The acceptance and use of a virtual learning environment in China

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Abstract

The success of a virtual learning environment (VLE) depends to a considerable extent on student acceptance and use of such an e-learning system. After critically assessing models of technology adoption, including the Technology Acceptance Model (TAM), TAM2, and the Unified Theory of Acceptance and Usage of Technology (UTAUT), we build a conceptual model to explain the differences between individual students in the level of acceptance and use of a VLE. This model extends TAM2 and includes subjective norm, personal innovativeness in the domain of information technology, and computer anxiety. Data were collected from 45 Chinese participants in an Executive MBA program. After performing satisfactory reliability and validity checks, the structural model was tested with the use of PLS. Results indicate that perceived usefulness has a direct effect on VLE use. Perceived ease of use and subjective norm have only indirect effects via perceived usefulness. Both personal innovativeness and computer anxiety have direct effects on perceived ease of use only. Implications are that program managers in education should not only concern themselves with basic system design but also explicitly address individual differences between VLE users.

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1. Introduction

Like so many other sectors, the education sector is experiencing rapid internationalization (Bennell & Pearce, 2003). Of particular interest, is the growing number of students from developing or transitional economies studying Western university degrees. They enroll either as a foreign student at a Western university, or join an internationally accredited and qualified educational institution in their home country which collaborates with a Western university. The globalization of education goes hand in hand with an increase in distance learning programs, supported by a rising utilization of internet-based electronic learning (e-learning) systems. E-learning systems help educational programs cross borders of time and space. The success of such educational programs depends to a considerable extent on student acceptance and use of these e-learning systems.
The individual acceptance and use of new technologies has been studied extensively over the last two decades. Especially the Technology Acceptance Model (TAM) by Davis, Bagozzi, and Warshaw (1989) and its successor TAM2 (Venkatesh & Davis, 2000) have received a lot of attention. These models have established themselves as being robust and parsimonious for predicting user adoption of a wide variety of new technologies. In this paper, we apply an extended version of TAM2 in a setting which is innovative in two respects.

First, the technology studied is an e-learning system, also known as a virtual learning environment (VLE). VLEs are designed for supporting and improving the individual study process. They do so by offering a repository for course documents, discussion forums, chat boxes, mass communication options, etcetera. Within the overwhelming amount of technology acceptance studies (see e.g., Sun & Zhang, 2006), the number of those studying the acceptance and use of VLEs is small but growing (see e.g., Martins & Kellermanns, 2004; Ngai, Poon, & Chan, in press; Ong, Lai, & Wang, 2004; Pituch & Lee, 2006; Selim, 2003).

The second aspect making the setting innovative is the fact that the sample consists of Chinese managers participating in an Executive MBA program. There is evidence that culture can be an important factor influencing the existence and strength of relationships in conceptual models of technology acceptance (Straub, Keil, & Brenner, 1997). To give counterweight to the current multitude of studies in Western settings, where culture is more individualistic, we choose the collectivistic culture in China as a setting for our research.

Besides the two setting characteristics, a third contribution to the literature comes from including the constructs of personal innovativeness in the domain of IT (PIIT) and computer anxiety. The first is defined as the willingness of an individual to try out any new information technology (Agarwal & Prasad, 1998). While this individual characteristic has been applied in models of technology adoption several times, its role is still not completely clear and deserves more research (Rosen, 2004). Lewis, Agarwal, and Sambamurthy (2003) state that PIIT has received consistent support as important predictor of technology acceptance outcomes. They do not, however, offer much theoretical nor empirical evidence for this claim. Another personal trait which is relatively under-researched in the field of technology acceptance is computer anxiety. Anxiety can be defined as the uncontrolled occurrence of an anxious or emotional reaction when it comes to performing a behavior (Compeau & Higgins, 1995), in this specific case: using a computer. Where PIIT captures the positive dimension of people to experiment with IT systems, computer anxiety might construct the negative side. The participant’s level of comfort with new technologies is often regarded to be of secondary importance in the process of choosing a school or study (program), for both participant and educational institution. It will therefore be instructive to know if and how these personality traits influence the acceptance and use of the e-learning system.

The paper is structured as follows. In the subsequent section, we provide an introduction to three basic models of technology acceptance: TAM, TAM2 and UTAUT. These models provide the underlying rationale which finally leads to our research model. Then, we develop our hypotheses. This is followed by a section in which we describe our methods for data collection. Thereafter, we test the measures for reliability and validity and present the findings and evaluation of the hypotheses. Results are discussed, and limitations and areas for future research are identified.

2. Literature review

2.1. Virtual learning environments

E-learning systems, or VLEs, are rapidly becoming an integral part of the teaching and learning process (Pituch & Lee, 2006). VLEs present a number of opportunities to business schools, including the potential to leverage a business school brand across geographical borders and the enhancement of face-to-face teaching. Furthermore it enables improvements in communication efficiency, both between student and teacher, as well as among students (Martins & Kellermanns, 2004). A VLE is a web-based communications platform, that allows students, without limitation of time and place, to access different learning tools, such as program information, course content, teacher assistance, discussion boards, document sharing systems, and learning resources (Martins & Kellermanns, 2004; Ngai et al., in press).

A factor critical to successful implementation of VLEs is student acceptance of the system (Martins & Kellermanns, 2004). A long tradition of research on technology acceptance has established that the (potential)
user’s perceived ease of use and perceived usefulness are central factors in explaining the acceptance and use of new technologies. Prior research into the acceptance of e-learning systems has confirmed that these factors are indeed significant predictors of student acceptance of such systems (Martins & Kellermanns, 2004; Ngai et al., in press; Ong et al., 2004; Selim, 2003). Technology acceptance studies in contexts other than e-learning point out that perceived ease of use and perceived usefulness are influenced by individual differences and by external factors such as system characteristics, the availability of support, and the social context in which technology adoption must take place (Sun & Zhang, 2006). Current studies in an e-learning context have studied the role of technical support (Martins & Kellermanns, 2004; Ngai et al., in press), various aspects of system quality (Pituch & Lee, 2006), encouragement by others (Martins & Kellermanns, 2004), and computer efficacy and experience (Martins & Kellermanns, 2004; Ong et al., 2004). We extend the current body of knowledge in the area of e-learning acceptance by investigating the roles of subjective norm, PIIT, and computer anxiety. These three factors relate to the individual and his/her stance towards technology, computers and referent others. Insights in the role and importance of these factors will help managers of educational programs understand why there are differences between individual students in their levels of VLE acceptance and use.

2.2. Technology acceptance

There are several models in the literature trying to explain individual technology adoption, with TAM (Davis et al., 1989) being the most researched one. The majority of models, including TAM, are inspired by the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975). Grounded in social psychology, TRA was very important to other models as it is one of the most fundamental and influential theories of human behavior (Venkatesh, 2000). TRA asserts that both the attitude towards a specific behavior and subjective norm have an impact on behavioral intention, which in turn determines actual behavior. Intentions are assumed to capture the motivational factors that influence a behavior, and thus indicate how hard people are willing to try or to what extent they are planning to make an effort, in order to perform the behavior (Ajzen & Fishbein, 1980). An attitude can be defined as a person’s negative or positive evaluation of performing the target behavior (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The assertion of TRA that any other factors influencing behavior do so only indirectly by influencing attitude, subjective norm, or their relative weights, constitutes one of the key assumptions of TAM (Davis et al., 1989).

TAM was the first model to mention psychological factors affecting computer acceptance, and the model assumes that both perceived usefulness and perceived ease of use of the new technology are central in influencing the individual’s attitude towards using that technology. An individual’s attitude is hypothesized to influence the behavioral intention to use a technology, finally relating to actual use. TAM deviated from TRA from the start, by leaving subjective norm out of the model. Furthermore, the mediating role of attitude was doubted. In the follow-up model TAM2 (Venkatesh & Davis, 2000), the attitude component was not included anymore, and the perceived technology characteristics directly influenced the individual’s intention to use the new technology under consideration. Additionally, social influences (operationalized as subjective norm) re-entered the model.

Both TAM and TAM2 have been applied in different forms to explain technology adoption in a wide variety of contexts, ranging from consumer to intra-organizational technology acceptance. However, other models have been proposed as well. Recently, Venkatesh, Morris, Davis, and Davis (2003) integrated eight models of technology acceptance into the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT represents a significant step forward in the technology acceptance literature, and it suggests four core constructs to explain and predict user acceptance of a new technology: performance expectancy (equivalent to perceived usefulness), effort expectancy (equivalent to perceived ease of use), facilitating conditions and social influence. These constructs explain up to 70% of the variance in usage intention. In our study however, we do not take UTAUT as the basis for our model. First of all, UTAUT’s high $R^2$ is only achieved when moderating the key relationships with up to four variables (gender, age, experience and voluntariness) in order to yield more significant coefficients. This makes the model less parsimonious than TAM and TAM2. More importantly, we find the grouping and labeling of items and constructs problematic, especially for facilitating conditions and social influence. The facilitating conditions construct integrates perceived behavioral control (Ajzen, 1991), facilitating conditions (Thompson, Higgins, & Howell, 1991) and compatibility (Moore &
It thus combines items on the fit between the technology and the individual’s work style, the availability of assistance, and the availability of required resources. It is difficult to see how such a wide variety of items can reflect one single psychometric construct. The construct of social influence integrates subjective norm (Ajzen, 1991), social factors (Thompson et al., 1991), and image (Moore & Benbasat, 1991). Social influence thus combines items on the individual’s perception that other people think he should use the new technology, the perception that others are supportive of using the new technology, and the perception that those who use the system have higher social status. Again, it is difficult to see how these disparate items would all reflect the same latent construct. Considering these drawbacks of UTAUT, we choose to rely on the more traditional and verified TAM2 as the basis for our conceptual model. This means we include subjective norm, but exclude attitude. In the following section, we develop our hypotheses and build the conceptual model.

2.3. Personality traits

Previous research has suggested that personality traits play an important role in technology adoption processes (Karahanna, Ahuja, Srite, & Galvin, 2002). In this research we focus on personal innovativeness and computer anxiety, as we feel these are particularly relevant in an e-learning context. Participants in an educational program with elements of distance learning will be aware that the use of computers is unavoidable. Nevertheless, we expect that in deciding to join the program, their motivation to obtain the degree will have outweighed their general attitude towards new technologies. Since the participant’s level of comfort is often not explicitly taken into account by both participant and educational institution, it is instructive to know if and how these personality traits influence the acceptance and use of the e-learning system.

Personal innovativeness in the domain of information technology (PIIT) can be defined as a person’s predisposition or attitude reflecting his tendency to experiment with and to adopt new information technologies independently of the communicated experience of others (Schillewaert, Ahearne, Frambach, & Moenaert, 2005). In short, it is the willingness of a person to try out an innovation and can on a more general level be seen as a conceptualization of risk taking propensity (Agarwal & Prasad, 1998; Bommer & Jalajas, 1999). It is a situation-specific, stable trait. This indicates that it has a stable influence across situations involving information technology (Thatcher & Perrewé, 2002). PIIT is different from the innovativeness construct as used by Rogers (1995) in his Innovation Diffusion Theory, which is the extent to which an individual is relatively earlier in adopting innovations compared to others. Rogers defines innovativeness as a behavior, while in this study, we see personal innovativeness as a form of openness to change.

A factor related to PIIT, but with an opposing effect, is computer anxiety. This factor has received considerable attention in the psychology literature. Within the context of computers, it can be defined as the emotional distress or the tendency of an individual to be uneasy, apprehensive and/or phobic towards the use of computers (Igbaria & Ivari, 1995). Being anxious about the implications of computer use such as the loss of important data, fear of looking foolish, damaging computer equipment or making other mistakes (McInerney, McInerney, & Sinclair, 1994), is a state-based personal trait (i.e. dependent on a specific situation). Negative perceptions towards technology and information systems, reduced usage, and lower end user satisfaction are often the result from computer anxiety (Howard & Mendelow, 1991; Igbaria & Nachman, 1990; Igbaria & Parasuraman, 1989). We use computer anxiety in our study to portray the negative (stress-related) side of personal traits, while personal innovativeness represents the positive end of the spectrum. This contrast answers calls of previous research for more research into the role of stress-based factors in the technology adoption literature (Igbaria & Ivari, 1995). Moreover, both incorporating a situation-specific, stable trait (PIIT) and a state-based personal trait (computer anxiety) also enables interesting comparisons to be made.

3. Research model and hypotheses

3.1. The traditional TAM hypotheses

Over the years, strong empirical support has been established in favor of TAM (Adams, Nelson, & Todd, 1992; Davis et al., 1989; Legris, Ingham, & Collerette, 2003; Venkatesh & Davis, 2000), making it a robust theory since it holds across persons, settings, and times. We use it in our study since TAM results from
previous studies indicate the model to be a good basis for analysis in this setting (Ong et al., 2004; Selim, 2003). In general, perceived usefulness and perceived ease of use have constituted a significant influence on an individual’s intention to use a technology or system (Ma & Liu, 2004; Schepers & Wetzels, 2006). The mediating role of attitude between these perceptions and behavioral intention has been doubtful from the start of TAM research and was therefore not considered in later assessments of the model (Venkatesh & Davis, 2000). Analogous to Schillewaert et al. (2005) we focus on current usage of technology, meaning that there is no need to examine intentions to use. We follow this trend and consistent with existing research we hypothesize,

**H1.** The perceived usefulness of the system will have a positive impact on system usage.
**H2a.** The perceived ease of use of the system will have a positive impact on perceived usefulness of the system.
**H2b.** The perceived ease of use of the system will have a positive impact on system usage.

### 3.2. The influence of subjective norms

Subjective norm is the person’s perception that most people who are important to him think he should or should not perform the behavior in question (Fishbein & Ajzen, 1975). It has also been conceptualized as normative beliefs (Vijayasarathy, 2004), social influence (Karahanna & Straub, 1999), and social norms (Hsu & Lu, 2004), and was originally part of TRA (Fishbein & Ajzen, 1975). However, since subjective norm was mentioned as being a problematic aspect by Davis et al. (1989) it was excluded from TAM. Despite this argumentation, numerous studies did incorporate the construct thereafter. In most cases, subjective norm is directly and significantly related to a person’s intention to use the system (Schepers & Wetzels, 2006). The reasoning is that when people in an individual’s environment think he should adopt the system, he tends to conform to these opinions and adopt the system. Venkatesh and Davis (2000) argue that this mechanism, which they call the compliance effect, occurs only in mandatory situations. Since our VLE environment constitutes a mandatory environment (i.e. participants have to use the system in order to complete the course), we follow their logic. A second mechanism through which subjective norm influences technology acceptance is via perceived usefulness. This is the mechanism of internalization (Venkatesh & Davis, 2000). When a person perceives that important referents think he should use the system, this person incorporates the referent’s beliefs into his own belief system: since a large number of people cannot be wrong in their opinion, the system must be useful in its purpose. Internalization may take place regardless of whether system adoption is mandatory or voluntary. On the basis of the social mechanisms of compliance and internalization we hypothesize,

**H3a.** Subjective norm will have a positive impact on perceived usefulness of the system.
**H3b.** Subjective norm will have a positive impact on system usage.

### 3.3. The influence of computer anxiety

Having fears about the implications of computer use such as the loss of important data or fear of other mistakes has been related to computer adoption behavior in several studies (e.g., Gilroy & Desai, 1986; Igbaria & Chakrabarti, 1990). Computer anxiety has been related to negative perceptions about computers, problems in playing with them, and avoidance of the technology (Igbaria & Iivari, 1995). If using IT makes an individual feel uneasy, this may increase perceptions of complexity of a technology or information system. People are afraid to look foolish when encountering a system which everybody finds easy to use. Consistent with the empirical findings of Igbaria and Iivari (1995), Venkatesh (2000), and Hackbart, Grover, and Yi (2003) we therefore hypothesize,

**H4.** Computer anxiety will have a negative impact on perceived ease of use of the system.
3.4. The influence of personal innovativeness in the domain of information technology

As indicated earlier, in this study we regard personal innovativeness as a form of openness to change. Being used to adapting to new systems and processes might reveal the usefulness and ease of use more quickly to an innovative person than to a non-innovative person (Schillewaert et al., 2005). Innovative persons know better what kind of technologies are in the field nowadays. They enjoy receiving news on this topic and are therefore more informed about the possibilities of these systems (Robinson, Marshall, & Stamps, 2005). Having worked with similar technologies enables them to draw parallels and more quickly adapt to the system. Therefore, PIIT can both relate to the perceived utility (usefulness) as well as to the perceived functioning (ease of use). Schillewaert et al. (2005) hypothesize both relationships to exist, but only find the relationship to perceived ease of use significant in a context of sales automation systems. Lewis et al. (2003) empirically show both relationships to exist in the context of adoption of internet technologies in a large, public university. Following similar reasoning, we hypothesize that PIIT is an antecedent to both perceived usefulness and perceived ease of use. This adheres to a central assumption of the basic TAM as well, that all external variables, however important they may be in explaining technology acceptance, only influence adoption indirectly via perceived usefulness or perceived ease of use. It is also in accordance with empirical research suggesting that individual characteristics influence information system usage via their effects on beliefs (Agarwal & Prasad, 1999). Hence we hypothesize:

H5a. Personal innovativeness in the domain of information technology will have a positive impact on perceived usefulness of the system.
H5b. Personal innovativeness in the domain of information technology will have a positive impact on perceived ease of use of the system.

It has been suggested in the literature that situation-specific, stable traits like innovativeness influence dynamic individual differences such as anxiety (Kanfer & Heggested, 1997). In the area of technology adoption, Thatcher and Perrewé (2002) empirically show a negative effect of personal innovativeness on computer anxiety. The logic behind this relationship is that more innovative persons are more used to experimenting with new technologies and incorporate existing knowledge in actions they undertake. They therefore feel more confident they can fulfill a task with a computer, or operate an information system. Indeed, in general, more innovative individuals tend to demonstrate higher levels of self-confidence about performing new tasks or when entering new situations (Kegerreis, Engel, & Blackwell, 1970). They are therefore not afraid to engage in “stimulating experiences” like the use of a new technology, i.e. they are more risk tolerant. Hence,

H5c. Personal innovativeness in the domain of information technology will have a negative impact on computer anxiety.

The hypotheses above give rise to the structural model which is depicted in Fig. 1.

4. Methodology

4.1. Data collection and sample characteristics

The sample consisted of 45 Chinese managers enrolled in an Executive MBA program, in which the use of a VLE was necessary for successful completion. The VLE (http://casslearn.city.ac.uk) was specifically designed for this Executive MBA program. The underlying e-learning platform (http://www.teletop.nl) was relatively new at the time, and had not been used in China before. All respondents belonged to the same cohort. The first author was involved in the design of the VLE, and was also responsible for delivering training in system use, which ensures that training was uniform for all respondents. A full afternoon was dedicated to the training, which included instruction and hands on practice. In addition, all students received a manual written by the first author.

The surveys were handed out in one of the workshops, three months into the program, and were completed in class. All 45 questionnaires were retrieved; one had to be excluded from further data analysis because it was
left blank for the greater part. Four cases had to be excluded from data analysis, because they showed a combination of a large number of high z-scores on the one hand and high bivariate and multivariate Mahalanobis Distances on the other hand (cf. Thode, 2002). Of the 40 remaining respondents, 14 are female, 26 are male. The age of these respondents is normally distributed, with the median age being between 36 and 40 years. The data were analyzed with PLS, which is a data analysis method particularly suited to smaller data sets (Chin & Newsted, 1999). As a generally accepted guideline, 10 times the number of predictors in the most complex relationship of the model is stated as a minimum requirement for sample size determination (Barclay, Higgins, & Thompson, 1995; Chin, 1998). In our model, the largest block consists of system usage with three predictors: social norms, perceived usefulness and perceived ease of use. Thus, application of the aforementioned guideline would yield a minimum sample size of 30 for our research. Earlier PLS studies, especially in the field of technology adoption, have shown that stable results can be obtained with samples of this size and smaller (Cool, Dierickx, & Jemison, 1989; Kahai & Cooper, 2003; So & Bolloju, 2005; Venkatesh & Davis, 2000; Yoo & Alavi, 2001).

4.2. Measures

For the measurement of the latent variables in the model, multiple items were used, based on previously published scales for the various constructs. We adapted the wording of existing items to the specific research setting where we deemed this relevant. All items relating to the independent variables were measured on a seven point Likert-type scale, where respondents had to indicate the extent to which they agreed with a given statement, ranging from “totally disagree” (1) to “totally agree” (7). Where applicable, references to “the system” in the items derived from the literature were replaced with the name of the VLE.

For perceived usefulness we used the four-item performance expectancy scale by Venkatesh et al. (2003). Perceived ease of use was operationalized by the four-item effort expectancy scale by Venkatesh et al. (2003). For subjective norm we used the original two-item scale based on Ajzen and Fishbein (1980) as used by Davis et al. (1989) in traditional technology acceptance studies. Anxiety was measured using four items from Venkatesh (2000) and Venkatesh et al. (2003). PIIT was assessed using four items from Agarwal and Prasad (1998). Intensity of use (USE) was operationalized with three newly developed items, each measuring the frequency of accessing one specific software component of the VLE system over the first three months of the EMBA program. The three items measured the frequency of accessing the program information pages, the news pages, and the study units. In contrast to the other scales, the seven answer categories for the scale measuring intensity of use ranged from “never” (1) to “more than once a day” (7).
5. Data analysis

The hypothesized model was tested with the use of PLS. PLS is a variance based latent variable structural equations modeling technique, which uses an estimation approach that places minimal demands on sample size and residual distributions (Chin, 1998). The evaluation of the model fit was conducted in two stages (Chin, 1998; Hulland, 1999). First, the measurement model is assessed, in which construct validity and reliability of the measures are assessed. Second, the structural model with hypotheses is tested.

5.1. Validity and reliability

To verify the validity and reliability of the measures, we observed the factor loadings from the confirmatory factor analysis (CFA) assessing the measurement model in PLS Graph 3.0 (Chin, 2001). The local fit indices composite reliability and average variance extracted (AVE) were examined as well. The factor loadings from the CFA provide evidence for convergent validity as all items load sufficiently high on the corresponding constructs. They all exceed the threshold value of 0.50 suggested by Peterson (2000). For reliability analysis, composite reliability was assessed. Composite reliability values vary from 0.82 to 0.91 and thus all are above the minimum value of 0.7 (Nunnally & Bernstein, 1994). The corresponding fit measures can be found in Table 1.

To check for discriminant validity, we applied the Fornell and Larcker (1981) test. The procedure dictates that the square root of the Average Variance Extracted (AVE) of each construct exceeds the correlation shared between the construct and other constructs in the model in order to achieve discriminant validity. Table 2 displays the details of this analysis. As can be seen, all constructs satisfactorily pass the test, as the square root of the AVE (on the diagonal) is larger than the cross-correlations with other constructs.

In sum, all fit criteria exceeded the threshold levels commonly suggested in the literature and demonstrate a good degree of reliability and validity of all constructs.

5.2. Testing of hypotheses

Statistical significance of the relations in the model was assessed using PLS Graph 3.0 (Chin, 2001) with a bootstrap procedure with 250 resamples. We find a direct positive impact of perceived usefulness on use, but no direct impact of perceived ease of use or subjective norm. Perceived ease of use and subjective norm both have a direct positive impact on perceived usefulness. Computer anxiety has a direct negative impact on perceived ease of use. PIIT has a positive direct impact on perceived ease of use, a negative direct impact on computer anxiety, but no significant impact on perceived usefulness.

In contrast to covariance structure analysis modeling approaches such as LISREL, PLS has no proper single goodness-of-fit measure, because its primary objective is maximization of variance explained, not minimization of the difference between the observed and the reproduced covariance matrices. The quality of a PLS model can be determined by examining the $R^2$ values of the endogenous constructs (Hulland, 1999). The model explains 31% of variance in use, 54% of variance in perceived usefulness, and 59% of variance in perceived ease of use. These $R^2$ values are comparable to those found in earlier studies on the acceptance and use of e-learning systems (e.g., Martins & Kellermanns, 2004; Ngai et al., in press; Ong et al., 2004). Furthermore, PIIT explains 10% of the total variance in computer anxiety. Fig. 2 shows a graphical representation of the outcomes of the model test.

6. Discussion and conclusion

In this paper, we set out to broaden our understanding of technology acceptance and use by including three relatively new elements into our study: a virtual learning environment (VLE) as the system under study, respondents from a collectivistic culture (the People's Republic of China), and two individual traits (personal innovativeness in the domain of information technology and computer anxiety) as independent variables. Of the nine hypotheses formulated at the start, six were confirmed by the data.

The finding that subjective norm impacts systems usage only indirectly via perceived usefulness, is an indication that a process of ‘internalization’ has taken place: the opinions of important referents (peers, course
Table 1
Summary of measurement scales

<table>
<thead>
<tr>
<th>Constructs items</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Factor loading</th>
<th>Composite reliability</th>
<th>Average variance extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer anxiety (ANX)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I hesitate to use a computer for fear of making mistakes I cannot correct</td>
<td>2.23</td>
<td>1.70</td>
<td>0.70</td>
<td>0.82</td>
<td>0.53</td>
</tr>
<tr>
<td>When using a computer, it scares me to think that I could lose a lot of information by hitting the wrong key</td>
<td>3.10</td>
<td>2.21</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers make me feel uneasy</td>
<td>1.63</td>
<td>1.01</td>
<td>0.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers are somewhat intimidating to me</td>
<td>3.05</td>
<td>1.88</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal innovativeness in the domain of information technology (PIIT)</td>
<td></td>
<td></td>
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<tr>
<td>If I heard about a new information technology, I would look for ways to experiment with it</td>
<td>4.55</td>
<td>1.60</td>
<td>0.77</td>
<td>0.83</td>
<td>0.56</td>
</tr>
<tr>
<td>Among my peers, I am usually the first to try out new information technologies</td>
<td>4.23</td>
<td>1.67</td>
<td>0.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In general, I am hesitant to try out new information technologies (reverse-scored)</td>
<td>5.05</td>
<td>1.75</td>
<td>0.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to experiment with new information technologies</td>
<td>5.25</td>
<td>1.65</td>
<td>0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived ease of use (PEOU)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My interaction with [the system] is clear and understandable</td>
<td>6.20</td>
<td>0.85</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was easy for me to become skilful at using [the system]</td>
<td>6.00</td>
<td>1.20</td>
<td>0.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find [the system] easy to use</td>
<td>5.98</td>
<td>1.12</td>
<td>0.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning to operate [the system] is easy for me</td>
<td>6.25</td>
<td>1.08</td>
<td>0.92</td>
<td></td>
<td></td>
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<tr>
<td>Perceived usefulness (PU)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find [the system] useful in my EMBA studies</td>
<td>6.68</td>
<td>0.62</td>
<td>0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using [the system] enables me to accomplish study tasks more quickly</td>
<td>5.90</td>
<td>0.96</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using [the system] increases my study productivity</td>
<td>5.88</td>
<td>1.02</td>
<td>0.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I use [the system], I will increase my chances of getting good study results</td>
<td>5.75</td>
<td>1.41</td>
<td>0.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjective norm (SN)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People who influence my behavior think that I should use [the system]</td>
<td>4.90</td>
<td>1.82</td>
<td>0.89</td>
<td>0.89</td>
<td>0.80</td>
</tr>
<tr>
<td>People who are important to me think I should use [the system]</td>
<td>5.60</td>
<td>1.41</td>
<td>0.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensity of use (USE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over the past 3 months, I have accessed the program information pages on [the system]</td>
<td>5.05</td>
<td>0.99</td>
<td>0.77</td>
<td>0.84</td>
<td>0.64</td>
</tr>
<tr>
<td>Over the past 3 months, I have accessed the news pages on [the system]</td>
<td>4.90</td>
<td>1.01</td>
<td>0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over the past 3 months, I have accessed the study units on [the system]</td>
<td>5.23</td>
<td>1.00</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
management, and lecturers) have become part of the belief structure of the respondent (Venkatesh & Davis, 2000). Internalization is a gradual process and hence the longer an individual works with a system, the less salient subjective norm becomes as a direct predictor of use. A similar effect is observed for perceived ease of use. In accordance with Selim (2003), we find no direct effect of perceived ease of use on usage of the VLE, but only an indirect effect through perceived usefulness. The non-significance of the direct effect is consistent with other recent research (e.g., Chau & Hu, 2002; Szajna, 1996; Wu & Wang, 2005). Further investigating the issue, Venkatesh et al. (2003) did not find any direct post-implementation effects of perceived ease of use, only pre-implementation effects. It has therefore been suggested that as users gain experience with a new system, perceived ease of use becomes less profound since instrumentality concerns overshadow concerns about the system’s the ease of use (cf. Adams et al., 1992; Straub et al., 1997).

The nature of the system may also explain why perceived usefulness surfaces as a significant predictor and perceived ease of use does not (cf. Agarwal & Prasad, 1997). The respondents need to use the system at least at a basic level in order to download study materials and keep up-to-date with the teaching schedules. More extensive use of the system, e.g., for asking questions to the lecturer, or discussions with fellow students, can have a direct effect on study results. As such, the extent to which the system is used can be expected to be triggered more by the perceived usefulness than by the perceived ease of use, as students are willing to overcome usability hurdles in favor of the prospect of better study results.

The effects of personal innovativeness on computer anxiety, and of computer anxiety and personal innovativeness on perceived ease of use were as expected, but the hypothesized effect of personal innovativeness on

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### Table 2

<table>
<thead>
<tr>
<th></th>
<th>ANX</th>
<th>PIIT</th>
<th>PEOU</th>
<th>PU</th>
<th>SN</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANX</td>
<td>0.725</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIIT</td>
<td>-0.231</td>
<td>0.751</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEOU</td>
<td>-0.619</td>
<td>0.502</td>
<td>0.850</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU</td>
<td>-0.417</td>
<td>0.321</td>
<td>0.651</td>
<td>0.790</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td>-0.009</td>
<td>0.072</td>
<td>0.199</td>
<td>0.375</td>
<td>0.894</td>
<td></td>
</tr>
<tr>
<td>USE</td>
<td>-0.189</td>
<td>0.250</td>
<td>0.291</td>
<td>0.479</td>
<td>0.002</td>
<td>0.801</td>
</tr>
</tbody>
</table>

For adequate discriminant validity, the square root of average variance extracted for each construct on the diagonal should exceed the interconstruct correlations (Fornell & Larcker, 1981). This condition is satisfied for all constructs.

---

For adequate discriminant validity, the square root of average variance extracted for each construct on the diagonal should exceed the interconstruct correlations (Fornell & Larcker, 1981). This condition is satisfied for all constructs.

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Fig. 2. PLS results. Notes: Variance explained (R²) between brackets. * Path coefficient significant at the 0.05 level; ** at the 0.01 level; *** at the 0.001 level.
perceived usefulness was not supported by the data. The absence of a significant direct relationship between personal innovativeness and perceived usefulness is consistent with the empirical results of Schillewaert et al. (2005) and Robinson et al. (2005), but inconsistent with the findings of Lewis et al. (2003). A positive and inquisitive stance towards new information technologies does help users to easily operate this kind of system, but does not directly influence their belief that use of this system will lead to better study results. Respondents that perceive the system as being easy to use in general, however, do believe more strongly that use of the system will help them in their studies. The ambiguous findings with respect to the relationship between PIIT and perceived usefulness may be explained by the type of system studied. When, as in our case, there is little leeway to achieve good results without use of the technology, its usefulness is less colored by the fun of using new technologies. Additional evidence is needed to see whether a concept like voluntariness (Moore & Benbasat, 1991) moderates the relationship between PIIT and usefulness. Table 3 presents a summary of the findings.

These findings have a number of implications for practice, in particular for managers of educational programs who use a VLE as a central information hub in their program. As the use of VLEs increases at the cost of traditional means of communication, it is of paramount importance that students actually use these systems to the best extent possible. The first prerequisite is of course that the system contains functionalities that increase study productivity, and that its interface is easy to use. The fulfillment of these basic requirements is the responsibility of the system designer. Teaching staff should feed the system with useful and up-to-date content. This will provide internal incentives for continued use of the system. Furthermore, course management should stress repeatedly that they find it important that students make extensive use of the system. On top of that, however, course management can make a difference by providing appropriate training to students such that their level of perceived ease of use increases and computer anxiety decreases. Already at the stage of the student intake, course management can spot those students with higher probabilities of low system use. A couple of questions on computer anxiety and PIIT can help identify those students that may need some extra coaching at the start of the program and during the initial stages of system adoption.

Our study suggests that the core TAM relationships hold just as well in a Chinese setting as they do in Western countries. The majority of hypothesized relationships are supported by the data. This suggests that, contrary to the findings of Straub et al. (1997), but consistent with the findings of Ong et al. (2004) and Pituch and Lee (2006), TAM does hold across cultures. This is reassuring for (Western) educational institutions who wish to internationalize their programs and use their home-grown e-learning systems to support programs abroad.

7. Limitations and future research

Like in every study, there are a number of limitations attached to our research. The first limitation relates to the size of this study’s sample. With 44 usable respondents, this is rather limited in size. However, previous studies, especially in the area of technology acceptance, have used similar sample sizes and

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>Supported?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1(+) PU</td>
<td>USE</td>
<td>Yes</td>
<td>Direct effect, consistent with many TAM-based studies (see Legris et al. (2003))</td>
</tr>
<tr>
<td>H2a(+) PEOU</td>
<td>PU</td>
<td>Yes</td>
<td>Direct effect, consistent with many TAM-based studies (see Legris et al. (2003))</td>
</tr>
<tr>
<td>H2b(+) PEOU</td>
<td>USE</td>
<td>No</td>
<td>PEOU is less salient in later stages of adoption (Adams et al. (1992), Venkatesh et al. (2003))</td>
</tr>
<tr>
<td>H3a(+) SN</td>
<td>PU</td>
<td>Yes</td>
<td>Direct effect, consistent with many TAM-based studies (see Schepers and Wetzel (2006))</td>
</tr>
<tr>
<td>H3b(+) SN</td>
<td>USE</td>
<td>No</td>
<td>SN is less salient in later stages of adoption (Venkatesh &amp; Davis (2000); Venkatesh et al., 2003)</td>
</tr>
<tr>
<td>H4(−) ANX</td>
<td>PEOU</td>
<td>Yes</td>
<td>Direct effect, consistent with Venkatesh (1999)</td>
</tr>
<tr>
<td>H5a(+) PIIT</td>
<td>PU</td>
<td>No</td>
<td>Attitude towards IT is a weak predictor of the usefulness of this kind of system</td>
</tr>
<tr>
<td>H5b(+) PIIT</td>
<td>PEOU</td>
<td>Yes</td>
<td>Direct effect, consistent with Lewis et al. (2003)</td>
</tr>
<tr>
<td>H5c(−) PIIT</td>
<td>ANX</td>
<td>Yes</td>
<td>Direct effect, consistent with Thatcher and Perrewé (2002)</td>
</tr>
</tbody>
</table>
found stable results (Cool et al., 1989; Kahai & Cooper, 2003; So & Bolloju, 2005; Venkatesh & Davis, 2000; Yoo & Alavi, 2001). Nevertheless, future research in this area should strive for larger sample sizes, such that more elaborate analyses can be performed. Because of the small sample size, we refrained from performing moderator analyses, but as previous studies have shown (e.g., Venkatesh et al., 2003), moderators can add significant explanatory power to the key relationships in technology acceptance models. Future research could therefore pay attention to the development of the roles of PIIT and computer anxiety over time (i.e. conduct a longitudinal research), or explicitly take into account personal factors like experience and tenure.

The second limitation relates to the dependent variable used in this study. We used self-reported extensiveness of use as our dependent variable. Although this practice is commonly accepted in technology acceptance studies (e.g., Adams et al., 1992; Davis et al., 1989; Venkatesh et al., 2003), we recommend future studies also include measures of usage efficiency and effectiveness and type of use (passive or active) alongside measures of usage extensiveness. Efficiency and effectiveness could for instance be determined by means of an experimental setup where one group uses traditional education materials, while the other group uses a VLE. By means of a survey, factors like overall process satisfaction and average study time can be measured. Objectively, the average of the final grades of all participants in each group can be compared in order to make statements on VLE effectiveness. This would enrich analysis and add theoretical rigor to the rather difficult to interpret use construct. As an additional limitation, extensiveness of use was measured using respondent self-reports. The results may therefore suffer from common method bias. While objective usage data or external rater assessments may provide more objective data, this was not deemed possible in the current setup. Basing results on these kinds of measures remains a challenge for future research.

Another limitation which needs to be mentioned is the fact that the respondents in this study were experienced managers in an Executive MBA program, for whom the use of the VLE was non-voluntary (study materials could not be accessed otherwise). Yet, unlike other mandatory settings, use of the system was not part of the job responsibilities of the users. The findings cannot be generalized to other settings without additional research. Specifically for future research into the acceptance and use of e-learning systems, it would be interesting to include a variable that measures the extent to which e-learning is integrated into the pedagogy of teaching and learning. It could be a multi-dimensional characteristic that addresses items such as how well the VLE online material matches with other material of the course, how well VLE-based communication complements other forms of communication, and how well the VLE provides feedback on course progress and mastery of material. One would expect this factor to have a positive impact on the perceived usefulness of a VLE.

Another interesting road for future research would be an investigation in the development of subjective norm over time. In this study it was recognized that internalization is a gradual process and hence the longer an individual works with a system, the less salient subjective norm becomes. Furthermore, from a managerial perspective it would be interesting to see what practices or actions influence an individual’s innovativeness with technologies or one’s computer anxiety. It is generally thought that computer training decreases computer anxiety. However, since many types of training exist, ranging from self-training following the guidelines in computer manuals to intensive courses supervised by software experts, it would be intriguing to see the effects of each of these types on individual characteristics.

The results seem to suggest that the core TAM relationships hold just as well for Chinese managers using an e-learning system as they do in the many TAM studies executed in Western countries for a wide variety of other types of information systems. In future studies, the impact of culture on VLE acceptance could be studied in a more structured way in a quasi-experimental setting. This would require a similar Executive MBA program, supported by the same VLE tool, to be run in multiple countries. In this way, the VLE tool and the pedagogical process could largely be held constant, while levels of individualism, masculinity, power distance, and uncertainty avoidance vary (cf. Sun & Zhang, 2006).

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