement and expertise, all of which may be considered proxies for elaboration likelihood (Sussman and Siegal 2003, Bhattacherjee and Sanford 2006, Angst and Agarwal 2009). These trials contributed to our understanding not only of the influencing processes but also the points of integration between ELM and IT acceptance theory.

However, most of these studies also focused on usefulness rather than attitude change similar to the majority of traditional IT acceptance related studies, such that the roles of attitude were not sufficiently investigated. Moreover, the effects of elapsed time during IT acceptance process were not appropriately evaluated although the roles of persuasion routes may change. For example, the accumulation of knowledge and experiences with time elapse may improve elaboration likelihood which would enhance the role of central route but attenuate the role of peripheral route to formulate attitude towards IT use.

The principal objective of this study was to gain insight into attitude changes occurring during IT acceptance from the perspective of ELM. In particular, the primary target of this study was the process of IT acceptance process via an education program. Because the Internet and computers are so ubiquitous, many people can attain IT acceptance, such as in the case of newly released online services or software, without any formal introduction to such products; however, some software – most notably programming languages and spreadsheets – may require education programs for acceptance to be a viable option. Thus, education programs for such IT products may be regarded not only as teaching and training in how to use them from a technical perspective, but also as a process by which program participators are persuaded to have a positive attitude towards the IT acceptance (Lee 2008). This study adopted an ELM based longitudinal approach to capture the changes in the roles of persuasion routes and attitude during IT acceptance – in this case, an education program. For empirical validation of the suggested model, junior business administration students who were participating in an Excel class were surveyed twice – once immediately after mid-terms, and once immediately after the final exam. The data were analysed via the partial least square (PLS) method in order to deduce some implications.

2. Theoretical background

2.1. Attitude

Attitudes represent a relatively enduring (i.e. stored in long-term memory) summary and general evaluation of, or feelings about, the evaluative feeling or response to an antecedent stimulus or attitude object captured in attribute dimensions such as good–bad, harmful–beneficial, pleasant–unpleasant and likable–dislikable (Fazio and Zanna 1981, Breckler 1984, Petty and Cacioppo 1986, Ajzen 2001, Petty 2001). Specifically, attitude formation is based not only on cognition such as rational judgement, but also behaviour such as experiences and affect such as emotional response (Breckler 1984, Fazio and Zanna 1981, Petty 2001, Crano and Prislin 2006).

The ability of attitudes to predict behavioural intentions continues to be a major focus of theory and research in psychology (Ajzen 2001). The majority of studies concerned with the prediction of behaviour from attitudinal variables were conducted from the perspective of the theory of reasoned action (TRA), in which people function in accordance with their intentions over the behaviour, while their attitude towards the behaviour determines their intentions (Fishbein and Ajzen 1975). Thus, attitude has been one of the core conceptions in the prediction and explanation of behaviour intentions and behaviour in social psychology (Ajzen 2001).

Nevertheless, many studies in IT adoption, most of which have been based on the TRA, have focused on beliefs such as perceived usefulness, rather than attitude change (Lee et al. 2003, Legris et al. 2003, King and He 2006). For example, most TAM-related studies have been based on research frameworks consisting of intention, perceived usefulness and perceived ease of use without attitude, which has been shown to be parsimonious and powerful for the prediction and explanation of user behaviour (Davis et al. 1989, Szajna 1996). Some studies have adopted attitude constructs in their research framework, but the roles of attitude have not been a driver of information systems (IS) use or use intention, but rather been limited to a mediator between beliefs and intentions: in other words, their focuses were on beliefs such as perceived usefulness rather than attitude (e.g. Chau and Hu 2002a,b, Hsu and Lin 2008, Mao and Palvia 2008).

Moreover, some studies have adopted beliefs such as perceived usefulness and perceived ease of use to represent attitude (Chin et al. 1997, Salisbury et al. 2002). However, although a person's attitude towards a behaviour may be influenced by beliefs (Fishbein and Ajzen 1975), attitude cannot readily be replaced by beliefs such as perceived usefulness. For example, perceived usefulness refers to the perspective user's subjective perception of the probability that using a specific application system will increase his or her job productivity (Davis 1989, Davis et al. 1989), and this can be regarded as a rational judgement about IT use. On the contrary, attitude towards IT adoption involves

one's feelings about using IT. Thus, while perceived usefulness may be a rationally based evaluation, in which job performance and returns from the system are assessed, attitude is evaluated by emotional factors, in attribute dimensions such as good–bad, harmful–beneficial, pleasant–unpleasant, and likable–dislikable, as described earlier (Ajzen 2001).

2.2. *Elaboration likelihood model*

The ELM is a type of dual-mode processing model that seeks to account for message-based persuasion – that is, the process of the individual's attitude changes as a result of being influenced by the messages effort (Cacioppo and Petty 1984, Petty and Cacioppo 1986, Petty *et al*. 1995, Wood 2000, Petty 2001). In the ELM, the determinants and processes of attitude change are dependent on people's motivations and capacity to process issue-relevant information (Wood 2000). This motivation and ability to elaborate contents in messages is referred to as the 'elaboration likelihood'. People with high degrees of elaboration likelihood depend principally on the central route, in which the quality of the argument inherent to the given message is carefully scrutinised and assessed, and then thoughtfully processed. In the central route, the relative merits and relevance of the provided arguments are the principal foci, the primary criterion for judgement is rational processing, and ability and motivation are considered sufficient to compel the individual to exert the requisite cognitive efforts to elaborate on the arguments contained within a message (Cacioppo and Petty 1984, Petty and Cacioppo 1986, Petty *et al*. 1995, Wood 2000, Petty 2001). Conversely, as people with low elaboration likelihood do not tend to possess the ability and motivation required for the exertion of such cognitive efforts, rather than considering such arguments in the message, these individuals tend to depend on the peripheral route, and are therefore dependent on simple cues with regard to the target behaviour, thus requiring significantly less cognitive effort (Cacioppo and Petty 1984, Petty and Cacioppo 1986, Petty *et al*. 1995, Wood 2000, Petty 2001).

What is theoretically noted in the core of the ELM is that the elaboration likelihood performs a more prominent moderating role than does determination in the relationship between influence routes and perception or attitude changes (Petty and Wegener 1999). People with high degrees of elaboration likelihood do not depend wholly on the central route, but their dependence on the central route predominates over their dependence on the peripheral route. This implies that the higher the elaboration likelihood is, the stronger will be the effects of the central route on perceptions or attitude changes, and the less profound

will be the effects of the peripheral route. Similarly, in cases of lower elaboration likelihood, the influence of the peripheral route tends to predominate over the influence of the central route.

2.3. *ELM in IT adoption*

Only a few previous studies have been conducted thus far regarding the process of IT acceptance from the perspective of ELM, but these have provided critical theoretical implications. For example, Sussman and Siegal (2003) assessed knowledge workers' adoption of advice via the integration of TAM with ELM. In particular, they assessed the moderating effects of knowledge workers' expertise and involvement with regard to the relationship between the two routes and usefulness. Their main contribution was to show that the two persuasion routes would shape usefulness, although their target is the adoption of knowledge rather than IT. Like Sussman and Siegal, Bhattacherjee and Sanford (2006) also evaluated the effects of two persuasion routes on usefulness and attitude with the moderating effects of job relevance and user expertise. They targeted the acceptance of a document management system by administrators and staff personnel during an education program. They demonstrated that ELM could provide new insights in IT acceptance by suggesting messages from external agents as external variables, and by evaluating the moderating effects of elaboration likelihood – such as job relevance and user expertise – on the relationship between these messages and perceptions (Bhattacherjee and Sanford 2006). The study of Angst and Agarwal (2009) can be differentiated from the other studies. Their target was the adoption of electronic health records in the presence of concern for information privacy (CFIP). Thus, their focus was on attitude rather than usefulness, and CFIP was adopted as a moderator between persuasion routes and attitude. Interestingly, they did not demonstrate the moderation effect of issue involvement that is used as a proxy for elaboration likelihood (Angst and Agarwal 2009).

Although the previous studies uncovered critically important theoretical implications, they also have the following two limitations. First, except in the study of Angst and Agarwal (2009), the role of attitude was not sufficiently investigated, even though the principal focus in ELM has been on attitude change. For example, in the study of Sussman and Siegal (2003), perceived usefulness was considered instead of attitude. In the study of Bhattacherjee and Sanford (2006), the main focus was on usefulness rather than attitude, although attitude was included in their research model. In particular, they expanded the concept of attitude into cognition, affect and behaviour, the so-called

tripartite model (Breckler 1984). However, at least in the ELM, it is more appropriate to define attitude via general evaluation dimensions rather than via a tripartite model containing factors that can function as both the antecedents and consequences of attitude change (Petty and Wegener 1999). For example, perceived usefulness and intention should not be regarded as a component of attitude, but rather as components of antecedents and consequences, respectively.

Second, the previous studies have adopted a cross-sectional approach. The duration of IT adoption may imply a change in the elaboration likelihood as experience and knowledge accumulate with the progression of the education program. At the same time, the extent of the effects of persuasion routes on attitude, as well as attitude on intentions, may be altered due to the change in the elaboration likelihood (Lee 2008). In other words, the roles of persuasion routes and attitude may be altered during the process of IT adoption, particularly in the case of an education program. Therefore, a longitudinal analysis of persuasion processes is expected to provide us with a framework for greater insight into the dynamic roles of persuasion routes, as well as attitudes, during the process of IT acceptance as compared to the cross-sectional approach.

3. Research model

In order to account for the IT acceptance process in an education program via ELM, this study suggests a research model like the one shown in Figure 1.

3.1. Variables

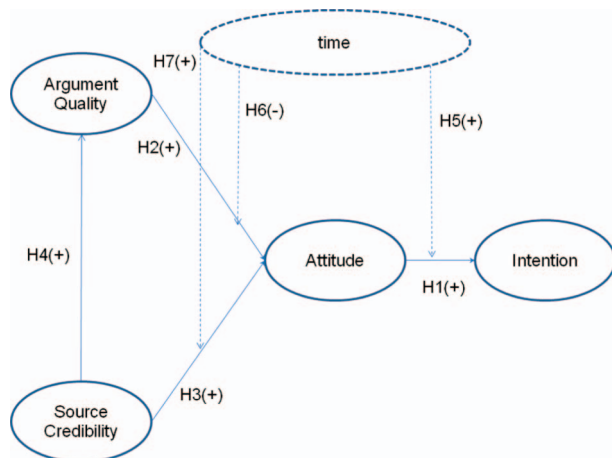The central route is typically operationalised as argument quality, which refers to the persuasive strength of arguments in a message, because it requires a person to think critically with regard to issue-related arguments (Petty and Cacioppo 1986). In the case of IT education, argument quality is a subjective evaluation of issues and contents provided by instructions in a class (Bhattacherjee and Sanford 2006, Lee 2008).

On the contrary, there are many potential peripheral cues in ELM: the number of messages, the number of message sources, the source likeability, and the source credibility. Among them, we have adopted source credibility, which is defined as the extent to which the recipient of the information perceives an information source as believable, competent, and trustworthy (Bhattacherjee and Sanford 2006), referring to a message recipient's perception of the credibility of a message source, and reflecting nothing with regard to the message itself (Sussman and Siegal 2003). For example, in the case of IT education, the students' perception of an instructor's competence and trustworthiness would be a typical source of credibility (Lee 2008).

Although there are several alternatives, most studies have adapted source credibility as a peripheral cue (Bhattacherjee and Sanford 2006, Brinol and Petty 2009). Especially, in IT acceptance, source credibility has been considered as a typical peripheral cue since many users often rely on expert advice to learn about the latest technology (Bhattacherjee and Sanford 2006). Most studies on information systems have also shown that perceptions of source credibility play an important role in judgement of IT acceptance (Mak *et al*. 1997, Sussman and Siegal 2003, Bhattacherjee and Sanford 2006, Lee 2008). Furthermore, the relationship between source credibility and attitude change was analysed and reviewed by numerous studies, and, thus, the items for measuring source credibility have been also well developed (Wiener and Mowen 1986).

3.2. Hypotheses

According to TRA, people act in accordance with their intentions over the behaviour, while intentions are, in turn, influenced by attitudes towards the behaviour and subject norms (Fishbein and Ajzen 1975). Thus, a positive attitude implies higher intention and behaviour than negative attitude. In regard to IT adoption, some studies have adopted attitude as an antecedent of the intention to use IT (e.g. Davis *et al*. 1989, Karahanna *et al*. 1999, Chau and Hu 2002a,b, Mao and Palvia 2008).

Figure 1.   Research model.

Hypothesis 1 (H1): Attitude towards using IT influences the intention of the IT use positively.

Perceived argument quality on an education program may be instrumental to the formulation of attitudes towards IT use. If argument quality is perceived as positive, then a positive attitude towards IT will be formulated, and if the argument quality is perceived as negative, a negative attitude will be formed. According to ELM, attitude change does not depend wholly on a central route, but partly on peripheral cues (Petty 2001). Thus, one of the peripheral cues, source credibility – that is, the evaluation of instructors in an education program – will also influence attitude change. In a previous study, the relationship between source credibility and attitude was evaluated (Bhattacherjee and Sanford 2006).

Hypothesis 2 (H2): Perceived argument quality influence attitude positively.

Hypothesis 3 (H3): Perceived source credibility influence attitude positively.

The relationship between source credibility and argument quality has not been the focus of the majority of ELM studies, as most issues in ELM have focused on comparisons between two persuasion routes in persuasion processes (Petty and Wegener 1999). However, many studies in education have demonstrated that students' evaluations of teachers determine the perceived quality of instructions (Davidovitch and Soen 2006), which can be considered as a perception of source credibility. For example, according to so-called Dr. Fox effect, a lecturer's authority, wit, and personality can 'seduce' students into the illusion of having learned, even when the educational content of the lecture was missing (Abrami *et al.* 1982). That is, a halo effect, a type of cognitive bias in which the perception of a particular trait is influenced by the perception of the former traits in a sequential series of interpretations, can occur in students who ascribe a high degree of source credibility to the instructor. Therefore, in our context, source credibility is likely to exert direct influence on argument quality. For example, comments or recommendations provided by more trusted instructors can be considered more relevant in the scrutiny and assessment of issues than would be the case with less trusted instructors. Therefore, source credibility may significantly influence and shape argument quality.

Hypothesis 4 (H4): Source credibility influence argument quality positively.

In a prior study, it was shown that the effect of attitude on use intention for users is stronger than for potential adopters of an IT, because users have direct experiences whereas adopters have only indirect experiences (Karahanna *et al.* 1999). The rationale for this hypothesis is that direct experience can be differentiated from indirect experience in terms of the amount of available information, information processing, and attitude accessibility (Fazzio and Zanna 1981). That is, because direct experiences imply more information, more actual behaviour, and readier memory access than indirect experience, the attitude–behaviour link via direct experiences will be stronger than that forged via indirect experience. The recent study also demonstrated that the effect of attitude on behavioural intention is significant for long-term users, but is not significant for mid-term and short-term users (Mao and Palvia 2008). In the context of this study, as the program progresses, students tend to have more opportunities for direct experience of IT use with knowledge. Therefore, the effects of attitude on intentions to use IT become stronger as the program progresses.

Hypothesis 5 (H5): The effect of attitude on use intention increases as an education program progresses.

Since attitude induced via the central route is generally more stable, more enduring, and more predictive of long-term behaviour (Petty and Wegener 1999, Petty *et al.* 1995), the role of argument quality in shaping attitude formation should persist as time passes. Moreover, the accumulation of knowledge and experience with IT use as the education program progresses should improve both the skills and expectations necessary for IT use, which should heighten the elaboration likelihood of the student (Petty and Wegener 1999). Therefore, as the program progresses, the role of the central route in shaping attitude – that is, the effect of argument quality on attitude – increases.

On the contrary, the effect of source credibility on attitude would decrease. Theoretically, there is a tradeoff between the impact of central and peripheral mechanisms on judgements along the elaboration likelihood continuum (Petty *et al.* 1995). That is, as the impact of central route processes on judgements increases, the impact of the peripheral route mechanisms on attitude decreases (Petty *et al.* 1995). As the program progresses, the effect of source credibility becomes a relatively less important determinant of attitude.

Hypothesis 6 (H6): The effect of argument quality on attitude is increased as an education program progresses.

Hypothesis 7 (H7): The effect of source credibility on attitude is decreased as an education program progresses.

4. Research methodology

Items utilised for the measurement of the constructs are shown in Table 1. The scale of argument quality and source credibility was adopted from previously conducted ELM-related IT acceptance studies (Sussman and Siegal 2003, Bhattacherjee and Sanford 2006). On the contrary, attitude and reuse intention were measured using pre-validated scales adapted from previous literature regarding IT usage (e.g. Davis *et al.* 1989, Taylor and Todd 1995, Karahanna *et al.* 1999, Bhattacherjee and Premkumar 2004, Bhattacherjee and Sanford 2006).

In order to evaluate our hypotheses, undergraduate students at Daegu University, Korea, were surveyed. They were attending a course called 'Business and Computers', a primary course on the appropriate use of Excel in the business environment. All of the study group subjects were freshmen in the business administration department and have no experience of Excel. Prior to the mid-term exam, the students were introduced to and trained on certain features of Excel including not only some primary concepts such as relative and absolute reference, database, charts, and certain functions but also some advanced features such as some macros and the visual basic application. A variety of business applications were also provided and given the opportunity to practice with techniques.

For longitudinal analysis, the surveys were conducted using the same questionnaires just prior to the mid-term and final exams. As is shown in Table 2, the 141 responders were 77.7% males and 22.3% females in the first survey, and the 166 were 76.5% males and 23.5% females in the second survey.

The PLS method was adopted for data analysis. PLS is one of the principal methods of analysis utilised in structural equation modelling, and is capable of modelling latent constructs under conditions of non-normality and with small sample sizes (Chin 2000). In particular, the PLS approach has been adopted in IS studies in which multi-group analyses were conducted with relatively small sample sizes, as in this study (e.g. Karahanna *et al.* 1999, Keil *et al.* 2000, Gefen *et al.* 2003, Bhattacherjee and Premkumar 2004). All analyses for the measurement model and structural model were conducted on the 1st and 2nd survey samples, respectively.

5. Data analysis

5.1. Measurement model

The measurement model was evaluated by demonstrating convergent and discriminant validity. Convergent validity refers to the level of the relationship between each measure and its assumed theoretical construct, whereas discriminant validity is indicated when each measurement item is correlated weakly with all other constructs, with the exception of the one to which it is theoretically associated (Gefen and Straub 2005).

We demonstrated convergent validity by assessing the loadings of all measurements, composite reliability, and average variance extracted (AVE) of each construct in the 1st and 2nd surveys, as is shown in Tables 3 and 4. Whereas they evidence significant path loading at a level of 0.01, all of our measures yielded composite reliability at 0.8803 or above and AVE at 0.6399 or above, which was consistent with the recommendation levels (higher than 0.5) (Fornell and Larcker 1981).

Discriminant validity was confirmed in two ways. Whereas the square root of AVE for each construct was higher than the correlations between it and all other constructs, as shown in Tables 5 and 6 (Fornell and Larcker 1981), the measurement items loaded highly on their theoretically assigned factor and not highly on other factors, as demonstrated in Tables 7 and 8 (Gefen and Straub 2005).

Table 1. Scales and items.

Argument quality (AQ)
AQ1	Until now the contents provided in class was informative.
AQ2	Until now the contents provided in class was helpful.
AQ3	Until now the contents provided in class was valuable.
AQ4	Until now the contents provided in class was persuasive.

Source credibility (SC)
SC1	The instructor was knowledgeable on Excel.
SC2	The instructor was trustworthy.
SC3	The instructor was credible.
SC4	The instructor was appeared to be an expert on Excel.

Attitude (ATT)
ATT1	Using Excel is a good idea.
ATT2	Using Excel is a wise idea.
ATT3	Using Excel will be pleasant.
ATT4	Overall I like the idea of using Excel.

Reuse intention (INT)
INT1	(After program) I plan to use Excel in the future.
INT2	(After program) I intend to continue using Excel in the future.
INT3	(After program) I expect my use of Excel to continue in the future.

Table 2. Gender distribution in sample.

Gender	1st survey	2nd survey
Male	143 (77.7%)	127 (76.5%)
Female	41 (22.3%)	39 (23.5%)
Total	184	166

Table 3. Psychometric indices of measurements (1st survey).

Construct		Item	Loading	Standard error	t Value
Argument quality	AVE = 0.7740	AQ1	0.8368	0.0403	20.7456
		AQ2	0.8745	0.0252	34.7672
	CR = 0.9208	AQ3	0.8781	0.0297	29.6032
		AQ4	0.8602	0.0274	31.4131
Source credibility	AVE = 0.8278	SC1	0.8652	0.0382	22.6636
	CR = 0.9351	SC2	0.9335	0.0196	47.6846
		SC3	0.9293	0.0169	54.8548
Attitude	AVE = 0.6399	ATT1	0.8435	0.0325	25.9534
		ATT2	0.8614	0.0278	30.9801
	CR = 0.8761	ATT3	0.767	0.0542	14.1437
		ATT4	0.7195	0.0597	12.047
Intention	AVE = 0.7104	INT1	0.8615	0.0494	17.4364
	CR = 0.8803	INT2	0.8077	0.0655	12.3323
		INT3	0.8583	0.0253	33.8987

Table 4. Psychometric indices of measurements (2nd survey).

Construct		Item	Loading	Standard error	t Value
Argument quality	AVE = 0.7550	AQ1	0.8931	0.8264	32.341
		AQ2	0.8721	0.9593	26.9748
	CR = 0.9249	AQ3	0.8864	0.9401	28.1861
		AQ4	0.8222	0.047	17.4901
Source credibility	AVE = 0.8290	SC1	0.8264	0.0411	20.1092
	CR = 0.9354	SC2	0.9593	0.0095	100.6029
		SC3	0.9401	0.0153	61.6459
Attitude	AVE = 0.6760	ATT1	0.8472	0.0336	25.2485
		ATT2	0.7876	0.0643	12.2478
	CR = 0.8929	ATT3	0.8489	0.0391	21.7316
		ATT4	0.8034	0.0523	15.371
Intention	AVE = 0.7779	INT1	0.9225	0.0173	53.3904
	CR = 0.9130	INT2	0.8843	0.033	26.8112
		INT3	0.837	0.0512	16.3346

Table 5. Correlation between constructs with square roots of AVE (1st survey).

	AQ	SC	ATT	INT
Argument quality (AQ)	0.8626			
Source credibility (SC)	0.6256	0.9098		
Attitude (ATT)	0.5665	0.4817	0.7999	
Intention (INT)	0.5008	0.3710	0.6879	0.8429

Note: Diagonal elements – square roots of the average variance extracted.

Table 6. Correlation between constructs with square roots of AVE (2nd survey).

	AQ	SC	ATT	INT
Argument Quality (AQ)	0.8689			
Source Credibility (SC)	0.5870	0.9105		
Attitude (ATT)	0.6212	0.4852	0.8222	
Intention (INT)	0.5750	0.4005	0.7142	0.8820

Note: Diagonal elements – square roots of the average variance extracted.

5.2. Structural model

The explanatory power of the structural models can be evaluated by assessing the R^2 value in the final dependent construct. In this study, the final dependent construct (reuse intention) had R^2 values of 0.4733 and 0.5101 in the 1st and 2nd survey, respectively (see Figures 2 and 3).

After the estimation of path coefficients using the entire sample, PLS was conducted using a bootstrapping technique to acquire the corresponding t value. Some hypotheses (*H1–H4*) are evaluated in terms of the sign (positive and negative) and the statistical significance of the t value for its corresponding path, whereas other hypotheses (*H5–H7*) associated with longitudinal analysis were evaluated via multi-group analysis in accordance with the method adopted by Keil *et al.* (2000). In the case of *H1–H4*, as is shown in Figures 2 and 3, hypotheses *H1* (ATT → INT), *H2* (AQ → ATT), and *H4* (SC → AQ) were supported with a significance level of < 0.01 in the 1st and 2nd

Table 7. Loading and cross loading for measurements (1st survey).

	AQ	SC	ATT	INT
AQ1	0.8368	0.5666	0.4215	0.4467
AQ2	0.8745	0.5418	0.5164	0.4153
AQ3	0.8781	0.5402	0.4797	0.4557
AQ4	0.8602	0.5172	0.5251	0.4164
SC1	0.5139	0.8652	0.419	0.3522
SC2	0.5552	0.9335	0.3972	0.2947
SC3	0.6283	0.9293	0.4883	0.3601
ATT1	0.5088	0.3685	0.8435	0.6419
ATT2	0.5007	0.4351	0.8614	0.6249
ATT3	0.3915	0.3554	0.767	0.4513
ATT4	0.3927	0.384	0.7195	0.4466
IN1	0.4509	0.3261	0.5807	0.8615
IN2	0.2777	0.1982	0.4766	0.8077
IN3	0.5045	0.3863	0.6583	0.8583

Note: Shaded cells = the loadings for the measurements on theoretically assigned factor.

Table 8. Loading and cross loading for measurements (2nd survey).

	AQ	SC	ATT	INT
AQ1	0.8931	0.5325	0.5431	0.4738
AQ2	0.8721	0.4491	0.5548	0.4675
AQ3	0.8864	0.4479	0.483	0.5231
AQ4	0.8222	0.598	0.5667	0.5326
SC1	0.4642	0.8264	0.3531	0.3222
SC2	0.5536	0.9593	0.4573	0.3683
SC3	0.5753	0.9401	0.4976	0.3974
ATT1	0.5414	0.4041	0.8472	0.6748
ATT2	0.5179	0.3214	0.7876	0.5309
ATT3	0.5315	0.4587	0.8489	0.5971
ATT4	0.4463	0.4071	0.8034	0.5317
IN1	0.5531	0.3621	0.6501	0.9225
IN2	0.4746	0.3171	0.5823	0.8843
IN3	0.489	0.3758	0.6507	0.837

Note: Shaded cells = the loadings for the measurements on theoretically assigned factor.
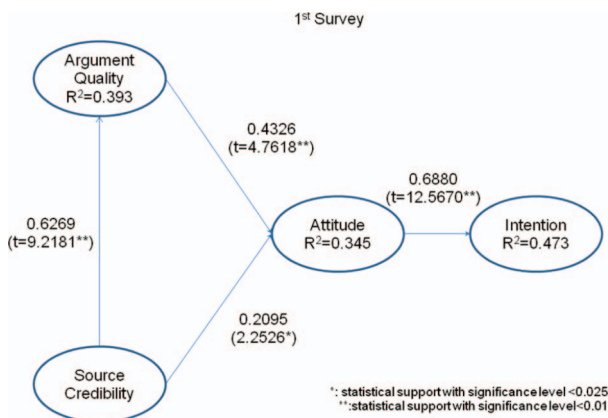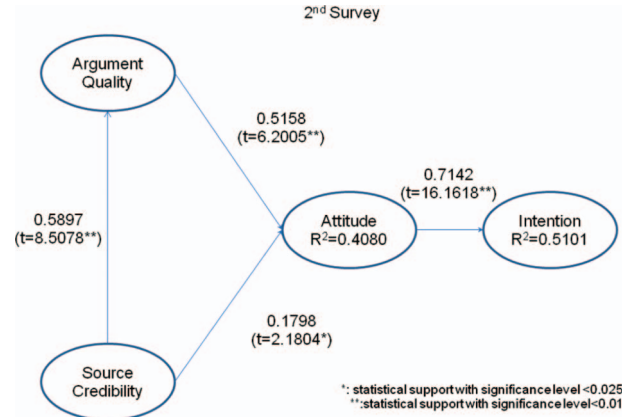

Figure 2. Path analysis in the 1st survey.

Figure 3. Path analysis in the 2nd survey.

surveys, and H3 (SC → ATT) with a significance level of < 0.025 in both surveys.

Hypotheses *H4–H6* were tested via a statistical comparison of paths in both surveys in accordance with the formula suggested by Chin (2000). As summarised in Table 9, hypotheses *H4–H6* were supported by the statistical results. That is, the effects of attitude towards intention and argument quality on attitude in the 2nd survey were demonstrated to be significantly stronger than in the 1st survey (*t* value = 8.3466 and 4.6248, respectively), whereas the relationship between source credibility and attitude were reduced significantly (*t* value = 2.6508).

6. Implications and conclusions

The principal objective of this study was to improve our understanding of attitude changes occurring during IT acceptance from the perspective of ELM. For this purpose, focusing on attitude rather than beliefs and adopting longitudinal analysis rather than a cross-sectional approach, this study suggested a research model in which two persuasion routes – argument quality and source credibility – were adopted as the antecedents of attitude and reuse intention as the dependent variable, with time duration as a moderating variable for the relationships. Based on two surveys given to junior business administration students participating in an Excel class, the data were analysed via the PLS method. As a result, all hypotheses were shown to be statistically supported.

Theoretical implications of this study were summarised as the following two. First, IT adoption was explained by the focus of ELM on attitude. Although the ELM technique was adopted from previous studies (Sussman and Siegal 2003, Bhattacherjee and Sanford 2006), the emphasis was placed on perceived usefulness, rather than attitude. Thus, the relationship between the central route and attitude could not be

Table 9. Test results of Hypotheses 4, 5, 6, and 7.

| Hypothesis | Relationships | 1st survey | | 2nd survey | | |
| | | Sample size $= 168$ | | Sample size $= 166$ | | |
		Path coefficient	Standard error	Path coefficient	Standard error	Difference
H45	ATT → INT	0.688	0.054	0.7142	0.0492	0.0262 (4.6334**)
H56	AQ → ATT	0.4326	0.0929	0.5158	0.0833	0.0832 (8.6138**)
H67	SC → ATT	0.2095	0.0949	0.1798	0.0757	−0.0297 (−3.1595**)

Note: Each value in parentheses is t value of difference $= \dfrac{PC_2 - PC_t}{\sqrt{\frac{n_1-1}{n_1+n_2-2}SE_1^2 + \frac{n_2-1}{n_1+n_2-2}SE_2^2}\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$

where $n_{(i)}$: sample size of the ith survey; $PC_{(i)}$: path coefficient of the ith survey; $SE_{(i)}^2$: standard error of the ith survey (Chin 2000).
**Statistical support with significance level < 0.01.

explained directly – rather, it could only be explained through mediation via perceived usefulness (Bhattacherjee and Sanford 2006). However, this study did explain the relationship between the central route and attitude, as is shown in hypothesis 2, which was theoretically based on ELM. This implies that attitude may perform a salient role in the determination of IT adoption and use. Particularly, the process of IT acceptance can be analysed from the perspective of attitudinal changes based on ELM without beliefs such as perceived usefulness.

Second, the dynamic features of IT acceptance process were elucidated. As time passes or as the education program progresses, the effect of the central route on attitude is increased, whereas the effect of source credibility on attitude is attenuated. This implies that a tradeoff between the impact of central and peripheral routes on attitude (Petty *et al*. 1995) can be also noted during IT acceptance. That is, in addition to job relevance and prior experiences (Sussman and Siegal 2003, Bhattacherjee and Sanford 2006), the time duration required for IT acceptance may play a moderating role between persuasion routes and attitude. Moreover, the dynamic feature of attitude on intention should also be noted. As in the case of persuasion routes and attitude, the effect of attitude on intention is increased with passing time or the progress of education program.

This study provided also some practical implications. First, the role of instructor is as important as the quality of instruction. The acceptance of hypothesis 3 (source credibility → attitude) implies that, in order to improve the efficacy of the education program, the enhancement of the instructor's credibility is as important as instruction quality. For example, the informing instructor's profile, which can be readily perceived by the program participators, can improve (or degrade) the persuasive strength of instruction, consequently shaping positive (or negative) attitudes towards IT use.

Second, the education program should emphasise practice. As a consequence of this study, direct experience obtained through practice, as opposed to instruction, might enhance the effect of attitude on intention. Thus, such a program should not only provide opportunities for practices such as homework, mini projects, and group projects, but also provide readily accessible computing environments and well-trained teaching assistants for program participators.

Third, a self-directed learning strategy is required at the later stages of the education program. Whereas in the early stages of the program the role of the instructor may be persuasive, in the later stages, self-directed learning enhances the effectiveness, since it heightens the elaboration likelihood and decreases dependency on the instructor. Thus, whereas the role of an instructor should shift from teaching to guidance, the trainees' role should evolve from that of a passive recipient of messages to that of an active processor of messages (Rovai 2004).

Despite theoretical and practical implications, this study had some limitations. First, our sample was limited to the users of a specific IT development tool – namely, Excel. Although spreadsheets can be utilised by a broader range of users owing to their ease of use and flexibility (Lawson *et al*. 2009), there may be some remaining questions regarding the representativeness. For example, the applications of our model to potential Java or C++ users might provide significantly different results from those observed with Excel users.

Second, some biases may have been relevant to our experimental procedures. Specifically, in both surveys, all items were simultaneously measured, and this may have led the respondents to give biased responses. For example, the response to attitude might be affected by reuse intentions.

Third, the other factors that would influence elaboration likelihood, such as skill level, were not

considered. For example, the students with high level skill would have also high degree of elaboration likelihood, which would influence not only attitude formulation or change but also argument quality and source credibility. Although the subjects of this study have no experience of using Excel, this study did not consider the change of their skill level as the progress of education program.

Finally, the study could be improved in the following ways. First, our model can be expanded longitudinally, and can thus encompass more than two surveys. Our model was based on two surveys, but three or more surveys should provide us with a more comprehensive and complete understanding of the relevant issues. Previous studies conducted via three surveys have provided us with some useful insights (e.g. Bhattacherjee and Premkumar 2004). In particular, monitoring at the pre-use or initial stages may enrich our model, which largely involved monitoring at the mid- and later stages. The expansion of the model by more than two surveys should be accompanied by a modification of the research model to fit the number of surveys conducted.

Second, temporal analyses of attitudinal changes might also uncover some interesting new research issues. Whereas previous studies have uncovered crucial implications for changes in beliefs during IT acceptance (Bhattacherjee and Premkumar 2004, Bhattacherjee 2006), explorations of changing persuasion routes on IT acceptance should help us gain insight into the other side of IT adoption studies. Fortunately, these studies can be guided by the theories adopted in previous studies. For example, the exploration of mediators in changing persuasion routes can be analysed from the perspective of expectation-confirmation theory, as has been the case in previous studies (Bhattacherjee and Premkumar 2004, Bhattacherjee and Sanford 2006).

Third, the detection of individual change during education program would also enhance the knowledge of IT acceptance. For the detection, it is necessary to match subjects in the surveys during education program, which was not conducted in this study.

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