E-learning adoption: the role of relative advantages, trialability and academic specialisation

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Abstract
Purpose – The purpose of this paper is to investigate Universiti Utara Malaysia (UUM) lecturers' perception of the decision regarding adopting e-learning as a teaching tool.

Design/methodology/approach – Data were collected from 244 lecturers in Universiti Utara Malaysia. Internal consistency using Cronbach alpha and exploratory factor analysis with Varimax rotation was conducted to confirm the measurement used. Logistic regression was run to examine factors influencing the adoption of e-learning as a teaching tool among lecturers in UUM.

Findings – After performing reliability and validity tests of the instrument, only six factors were included in the framework out of nine factors affecting adoption. The research model showed a reasonably good fit with the data and empirical results confirm that only relative advantages, trialability and academic specialisation positively influence the adoption decision. Thus, the findings have provided evidence of the importance of relative advantages, trialability and academic specialisation in understanding the adoption decision before introducing new online technology and instructional delivery in education.

Research limitations/implications – The measurement of perception was accessed after the adoption process might contribute to post-adoption experience, and the findings are limited to a specific sample that somewhat minimises the generalisability of the result. Future research should aim at examining the proposed framework in a broader range of public higher learning institutions that use e-learning application in delivering knowledge.

Originality/value – The research provides a new perspective on lecturers’ adoption of new technology and focuses on the substance of the instrumentation.

Keywords Innovation, E-learning

Paper type Research paper

Introduction
In recent years there has been an increased interest in the topic of technology used in the classroom and awareness of how technology is adopted as an innovation (Holcombe, 2000). The introduction and successful adoption of new technology, particularly the e-learning has created an interest among researchers because the technology would lead to the modification of traditional classroom teaching. In spite of the claims about the impact of technology in classroom and its influence on the changes of teaching approaches, little is known about lecturers’ opinion on, and experience of, using educational technology (Eynon, 2005). It is important to acknowledge their opinion about new educational technology because university teaching is also undergoing technological revolution (Johnston and McCormack, 1996).

To gain the fullest advantage in this changing trend of teaching tool usage, lecturers have to exploit the potential of information technology (IT) to support their learning and teaching process and at the same time add value to the existing teaching methodology (Broad et al., 2003). Additionally, Newton (2003) highlighted that the use...
of IT in education will: improve access to education and training itself; enhance the quality of teaching and learning; and mark the need for higher institutions to maintain competitive advantage in this changing market place for students. This has led to full exploitation of IT in improving the teaching and learning process, while delivering educational programmes to more students at a lower cost (Peled, 2000).

E-learning in this study is defined as a web-based educational system (LearningCare management system) that utilizes IT and computer networks (internet and intranet). In Universiti Utara Malaysia (UUM), University Teaching and Learning Centre (UTLC) plays an important role to implement e-learning in the university through the LearningCare management system and promote the usage among UUM’s community. By using the internet, LearningCare allows lecturers to link the courses taught for students to access all related resources for the course. To be specific, e-learning in UUM uses mixed method between component of LearningCare and face to face teaching method. E-learning was first implemented in May 2002/2003 semester, and it is a complement of existing conventional/traditional system with the proportion of 30:70.

Benefits of using e-learning include flexibility in terms of time and location (Fayter, 1998, Homan and Macpherson, 2005) also compensated any deficiencies in the traditional system (Fayter, 1998). Despite the benefits of using the Internet in the classroom, the current understanding of the adoption diffusion of this technology is still limited. In reviewing the current literature, the following gaps were found; firstly, much of the literature focuses on the adoption decision of the internet among firms. For example, studies done by Kendall et al. (2001), Pin et al. (2000); Premkumar and Robert (1999), and Soh et al. (1997). However the adoption decision of Internet usage in education line is still lacking Secondly, not much attention is given to determine the factors influencing lecturers to adopt the Internet as a teaching tool. Previous studies conducted by Martins et al. (2004) and Holcombe (2000) had focused on the adoption decision among teachers in schools. Thirdly, much research in this area do not pay much attention on the substance of the instrumentation, whereby validity of the instrument is not established.

This study is aimed at narrowing those gaps. First, this study focuses on adoption decision among lecturers in education line. Second, this study examines factors influencing lecturers to adopt e-learning as a teaching tool. For this purpose, this study uses the theory of perceived attributes (Rogers, 1995) as the central construct. Third, based on a study done by Martins et al. (2004) who used the instrument developed by Moore and Benbasat (1991), the validity and reliability of the instrument as a measurement of the latent variable were empirically tested. The importance of the statistical measurement had been taken into consideration because good research is invariably dependent upon measurement (Roscoe, 1975).

The purpose of this study is to empirically test whether the perceived attributes have any relationship with the lecturer’s decision to adopt e-learning as their teaching tools. As a result, our knowledge of the diffusion process would be greatly improved and would better prepare us to confirm the theory proposed by Rogers (1995).

The remainder of this paper is organised as follows: in the next section, the theoretical framework underlying this study, the hypotheses formulation and the research model are explained. Next, the research methodology is described, followed by the data and measures used before the discussion of the results is presented. In the final
section, the implications of the empirical results are discussed, along with an outline of some directions for future research.

Adoption of e-learning: an innovation perspective

The use of the internet leads to the modification of traditional classroom teaching to keep pace with the rapidly evolving high technology marketplace for higher education. “Teaching as telling” is still the most common way of working in higher education (Fayter, 1998), whereby lecturers deliver lecture aided by overhead transparencies or chalkboard in a large lecture hall (Johnston and McCormack, 1996). Nowadays, as university teaching is undergoing technological revolution (Johnston and McCormack, 1996), the use of IT in teaching can be regarded as an advantage to enhance learning and teaching process.

E-learning exploits Internet technologies to transport learning, knowledge and skills (Imamoglu, 2007) and at the same time offers incredible opportunities for lecturers and students. Through e-learning, students are able to access learning materials online to support their learning needs and lecturers are able to delegate instruction, communicate with students outside the lecture time. As an instructional technology, LearningCare adoption is considered as innovation-based disciplines (Surry, 1997) that contribute to the diffusion of innovation studies.

Innovation studies have been studied among researchers since the early and mid-1980 (Swanson, 1994) from the early days of computerization. Rogers (1995) defined diffusion as the process by which an innovation is adopted and gained acceptance by members of a certain community, whereby four major factors will interact to influence the diffusion of an innovation. The four major factors that influences the diffusion process are the innovation itself, how information about the innovation is communicated, time, and the nature of the social system into which the innovation is being introduced (Rogers, 1995). Rogers (1995) had clearly differentiated the adoption process from the diffusion process whereby the diffusion process occurs within society, as a group process; whereas, the adoption process is pertained to an individual.

Rogers (1995) proposed perceived attributes theory, which states that potential adopters judge an innovation based on their perception. According to Rogers, from 49-87 per cent of the variance of the rate of adoption is explained by five attributes, which are:

(1) Relative advantage, the degree to which an innovation is perceived as being better than the idea it supersedes where potential adopters want to know the degree to which a new idea is better than the existing practices; therefore, they are motivated to seek information to decrease uncertainty about the relative advantage of an innovation.

(2) Compatibility, the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.

(3) Complexity, the degree to which an innovation is perceived as relatively difficult to understand and use by its potential adopters.

(4) Trialability, the degree to which an innovation may be experimented with on a limited basis by its potential adopters.

(5) Observability, the degree to which the results of an innovation are visible to others and to potential adopters.
According to Surry (1997), theory of perceived attributes has been used as the theoretical basis for several studies relevant to the field of instructional technology. It is because the theory itself offers a unique way of examining how the new instructional technology is adopted or rejected. Martins et al. (2004) for example, has used this theory to determine the factors that influenced teachers in language school to adopt the Internet as a teaching tool. They found that observability and trialability were found to be the two most significant predictors of adoption. He used instrumentation from Moore and Benbasat (1991) without conducting any reliability and validity test. It is based on argument that the scales suggested by Moore and Benbasat (1991) demonstrated acceptable level in terms of reliability and validity. However, even though Moore and Benbasat (1991) has developed a set of general scale items to measure each of the main attributes in the theory of perceived attributes and claimed that it can be applied to any particular innovation, we still believe that the instrumentation need to be reconfirm. This confirmatory approach is taken to assess the degree to which the data meet the expected structure as discussed by Moore and Benbasat (1991). Moreover, the instrument will be tested on a different subject and culture.

Some may ask why we are interested in using theory of perceived attributes, rather than using other intention-based theories to explain different user technology acceptance such as technology acceptance model (TAM), theory of reasoned action (TRA) and theory of planned behaviour (TPB). First, this theory has been widely used as a theoretical basis for studies in the field of instructional technology. Second, our intention is not to measure belief and acceptance attitudes among users, as what has been done in intention-based studies. Our focus is on individual adoption innovation decision, particularly on individual decision in adopting a particular technology. In this case, our intention is on the adoption of a new idea (e-learning in education) by individual. Therefore, we need to understand factors that influence the adoption decision by measuring perceived characteristics that would influence individual intention to adopt. Among others, Rogers (1995) focused on a narrower view of innovators (Swanson, 1994) and on individual adoption.

Research model
Considered as an innovation in the educational context, this study has investigated the determinants that support or impede the adoption of e-learning as a teaching tool among lecturers at UUM by using the theory of perceived attributes. According to Rogers (1995), adoption refers to a decision to make full use of an innovation as the best action available. In this study, the term “adoption” will refer to a decision to make full use of the e-learning as a teaching tool among lecturers in UUM.

An adoption model tailored for e-learning is depicted in Figure 1.

Figure 1 shows the model of the study. The independent variable is e-learning adoption, which is the variable of primary interest. The variance in the dependent variable is accounted by six independent variables, whereby their selection is based on the literature supporting of their relevance. To investigate factors that have influenced lecturer’s adoption decision, we focus on two major attributes as the central construct; namely:

1. Demographic information.
2. Rogers theory (theory of perceived attributes).
Demographical information

We suggest that gender (Thompson and Lim, 1996; Kaplan, 1994; Thompson, 2001; Oyelaran-Oyeyinka and Adeya, 2003; Ismail, 2000), age (Thompson and Lim, 1996; Oyelaran-Oyeyinka and Adeya, 2003; Ismail, 2000), academic specialization (Oyelaran-Oyeyinka and Adeya, 2003; Ismail, 2000) and number of years in UUM (Ismail, 2000) can affect adoption decision among lecturers in UUM.

Gender

Several studies have investigated on various issues pertaining to computer usage and the internet with gender differences. Generally, the users of the internet are predominantly males as they are assumed to be more interested in learning about computers (Thompson, 2001). Previous studies found that differences between genders exist in terms of Internet usage activities (Thompson, 2001; Kaplan, 1994). However, Oyelaran-Oyeyinka and Adeya (2003), and Ismail (2000) failed to support that gender differences exist in terms of Internet usage activities. Thus, the first hypothesis is:

**H1.** There is a significant difference in adoption of e-learning between male and female lecturers.

Age

Elder *et al.* (1987), as cited in Thompson and Lim (1996) revealed that older workers are more likely to experience techno stress (physical and emotional burnout caused by inability to adopt new technology) in using personal computers compared to younger workers. In another study, Oyelaran-Oyeyinka and Adeya (2003) noticed that younger
individuals are more likely to use the internet. However, there are studies that conflict with earlier studies suggesting that age may not have an effect on attitudes towards internet usage (Ismail, 2000). Therefore, to further clarify such relationship, the second hypothesis is developed as:

\[ H2 \] There is a significant difference in adoption of e-learning among lecturers of different age groups.

**Academic specialisation**

We use the term academic specialisation to represent the faculty. In relation to this, Oyelaran-Oyeyinka and Adeya (2003) tested the relationship between academic specialisation with the usage of the Internet and found that no significant relationship exists between academic specialisation with computers, e-mail, and internet usage. In contrast, Ismail (2000) found that the place of employment has a significant influence on Internet usage. This contradicting findings leads us to expect a relationship to exist between academic specialisation and adoption decision. Thus, the following is hypothesised:

\[ H3 \] There is a significant difference in adoption of e-learning among lecturers of different academic specialisation group.

**Number of years in UUM**

This study also includes the aspect of tenureship, which will be referred to as the number of years in UUM. Ismail (2000) used the term tenure to represent the number of years of a lecturer’s experience in his or her position. He found that tenureship has no significant influence on internet usage among accounting lecturers of public universities in Malaysia. With regard to the issue of whether tenureship and adoption decision would have any relationship, it may be assumed that lecturers with a longer number of years in UUM would have been more supportive to the adoption of e-learning. We believe that it is worthwhile to investigate this issue. Consequently, the following hypothesis is posited:

\[ H4 \] There is a significant difference in adoption of e-learning among lecturers in different groups of the number of years in UUM.

**Perceived attributes of innovation**

Might perceived attributes of innovation exert an interactive relationship on the adoption decision? Otherwise, if an interactive relationship does not exist between the perceived attributes of innovation and adoption decision, then what should it be?

**Relative advantages**

A relative advantage is defined as the degree to which lecturers perceive a new technology as superior to existing substitute (Bennett and Bennett, 2003), and at the same time indicate the benefits and the costs resulting from the adoption of a new technology (Rogers, 1995). Martins et al. (2004) found that relative advantages have little influence towards the adoption of the Internet as a teaching tool at a foreign language school. This finding is contradictory with previous studies (Mehrtens et al., 2001; Kendall et al., 2001; Poon and Swatman, 1999; Premkumar and Robert, 1999) who found that relative advantages are expected to emerge as the most essential factor that
affect firms’ willingness to adopt new technology. We presume that relative advantages are positively correlated with adoption decision. This means that, lecturers who believe that using e-learning will enhance their teaching and learning processes are more likely to adopt the instructional technology. For this reason, the following hypothesis is posited:

\[ H_5 \] The more positive the relative advantages as perceived by UUM’s lecturers, the higher the level of adoption of e-learning.

**Compatibility**
In this study, compatibility is defined as the degree to which lecturers feel that the new technology is consistent with their values and philosophy of teaching (Bennett and Bennett, 2003). Even though Premkumar and Robert (1999) and Martins et al. (2004) did not directly mention the relationship between compatibility and adoption decision, they still admitted that the relationship between compatibility and adoption does exist. Thus, the following is hypothesised:

\[ H_6 \] The more positive the perceived compatibility by UUM’s lecturer, the higher the level of adoption of e-learning.

**Complexity**
A common theme in the adoption literature is the issues of complexity of new technologies. Complexity is the degree to which the technology is difficult to understand or use (Bennett and Bennett, 2003). Martins et al. (2004) revealed that complexity has little influence towards the adoption of the Internet as a teaching tool at a foreign language school. Even though previous studies indicated that complexity has little implication towards adoption, the complexity issues do exist. As lecturers perceived something with innovative features as complex and difficult to adopt, the tendency to adopt would certainly be reduced. It may also be assumed that lecturers perceived their adopted instructional technology to be complex, would tend to diffuse it slowly and in limited capacity, thus not realising its full benefits. It is expected that a negative relationship between complexity and adoption decision may exists, and the following hypothesis is posited:

\[ H_7 \] The more positive the perceived complexity by UUM’s lecturer, the lower the level of adoption of e-learning.

**Trialability**
Several researchers agreed that trialability is one of the most important components in the process of adopting new technology (Martins et al., 2004; Kendall et al., 2001; Rogers, 1995). In this study, trialability refers to the degree to which lecturers can test the technology before deciding whether to adopt it or not (Bennett and Bennett, 2003). Martins et al. (2004) discovered that trialability was the most significant variable towards influencing the adoption of the Internet as a teaching tool at a foreign language school. Thus, it is expected that trialability and adoption will have a positive relationship, and the following is postulated:

\[ H_8 \] The more positive the trialability perceived by UUM’s lecturer, the higher the level of adoption of e-learning.
**Observability**
Observability is defined as the ease to which the technology can be observed, imagined, or described by the potential users (Bennett and Bennett, 2003). Prior research has provided some information that observability has emerged as a significant determinant towards adopting the Internet as a teaching tool (Martins et al., 2004). Rogers theory states that observability has a positive relationship with adoption decision. It is believed that when potential adopters observe the new technology being introduced as visible, they are likely to adopt the innovation. Thus, the following is hypothesised:

\[ H9 \text{. The more positive the observability perceived by UUM's lecturer, the higher the level of adoption of e-learning.} \]

**Methodology**
This research used an online questionnaire approach compared to the method used by Martins et al. (2004), where their respondents were surveyed using a mailed questionnaire. This method was chosen because lecturers are provided with IT applications and computer facilities that would enable them to answer the questionnaire online. Moreover, respondents have enough time to reply conveniently and this would involve minimal cost and the information gathered is easily coded.

**Unit of analysis**
As this is a case study using qualitative approach and primarily examines lecturer’s adoption decision as a dependent variable, the data were collected from all lecturers in UUM. Therefore, no sampling selection is conducted. The reason is that every lecturer is involved in teaching and has accessed to e-learning.

**Data collection**
The online survey questionnaires were set up to be filled in by 994 lecturers. Following to this method, lecturers were informed and were ask to answer it on online basis. To improve the response rate, the questionnaire was personally administered by e-mail to the non-responding respondents. Thus, a total of 244 sets of survey questionnaire were received, which constitutes 26 percent of the response rate. Of the 244 respondents, 59 percent were male \((n = 144)\) and 41 percent were female \((n = 100)\). As for the age, 55 percent were between 25 and 30 years old \((n = 133)\), 25 percent were between 31 and 35 years old \((n = 61)\), 10 percent were between 36 and 40 years old \((n = 24)\), 8 percent were between 41 and 45 \((n = 19)\), and 3 percent were 46 years old and above \((n = 7)\). Most of them (68 per cent, \(n = 163\)) are working in UUM less than five years whilst most of the respondents were from the Faculty of Accountancy, constituting 21 percent \((n = 50)\) of the total respondents.

**Measures**

**Instrumentation**
The instrument in this study was adopted from Martins et al. (2004), who used the instrument developed by Moore and Benbasat (1991). It was a generic framework for diffusion questionnaire. The questionnaire, according to Moore and Benbasat (1991) is general enough to be used with modification for the type of innovation being studied.
Interestingly, Rogers (1995) acknowledged the work done by Moore and Benbasat (1991) and agreed that the items can be applied to any particular innovation. There are three parts in the questionnaire; part A was used to collect demographic information such as gender, age, number of years in UUM and academic specialisation. Meanwhile in part B, respondents were asked to rate their opinion about e-learning usage using five point Likert scale. In part C, respondents were asked to rate their perception about e-learning usage as a teaching tool using Likert scale ranging from 1-point (strongly disagree) and 7-point (strongly agree). For example, “there are enough people in my organisation to help me try the various uses of e-learning”, “before deciding to use e-learning, I was able to properly try it out” and “I think using e-learning fits well with the way I like to work”.

Reliability and validity of measures

The result for internal consistency using Cronbach alpha confirmed that the measures of the major constructs exhibited good reliabilities. Table I shows result of the internal consistency for the constructs. The values of Cronbach alpha for the five constructs ranged from 0.857 to 0.952, thereby signifying acceptable levels of reliability and appeared robust enough to carry out further study. Further examination on observability items indicates that one item has the lowest corrected item-total correlations, i.e. at a value of −0.02. Thus, this item was dropped from the observability measurement. After dropping the item, the alpha value become 0.920.

In addition, exploratory factor analysis using principal component extraction with Varimax rotation was conducted to measure the major constructs, and the results are reported in Table II. After examining the Eigenvalues of factorial analysis of 21 statements, two factors were extracted to determine factors influencing the adoption of e-learning in UUM. The result is not similar to the research framework shown in Figure 1. The two factors are defined as; factor 1 is relative advantages; and factor 2 is trialability. It shows that in general, relative advantages and trialability still dominate the lecturer’s decision in adopting e-learning. The Barlett test of sphericity for both constructs are significant (sig = 0.000) and the Kaiser-Meyer-Olkin (KMO measure of sampling adequacy) for the constructs are adequate with values greater than 0.70.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Alpha value</th>
<th>Number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative advantage</td>
<td>0.944</td>
<td>5</td>
</tr>
<tr>
<td>Trialability</td>
<td>0.857</td>
<td>5</td>
</tr>
<tr>
<td>Compatibility</td>
<td>0.952</td>
<td>4</td>
</tr>
<tr>
<td>Complexity</td>
<td>0.919</td>
<td>4</td>
</tr>
<tr>
<td>Observability</td>
<td>0.920</td>
<td>4</td>
</tr>
</tbody>
</table>

Table I.
Cronbach alpha reliability analysis

<table>
<thead>
<tr>
<th>Construct</th>
<th>No. of items</th>
<th>Min</th>
<th>Max</th>
<th>Variance explained (%)</th>
<th>KMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative advantages</td>
<td>17</td>
<td>0.618</td>
<td>0.987</td>
<td>67</td>
<td>0.966</td>
</tr>
<tr>
<td>Trialability</td>
<td>4</td>
<td>0.601</td>
<td>0.851</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Table II.
Result of factor analysis
(Morgan and Griego, 1998), where the variance explained (for the constructs) were 67 and 74 per cent. Factor loading of the two constructs are within 0.6 and 0.9, which is above acceptable value of 0.3. Thus, both constructs have construct valid.

Rogers (1995) noted that “past research indicate that these five qualities are the most important characteristics of innovations in explaining the rate of adoption. Each attributes listed is somehow empirically interrelated with the other four, but the attributes are conceptually distinct”. However, after conducting the factor analysis, despite the five items proposed by Rogers (1995), it is only suggested that only two items are valid to measure the adoption decision among lecturers in UUM, which are relative advantages and trialability. Therefore, these hypotheses have been dropped:

H6. The more positive the perceived compatibility by UUM’s lecturer, the higher the level of adoption of e-learning.

H7. The more positive the perceived complexity by UUM’s lecturer, the lower the level of adoption of e-learning.

H9. The more positive the observability perceived by UUM’s lecturer, the higher the level of adoption of e-learning.

Roscoe (1975) defined the correlation coefficient as an index of relationship between two variables and it is used to test whether there is a relationship between two or more variables. Therefore a Pearson correlation product moment analysis was conducted to examine any multicollinearity problems in the constructs. The highest value of correlation is 0.19 (p-value is significant at 0.05, two-tailed), i.e. between YEARJ (number of years in UUM) and ACAS (academic specialisation). The lowest value of correlation is −0.49 (p-value is significant at 0.05 level, two-tailed), i.e. between AGE (age) and YEARJ (number of years in UUM). Therefore, the multicollinearity problem is not serious, and this result is reported in Table III.

Results
Initially, it is intended to analyse the data by using multiple regression. However, the dependent variable failed the normality test (Kolmogorov-Smirnov test). As the basic assumption of multiple regression could not be fulfilled because the distribution was skewed left (i.e. negatively skewed), the data related to the dependent variables were collapsed. In the process of collapsing data, an arbitrary decision was made. Those who scored below 18 will be given a score of “0”, while those who scored 18 or below 30

<table>
<thead>
<tr>
<th></th>
<th>RA</th>
<th>Trial</th>
<th>ACAS</th>
<th>yearj</th>
<th>gender</th>
<th>age</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA</td>
<td>1</td>
<td>0</td>
<td>−0.095</td>
<td>−0.075</td>
<td>−0.107</td>
<td>−0.022</td>
</tr>
<tr>
<td>TRIAL</td>
<td>1</td>
<td>0.072</td>
<td>0.023</td>
<td>0.003</td>
<td>−0.090</td>
<td></td>
</tr>
<tr>
<td>ACAS</td>
<td>1</td>
<td>0.186*</td>
<td>−0.048</td>
<td>−0.201**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEARJ</td>
<td>1</td>
<td>−0.066</td>
<td>−0.494**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GENDER</td>
<td>1</td>
<td>1</td>
<td>−0.135*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>1</td>
<td></td>
<td></td>
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</table>

**Notes:** *Correlation is significant at the 0.01 level (two-tailed); **Correlation is significant at the 0.05 level (two-tailed)
will be given a score of “1”. Thus, the dependent variable was categorized as a dichotomous variable, i.e. 1 = adopted; 0 = not adopted. There is no specific or scientific approach that can be used to categorize the data. Thus, an arbitrary approach and professional judgement were exercised to categorize the data (dependent variable) into a dichotomous variable. Subsequently, a logistic regression analysis was adopted to estimate the hypothesised relationships. The equations for the logistic model are:

\[
\text{Logit} (\text{ADOPT}) = \beta_0 + \beta_1 \text{GENDER} + \beta_2 \text{AGE} + \beta_3 \text{ACAS} + \beta_4 \text{YEARJ} + \beta_5 \text{RA} \\
+ \beta_6 \text{COM} + \beta_7 \text{PLEX} + \beta_8 \text{TRIAL} + \beta_9 \text{OBSERVE}
\]

A logistic regression analysis was performed with e-learning adoption decision as the dependent variable and gender [GENDER], age [AGE], academic specialisation [ACAS], number of years in UUM [YEARJ], relative advantage [RA], and trialability [TRIAL] as predictor variables. A total of 244 cases were analysed and their number is sufficient for the logistic regression analysis. As a rule of thumb, Roscoe (1975) suggested that the minimum sample size should be ten times the number of independent variables. In this study, the number of independent variables is 6 and the minimum sample size should be 60. Thus, the actual sample size is greater than the suggested sample size. Therefore, the sample size under logistic regression is more than sufficient.

The goodness of fit statistics was measured by using the Hosmer and Lemeshow test showing a significance value of 0.71. Thus, the null hypothesis had failed to be rejected, indicating that the model is a good fit to the available data. In terms of measurement for the accuracy of prediction, the overall predictive accuracy in this model is 75 percent, as shown in Table IV.

The relationships between the dependent variables and independent variables are moderate as recorded by Cox and Snell = 0.283 or Nagelkerke = 0.378. Table V presents the results of the logistic regression analysis.

The results of the hypotheses regarding the adoption decision among lecturers were mixed. Since the relationship between academic specialisation and adoption decision may not be linear, a set of dummy variables was used for academic specialisation to reflect the faculty in UUM. The result showed that H3 is supported (Wald statistic = 30.001) suggesting that a different category of academic specialisation is significantly related to the adoption decision. It also indicates that the Faculty of Accountancy [ACAS1], Faculty of Cognitive Sciences and Education [ACAS3], Faculty of Finance and Banking [ACAS6], Faculty of Information Technology [ACAS8], and

<table>
<thead>
<tr>
<th>Predicted</th>
<th>Logistic regress (0,1)</th>
<th>Percentage correct (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.00</td>
<td>76.0</td>
</tr>
<tr>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>0.98</td>
<td>98</td>
<td>73.9</td>
</tr>
<tr>
<td>0.31</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Overall percentage</td>
<td>75.0</td>
<td></td>
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</table>

Table IV. Classification table
Faculty of Management of Technology [ACAS10] are significant, compared to those from the Faculty of Tourism, Hospitality, and Environmental Management as the reference group.

$H5$ examines the impact of relative advantages on adoption decision. The value of the coefficient reveals that an increase of one unit in relative advantages is associated with an increase in the odds log of e-learning adoption by 0.74. This indicates that the adoption of e-learning would most likely increase by half (1/Exp(B) = 1/2.105 = 0.475) when the lecturers perceived relative advantages increase by one unit. Thus, the null hypothesis is rejected. The present study has evidence to support $H5$, which are the relative advantages shown to be positively related to the adoption of e-learning.

$H6$, which is to measure the influence of trialability on adoption decision reveals that trialability is positively related to the adoption of e-learning. Based on the results presented in Table IV, an increase of one unit in trialability is associated with an increase in the odds log of e-learning adoption by 0.6. This indicates that the adoption of e-learning is most likely to increase by 0.6(1/Exp(B) = 1/1.815 = 0.551) when lecturers perceived trialability increases by one unit. Thus, the null hypothesis is rejected and this study has evidence to support $H6$.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>Sig.</th>
<th>Exp(B)</th>
<th>Odd Log (1/Exp(B))</th>
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</thead>
<tbody>
<tr>
<td>RA</td>
<td>0.744</td>
<td>0.190</td>
<td>15.341</td>
<td>0.000*</td>
<td>2.105</td>
<td>0.475</td>
</tr>
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<td>TRIAL</td>
<td>0.596</td>
<td>0.171</td>
<td>12.161</td>
<td>0.000*</td>
<td>1.815</td>
<td>0.551</td>
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<tr>
<td>ACAS</td>
<td>30.001</td>
<td>0.0015*</td>
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<td></td>
</tr>
<tr>
<td>ACAS (1)</td>
<td>2.512</td>
<td>1.189</td>
<td>4.462</td>
<td>0.0175*</td>
<td>12.327</td>
<td>0.081</td>
</tr>
<tr>
<td>ACAS (2)</td>
<td>0.813</td>
<td>1.314</td>
<td>0.383</td>
<td>0.268</td>
<td>2.254</td>
<td>0.444</td>
</tr>
<tr>
<td>ACAS (3)</td>
<td>2.278</td>
<td>1.287</td>
<td>3.133</td>
<td>0.0385*</td>
<td>9.755</td>
<td>0.103</td>
</tr>
<tr>
<td>ACAS (4)</td>
<td>0.496</td>
<td>1.274</td>
<td>0.151</td>
<td>0.349</td>
<td>1.642</td>
<td>0.609</td>
</tr>
<tr>
<td>ACAS (5)</td>
<td>0.410</td>
<td>1.332</td>
<td>0.095</td>
<td>0.379</td>
<td>1.507</td>
<td>0.664</td>
</tr>
<tr>
<td>ACAS (6)</td>
<td>1.864</td>
<td>1.326</td>
<td>1.976</td>
<td>0.08**</td>
<td>6.447</td>
<td>0.155</td>
</tr>
<tr>
<td>ACAS (7)</td>
<td>−0.192</td>
<td>1.327</td>
<td>0.021</td>
<td>0.446</td>
<td>0.826</td>
<td>1.211</td>
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<tr>
<td>ACAS (8)</td>
<td>1.952</td>
<td>1.227</td>
<td>2.532</td>
<td>0.056**</td>
<td>7.043</td>
<td>0.142</td>
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<tr>
<td>ACAS (9)</td>
<td>1.109</td>
<td>1.374</td>
<td>0.652</td>
<td>0.21</td>
<td>3.033</td>
<td>0.330</td>
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<td>ACAS (10)</td>
<td>1.793</td>
<td>1.287</td>
<td>1.942</td>
<td>0.082**</td>
<td>6.009</td>
<td>0.166</td>
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<td>ACAS (11)</td>
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<td>1.411</td>
<td>0.032</td>
<td>0.429</td>
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<tr>
<td>ACAS (12)</td>
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<td>1.213</td>
<td>0.795</td>
<td>0.187</td>
<td>2.948</td>
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<tr>
<td>GENDER (1)</td>
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<td>0.342</td>
<td>0.063</td>
<td>0.38</td>
<td>0.901</td>
<td>1.110</td>
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<td>YEARJ</td>
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<td>2.293</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEARJ (1)</td>
<td>−1.299</td>
<td>1.032</td>
<td>1.586</td>
<td>0.104</td>
<td>0.273</td>
<td>3.663</td>
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<tr>
<td>YEARJ (2)</td>
<td>−0.203</td>
<td>0.647</td>
<td>0.099</td>
<td>0.377</td>
<td>0.753</td>
<td>1.328</td>
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<tr>
<td>YEARJ (3)</td>
<td>0.206</td>
<td>0.376</td>
<td>0.301</td>
<td>0.292</td>
<td>0.583</td>
<td>1.715</td>
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<tr>
<td>AGE</td>
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<td></td>
<td>1.426</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGE (1)</td>
<td>0.132</td>
<td>1.063</td>
<td>0.015</td>
<td>0.451</td>
<td>1.141</td>
<td>0.876</td>
</tr>
<tr>
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<td>1.024</td>
<td>0.029</td>
<td>0.432</td>
<td>0.864</td>
<td>1.157</td>
</tr>
<tr>
<td>AGE (3)</td>
<td>0.095</td>
<td>1.093</td>
<td>0.007</td>
<td>0.466</td>
<td>0.931</td>
<td>1.074</td>
</tr>
<tr>
<td>AGE (4)</td>
<td>0.648</td>
<td>1.135</td>
<td>0.326</td>
<td>0.284</td>
<td>1.912</td>
<td>0.523</td>
</tr>
<tr>
<td>Constant</td>
<td>−1.636</td>
<td>1.447</td>
<td>1.278</td>
<td>0.129</td>
<td>0.195</td>
<td>0.512</td>
</tr>
</tbody>
</table>

Notes: $-2$ Log likelihood = 256.182, Cox and Snell $R^2 = 0.283$, Nagelkerke $R^2 = 0.378$, Goodness of fit = 5.425; * $p < 0.05$; ** $p < 0.1$; Hosmer and Lemeshow = 0.71, df = 8
As for gender, number of years in UUM, and age, the Wald statistic value shows that these groups are not significant. The result revealed that gender, number of years in UUM, and age are insignificantly related to the adoption decision. Thus, $H1$, $H2$, and $H4$ are rejected.

**Discussion**

This study examined factors influencing the adoption of e-learning using Perceived Attributes Theory. Based on data collected, this theory is used to explain the adoption decision of e-learning by lecturers in UUM. The hypothesised relationships were empirically tested, and the results confirm that the adoption decision is positively influenced by relative advantages, trialability, and academic specialization.

Results from this study are consistent with Martins et al. (2004) who examined the Internet adoption rate as the dependent variable. This study indicates that the adoption decision as a dependent variable is well predicted by relative advantages and trialability.

The relationship between relative advantages is positive and significant. This confirms the study by Martins et al. (2004) and Holcombe (2000). Findings from this study also supported the view that relative advantages are positively related to an increasing rate of adoption. Thus, it can be concluded that relative advantages is a significant factor that encourages participation in the adoption of new technologies (Mehrtens et al., 2001; Kendall et al., 2001; Iacovou and Benbasat, 1995).

This study also revealed that the trialability variable is one of the significant determinants in influencing the rate of adoption among lecturers. This is similar to what has been found by Martins et al. (2004), where trialability was the most significant variable towards influencing the internet adoption as a teaching tool at foreign language schools. Thus, the implication of these findings suggests that lecturers need to be given the opportunity to pre-test the technology prior to implementation (Bennett and Bennett, 2003).

Another important finding that pertains to the factors in explaining the relationship between adoption decision and demographical characteristics is related to academic specialization. Lecturers from the Faculty of Accountancy, Faculty of Cognitive Sciences and Education, Faculty of Finance and Banking, Faculty of Information Technology, Faculty of Technology Management and Faculty of Quantitative Sciences have shown significant and positive relationship compared to those from the Faculty of Tourism, Hospitality, and Environmental Management that is used as the reference group. This is in line with previous study done by Ismail (2000), who found that place of employment has a significant influence on internet usage. A closer look at these findings reveal that a faculty with a high IT-related environment has more favourable attitudes towards the adoption of e-learning as a teaching tool.

However, it is unexpected that there is no significant relationship between gender, age, and numbers of years in UUM with the adoption decision. The insignificant result between age and adoption contradicts previous findings that indicated young and educated lecturers tend to use the internet more (Oyelaran-Oyeyinka and Adeya, 2003). Nevertheless, this result concurs with Ismail (2000) who also found insignificant relationship between age and internet usage. On the other hand, the insignificant relationships between gender and number of years in UUM with adoption are consistent with Oyelaran-Oyeyinka and Adeya (2003) and Ismail (2000). In addition,
Bullard (1998), in a research on attitude towards educational technology also indicated that there was no difference between male and female university professors. One likely reason is that continuous training provided by UTLC demands lecturers to be updated and to be more flexible in using e-learning. Therefore, gender, age, and number of years in UUM are not factors that influence the e-learning adoption in UUM.

Theoretical implications
Another purpose of this study was to validate measurement for perceived attributes, variable hypothesised to be determinants of e-learning adoption. After conducting factor analysis, the most critical findings show that only two attributes from the perceived attributes of innovation were applicable to be tested in this study. This implies that the theory proposed by Rogers (1995) is not conclusive. It is also evidenced from this study that the variables introduced by Rogers (for example observability, complexity and compatibility) are questionable in terms of their validity as latent variables. Although the process of measurement model was not conducted, this study contends that only relative advantages and trialability should be the dimension under perceived attributes of innovation. This is supported by Kearns (1992), who suggested that a single set of innovation attributes is not very reliable as predictors of adoption, particularly when applied across multiple institutional contexts. From a different point of view, Downs and Mehr (1976) claimed that instability exists in the conceptual study of innovation in a complex organisation. As a result, factors found to be important for innovation in one study may be found to be considerably less important, not important at all, or even inversely important in another study (Downs and Mehr, 1976).

Managerial implications
First and foremost, the University Teaching and Learning Centre (UTLC) and UUM Computer Centre should enhance the quality of e-learning and at the same time consider relative advantages, trialability, and academic specialisation when introducing new technologies. Consistent with Wild et al. (2002), it is agreed that combining the characteristics of effective traditional learning with those of effective online learning will provide a rich and varied presentation environment that will satisfy individual need of users. In addition, it can also be enhanced by educating the lecturers and also students about the importance and advantages of using e-learning in teaching and learning processes. To improve lecturers’ participation in using e-learning as a teaching tool, a control mechanism must exist to monitor lecturers participation in using the technology. Furthermore, UUM must provide extra incentives (e.g. merit for performance appraisal) for the time and effort that lecturers spend in using the technology.

Secondly, the lecturers themselves should fully exploit the instructional technology to make the teaching and learning processes more interesting compared to the conventional method. This study also agreed with Peled (2000) who noted that a full exploitation of instructional technology can improve teaching and learning processes, and at the same time deliver the education to more students at a lower cost.

Thirdly, if lecturers’ contributions are ignored, UTLC and the UUM Computer Centre alone are not enough. Since instructional technology is a method of a two-way communication, students should be enforced to use the technology as well. Hence,
lecturers must show positive effort towards using the technology as well as showing good example to the students.

Limitations and future research
This study is subjected to several limitations. Data collection for this study were using on-line survey questionnaire. Follow-ups were made through personally administered e-mail to all lecturers due to the low response rate. It must be acknowledged that the perceptions on the adoption decision towards e-learning were gathered after the adoption process. Thus, the result might be influenced by post adoption experience of the lecturers.

Secondly, this study is a case study but using the questionnaire approach for the purpose of analysis. Thus, findings are limited to a specific sample only. The restriction of the sample to only UUM lecturers somewhat minimises the generalisability of the results. Further studies are essential to examine the proposed framework in a broader range of educational institutions especially other Public Higher Learning institutions that use e-learning applications in delivering knowledge to students.

Thirdly, the suggested model is constrained by the limited numbers of variables. Future studies are needed to conduct more extensive and qualitative studies to examine the extent to which the insignificant factors in this study really influence the adoption decision. Meanwhile, future researchers could further elaborate the model to account for the 25 percent that remains unexplained, suggesting that other factors should also be considered.

References


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