Journal of Engineering and Applied Sciences 7 (1): 23-30, 2012
ISSN: 1816-949X

The Innovation Adoption Perspective in M-learning for Engineering Education

[1]Pansak Thaiait, [2]Kalayanee Jitgarun and [3]Weerachai Chaokumnerd
[1]Learning Innovation in Technology Program, [2]Department of Electrical Technology Education, Faculty of Industrial Education and Technology, King Mongkut's University of Technology, Thonburi Bangkok, Thailand
[3]Department of Telecomunications Engineering, Dhurakij Pundit University, Bangkok, Thailand

Abstract: Mobile learning (M-learning) is a new, exciting and promising field. M-learning likely to provide more information, rather than knowledge, misses the mark. Information and knowledge are not identical, however there is an intimate relationship between user and innovation adoption perspective. Thus, this research was to study and examine an innovation adoption perspective from engineering students' intention of M-learning degrees. Given the development in M-learning and its potential impact on how learning takes place, this research emphasizes M-learning represents adoption of an innovation in engineering education. It therefore, examined M-learning adoption via Rogers's Relational Model of perceived innovation trait. A questionnaire survey was developed to collect data from a sample of 401 Thai engineering students. The sample was obtained by using the Random Sampling Method. Research methods were applied to collect quantitative data using interviews and questionnaires for participant and non-participant observations. The research tools were checking via Back Translation Technique. The analysis had shown that the perspective of relative advantage, the mean was 4.21 with SD = 0.67. The perspective of compatibility, the mean was 4.00 with SD = 0.74. The perspective of complexity, the mean was 3.91 with SD = 0.75. The perspective of trialability, the mean was 3.76 with SD = 0.77. The perspective of observability, the mean was 3.81 with SD = 0.73. Finally, we can be concluded that this study can help for creating a society of learning, improve the adoption potential and a wide sharing of knowledge.

Key words: Innovation adoption, mobile learning, engineering education, society, analysis, Thailand

INTRODUCTION

At present, the technology change can develop the quality of education innovation and technology. Education innovation is important factor in the rapid distribution of information. It has been adapted for work in various fields such as industry, business and education. Mobile learning is an interesting option to distribute knowledge and support learners with different backgrounds and learning skills. They can select the lesson that they want to learn and there is no limit in place and time. The features of Mobile learning are application programs that have subjects and details of several lessons. Also has an exercise test to evaluate the efficiency of the student. Mobile learning is a one thing for creates a variety of ways to deliver and provide electronic resources for learner (Milrad *et al*., 2002). Thus, Mobile learning is professionals cite benefits to learner. The learner benefits from the opportunity to prepare themselves for greater ability and increase their competitive in a globalization. However, a big advantage is that the Mobile learning also supports the delivery of multimedia elements, such as sound, video and interactive hypermedia (Lipman, 1991).

In addition, Mobile learning can provide flexibility and convenience. It can overcome some traditional barriers such as time and place. Learners can access materials independently (Seppala *et al*., 2002). In addition, Mobile learning does not require extensive computer skills, although familiarity with smart phones and software does help to reduce the intimidation factor (Baker, 2000). Technology has been applied to learning, since decades but it has really flourished with the advent of the web. In recent years, the quick growth of mobile technologies is promising a new revolution that might be comparable with the web.

Corresponding Author: Pansak Thaiait, Learning Innovation in Technology Program, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, Bangkok, Thailand

The forecasts shown about 65 million handhelds will be sold and that approximately 38% of them will be smart phones, integrating PDA functionality with features for communication (Steinberger, 2002). More and more mobile devices with improved capabilities are appearing on the market.

Lots of mobile clients already support internet access, it making easier and less costly to develop portable education applications. Mobile learning is a field which combines mobile computing and E-learning. Many researchers are working in this new field. Thus, Mobile learning is an impotent tool to develop innovation. Many researchers rethink the way to develop innovation for learner.

Mobile learning (M-learning) is a one thing for creates a variety of ways to deliver and provide electronic resources for learner. Some methods such as system to deliver text, video and animation to learner.

However, M-learning is still a new ideas for many people, preferably in engineering education and attitudes towards its adoption has not been fully studied. A better perception of M-learning adoption intentions in engineering education would enable M-learning providers to offer courses that are more likely to be recognition by future M-learners. This research aims to study and examine M-learning adoption perspective in engineering education area from an innovation adoption perspective. To achieve research objectives, diffusion of Innovation Theory (Rogers, 1995) was employed. Research hypotheses were established based on Rogers's Relational Model.

Five innovation adoption attributes suggested by Rogers were modified in the context of M-learning and were used in the survey questionnaire design and data analysis. The survey was carried out with Thai undergraduate engineering students to examine their intentions to study engineering degrees via M-learning programs provided by M-learning Center, Rangsit University, Thailand.

Research methods were applied to collect quantitative data using interviews and questionnaires for participant and non-participant observations as well as documentary studies.

Collect quantitative data was conducted to reveal the relationship between students' attitudes towards innovation attributes and their adoption intention. The research makes a number of contributions to both theory and practice by examining M-learning take-up intentions from an innovation adoption perspective in the context of engineering education. The key concepts are discussed in the conclusion of the study.

LITERATURE REVIEW

Mobile learning: M-learning is often defined as E-learning through mobile computational devices. In general by mobile device, we mean PDAs and digital cell phone but more generally we might think of any device that is small, autonomous and unobtrusive enough to accompany us in every moment in our every-day life and that can be used for some form of learning. These small tools can be seen as instruments for accessing content, either stored locally on the device or reachable through interconnection. They can also be a tool for interacting with people, via voice and through the exchange of written messages, still and moving images (Davies *et al*., 2002).

There are many properties that differ when comparing a mobile device from a desktop PC (the usual medium to deliver E-learning) and they have impact on what is reasonable, useful and even pleasant to do on such devices. Some of them are the output (i.e., the screen size and resolution capabilities, etc.); input (i.e., keypad, touch-screen, voice input); processing power and memory; supported applications and media types. When we try to transfer services provided by an E-learning platform into services in an M-learning platform, some of them should change to fulfill the limitations of the small devices, some are impossible to be delivered in a certain context but also new services appear, provoked by the mobility (Ryan, 2001).

Rogers's Relational Model: The process by which an innovation (new idea, product, practice or service) is communicated through certain channels over time among members of a social system and subsequently considered for adoption, utilization and implementation (Rogers, 1995).

Some innovations are communicated and adopted at great speed and others never appeal to many people (Rogers, 2004). The difference in rate of adoption can often be explained by the differences in how the potential adopter perceives the innovation's characteristics or attributes.

Many researches have shown that perceived characteristics of the innovation have explained 49-87% of the variance in rate of adoption. Studies of perceived attributes have included several attributes or characteristics that have been used to predict the rate of adoption (Rogers, 1995).

Rogers identified five attributes of an innovation that are key influences on innovation adoption and diffusion. Rogers' Model includes 5 dimensions

Table 1: Five dimensions characteristics innovation adoption and diffusion, Rogers' Model

Dimensions	Definition	Application
Relative advantage	The degree to which an innovation is perceived as being better than the idea it supersedes	The benefits may be in relation to economic, social status or other factors. Innovations that appear to be beneficial when compared to other methods both current and previous are more likely to be adopted
Compatibility	The degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters	Adoption is more likely when the innovation is consistent with the economic, sociocultural and philosophical value system of the adopter13 and the adopter's expectations and needs. Ten positioning techniques match the needs and values of potential adopters with the innovation to facilitate its introduction
Complexity	The degree to which an innovation is perceived as relatively difficult to understand and use	Innovations that are perceived as more complex are less likely to be adopted. Complexity is the only attribute negatively related to adoption. Some researchers have used the term simplicity so that the attributes would have the same directionality in terms of their relationship with adoption
Trialability	The degree to which an innovation may be experimented with on a limited basis	Innovations that can be tried before adoption are adopted more rapidly than those that cannot, especially among those who adopt earlier relative to the majority of potential adopters. Later adopters use the experience of peers as a vicarious trial of the innovation
Observability	The degree to which the results of an innovation are visible to others	When a person sees another person using a particular innovation, such as a cellular phone, the other person models how the innovation works as well as the benefits of use. One is less likely to observe the results of an innovative idea so innovative products are more likely to be adopted than innovative ideas

characteristics; relative advantage, compatibility, complexity, trialability and observability (Table 1).

Engineering education in Thailand: Thailand's educational system is divided into four levels, namely; pre-school, primary, secondary and tertiary levels. The provision of pre-school, primary and secondary education, including vocational and technical education is under the responsibility of the Ministry of Education while the provision of tertiary education is under the supervision of both the Ministry of Education and the Ministry of University Affairs. According to the 1999 National Education, University Education is available to students who have completed the upper secondary level of education. To cope with thousands of upper secondary school leavers wishing to continue their studies at university level, admission to university is done by a competitive national university entrance examination. Universities are under the responsibility of the Ministry of University Affairs which is also responsible for private higher educational institutions. There are presently 24 state universities in Thailand, 12 of which are in Bangkok while the remainder is located in the provinces. In addition, there are 51 private colleges and universities offer undergraduate courses in such fields as Agriculture, Arts, Architecture, Business Administration, Archaeology, Education, the Humanities, Law, Social Sciences and Political Science.

Programs of studies at Master's degree level are offered at about 46 universities and several doctoral degree programs are being conducted at approximately 20 universities (Office of the National Education Commission, 1999).

Bachelor degree programs in engineering and related technology generally contain between 140-150 credits which are normally spread >8 semesters or 4 academic years. Engineering education also specifies a minimum of 30 credits for general studies including Physical Science, Mathematics, English language, Social Science and Humanities and 6 credits of free electives. The Engineering Profession Control Committee which issues practicing licenses for civil, electrical, industrial, mechanical and mining engineers, requires at least 39 credits of compulsory engineering subjects for each of the engineering disciplines. Practicing licenses are not required for other engineering disciplines such as computer or environmental engineering.

There are three approaches to bachelor degree engineering education. The first approach puts all the 1st year students together to take common studies and then separates them into various disciplines from the 2nd year onwards.

The second approach separates students into disciplines as soon as they are admitted to their 1st year. The third approach takes vocational students who possess a higher diploma in vocational education which puts them into appropriate disciplines. Appropriate subjects from their vocational education may be accredited (Office of the National Education Commission, 1999).

MATERIALS AND METHODS

This study was to examine an innovation adoption perspective from engineering students' intention of M-learning degrees. Students provided demographic information and were asked to report their perceptions of the innovation and their intention to adopt it in the near future. These data were used to conduct analyses to develop valid and reliable perceived attribute measures.

The M-learning innovation: M-learning was a multimedia mobile application that was designed to be used as a supplement to a bachelor degree program in engineering course. The Instructional forms of M-learning could be categorized into 2 groups as teacher-related instruction forms are following activities; sending messages to learners, sending video to learners, simulating virtual situations, downloading activities for learners, downloading games for learners, building database for learners, checking and/or correcting learner's exercises online, making learner's records and registering learners. Learner-related instruction forms are following activities; sending/receiving messages, sending/receiving video, sending/receiving assignments to/from teachers, learning via games, learning how to solve problems via games, transferring learning activities via internet and using mobile devices to search for data (Fig. 1).

Population and sample:

- Population of this study was composed of engineering students who are study in Rangsit University, Thailand
- Sampling group was composed of 401 engineering students in Rangsit University, Thailand, selected by Random Sampling Method

Survey instruments: Based on the literature review of previous innovation adoption studies, this research adapted a range of the validated survey constructs developed by Moore and Benbasat (1991) who systematically examined the perceived attributes of IT innovations and developed an instrument to measure users' perceptions. Duan *et al*. (2010) study the innovation adoption perspective that research aims to examine from an innovation adoption perspective, Chinese students' intention of taking up E-learning degrees. Many research studies about innovation adoption perspective but it was not designed for M-learning.

This study adapts and modified to suit the purpose of the current study. This instrument was developed with items likely to fall into specific subscales for Rogers' 5 perceived attributes based on a previous study by Yanqing Duan and Moore. Table 2-6 shows the constructs, variables and survey items used in the survey. A total of 43 items were used to measure five perceived innovation attributes. The number of items used to measure each construct should be sufficient and comprehensive.

Data analysis: An initial study was conducted at Rangsit University, Thailand. The survey was on a 5-point Likert-type scale. Data collection was done by questionnaires then the questionnaires were analyzed to

Table 2: Perceived of relative advantage for M-learning innovation

Items	Mean±SD
M-learning cost relatively lower	3.91±0.94
M-learning offers more flexibility	4.15±0.67
M-learning can adapt to my own need	3.94±0.86
M-learning allow me to work at my own pace	4.09±0.76
M-learning enables me to easily access my course material	4.38±0.65
M-learning increases the efficiency of my study	4.36±0.59
M-learning increases the effectiveness of my study	4.28±0.49
M-learning widens my personal learning experience	4.37±0.52
M-learning in general has more advantages than learning in a traditional way	4.41±0.53
Total	4.21±0.67

Fig. 1: The M-learning innovation

Table 3: Perceived of compatibility for M-learning innovation

Items	Mean±SD
M-learning is compatible with my mobile device	3.84±0.85
M-learning is compatible with my learning style	3.75±0.70
The degree will not put me into a negative position against somebody who has the same degree studying in the traditional way	3.53±0.74
M-learning is more suitable to my learning style	4.12±0.77
M-learning is more suitable to my life style	4.04±0.78
M-learning suits my personality	4.08±0.77
M-learning meets my personal career goal	4.24±0.65
M-learning meets my personal learning needs	4.18±0.72
M-learning is more suitable than traditional	4.26±0.68
Total	4.00±0.74

Table 4: Perceived of complexity for M-learning innovation

Items	Mean±SD
M-learning needs higher level of computer knowledge than I currently have	4.17±0.66
There are some specific technologies that I am not aware of in m-learning	4.13±0.61
The degree will not put me into a negative position against somebody who has the same degree studying in the traditional way	4.23±0.70
M-learning system is more complex to use participating in e-learning requires more mental effort	3.75±0.85
M-learning is more suitable to my life style	4.08±0.71
M-learning suits my personality	3.84±0.75
M-learning meets my personal career goal	3.44±0.83
M-learning meets my personal learning needs	3.95±0.82
M-learning is more suitable than traditional	3.64±0.83
Total	3.91±0.75

Table 5: Perceived of trialability for M-learning innovation

Items	Mean±SD
There are chances to try essential software needed before starting an M-learning course	3.79±0.81
There are chances to try demos of different M-learning courses before starting an M-learning course	3.76±0.80
There are opportunities to talk to other M-learners before starting an M-learning course	3.69±0.78
There are opportunities to look at M-learning content before starting an M-learning course	3.73±0.78
There are opportunities to try M-learning services before starting an M-learning course	3.74±0.78
In general, M-learning offers opportunities to try a course before starting an M-learning course	3.74±0.77
There are opportunities to collaborative with other learner before starting an M-learning course	3.85±0.80
There are M-learning support many model of mobile device	4.05±0.68
There are chances to try M-learning services more than traditional way	3.50±0.70
Total	3.76±0.77

Table 6: Perceived of observability for M-learning innovation

Items	Mean±SD
The benefits of M-learning can be demonstrated	4.16±0.59
There are plenty of chances to know about M-learning	3.91±0.71
There are plenty of chances to know about benefits of M-learning	3.89±0.75
The benefits of taking an M-learning course are apparent to me	3.99±0.71
I have no difficulty to tell others about benefits of M-learning	3.82±0.71
M-learning offers opportunities to shear personality	3.75±0.75
M-learning offers opportunities to communication with my friend	3.72±0.74
There are M-learning support many model of mobile device	3.78±0.76
In general, M-learning services easy to learn more than traditional way	3.32±0.86
Total	3.81±0.73

find out the conclusion. Data analysis was done using SPSS/FW (Statistic Package for Social Science/for Windows) software.

The part with selection items was analyzed using frequency and percentage. The part with five scales was analyzed using mean (X), Standard Deviation (SD) and correlation. The levels of agreement from respondents were as follows:

Average score:

- 4.50-5.00 means definitely agree
- 3.50-4.49 means strongly agree
- 2.50-3.49 means quite agree
- 1.50-2.49 means quite disagree
- 1.00-1.49 means strongly disagree

RESULTS AND DISCUSSION

This study used the innovation adoption perspective by Rogers (1995) consists of five perceived innovation attributes:

- Relative advantage
- Compatibility
- Complexity
- Trialability
- Observability

The overall perceived of relative advantage in facilitating learning process towards the M-learning innovation was also conducted to identify perceived level

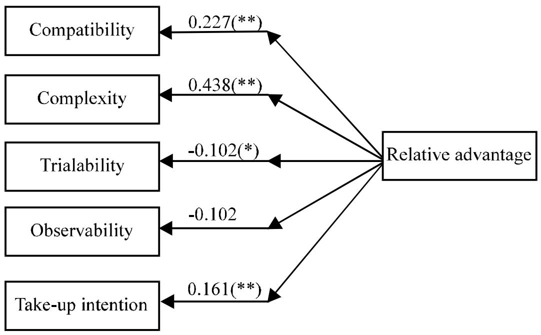

Fig. 2: The correlations of relative advantage and five perceived innovation attributes

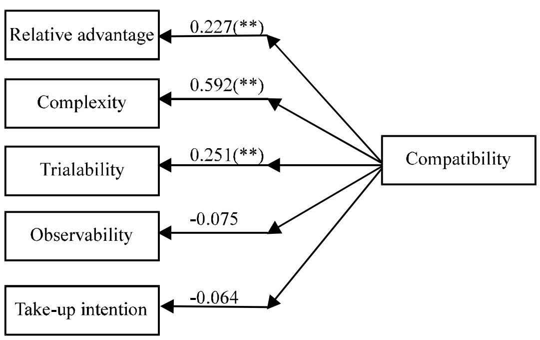

Fig. 3: The correlations of compatibility and five perceived innovation attributes

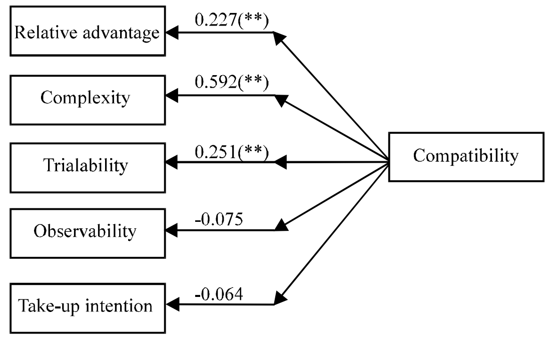

Fig. 4: The correlations of compatibility and five perceived innovation attributes

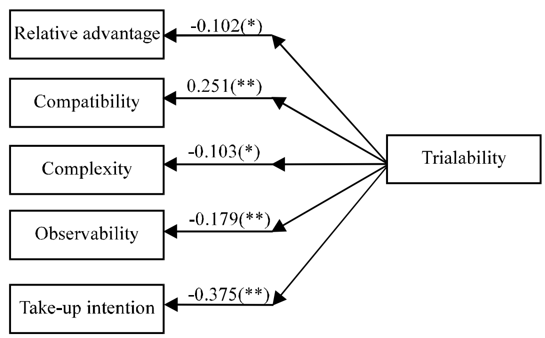

Fig. 5: The correlations of trialability and five perceived innovation attributes

of engineering students. The level of perceived was determined through relative advantage of Rogers's relational model, these showed means of 4.21 (SD = 0.67). The correlations of relative advantage and five perceived innovation attributes shown that the relative advantage closely correlate with complexity (Fig. 2). It estimated as strongly agree and the degree of clarity of system was rated higher than target levels.

The overall perceived of compatibility in enhancing learning outcome towards the M-learning innovation was also conducted to identify perceived level of engineering students. The level of perceived was determined through compatibility of Rogers's Relational Model, these showed means of 4.00 (SD = 0.74). The correlations of compatibility and five perceived innovation attributes shown that the correlations closely correlate with complexity. It estimated as strongly agree and the degree of clarity of system was rated higher than target levels (Fig. 3).

The overall perceived of complexity in enhancing learning outcome towards the M-learning innovation was also conducted to identify perceived level of engineering students. The level of perceived was determined through compatibility of Rogers's Relational Model, these showed means of 3.91 (SD = 0.75). The correlations of compatibility and five perceived innovation attributes shown that the complexity closely correlate with complexity. It estimated as strongly agree and the degree of clarity of system was rated higher than target levels (Fig. 4).

The overall perceived of trialability in enhancing learning outcome towards the M-learning innovation was also conducted to identify perceived level of engineering students. The level of perceived was determined through trialability of Rogers's Relational Model, these showed means of 3.76 (SD = 0.77). The correlations of trialability and five perceived innovation attributes shown that the trialability closely correlate with compatibility. It estimated as strongly agree and the degree of clarity of system was rated higher than target levels (Fig. 5).

The overall perceived of observability in enhancing learning outcome towards the M-learning innovation was also conducted to identify perceived level of engineering students. The level of perceived was determined through observability of Rogers's Relational Model, these showed means of 3.81 (SD = 0.73). The correlations of observability and five perceived innovation attributes shown that the observability closely correlate with

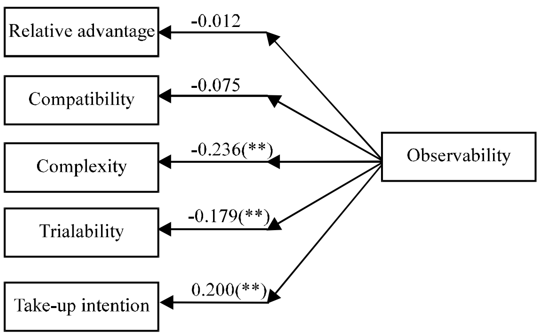

Fig. 6: The correlations of observability and five perceived innovation attributes

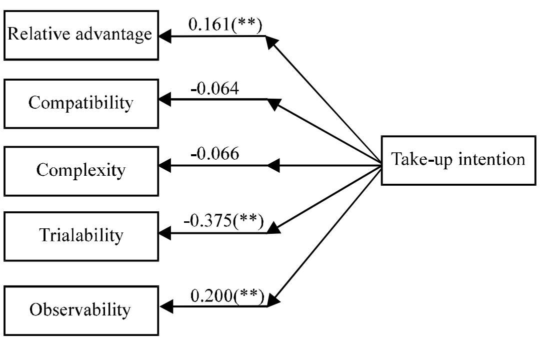

Fig. 7: The correlations of take-up intention and five perceived innovation attributes

take-up intention. It estimated as strongly agree and the degree of clarity of system was rated higher than target levels (Fig. 6 and 7).

CONCLUSION

In this study, the researchers have to study and examine an innovation adoption perspective from engineering students' intention of M-learning degrees. This study was conducted to examine how target audiences of M-learning innovations respond to them, particularly engineering programs. Because of the time, expense and effort needed to develop useful and interesting technological innovations for engineering education need to examine their acceptability and attraction during development and implementation.

The investigation was framed using recommendations from diffusion theory regarding the study of perceived attributes and their relationship to adoption intentions. The findings from the analysis and internal consistency reliability demonstrated that 5 interpretable factors with acceptable internal consistency existed in the questionnaire on perceived attributes. The attributes appeared to cluster together in a logical way for 5 attributes: Relative advantage, compatibility, complexity, trialability and observability. The studies find that the correlations between innovation adoption perspective and learning intention.

The correlations of take-up intention and five perceived innovation attributes shown that the take-up intention closely correlate with observability. It can be conclusions that the perceived innovation influence to take-up intention in learning.

RECOMMENDATIONS

The findings from this study suggest future lines of inquiry. Because the perceived attribute instrument in this study was determined to be valid and reliable, further study of M-learning for engineering education should be conducted using the items selected in the internal consistency analysis. This would determine the instrument's usefulness in other situations and add to the literature on the diffusion potential of other education innovations.

An attribute other than the 5 suggested by Rogers (1995), translatability emerged out of the analysis. The items in this attribute referred to the perceived ability to use and transfer knowledge gained from an innovation. Such an attribute may hold promise for reviewing engineering education innovations. Studies are needed to examine the usefulness of this attribute and to determine its ability to predict adoption intentions.

ACKNOWLEDGEMENTS

Researcher would like to express his great gratitude to King Mongkut's University of Technology Thonburi, without all the assistance the completion this research would not have been possible. Also, he wish to especially thank the E-learning Center, Rangsit University for making some useful comments on both the concept of the evolutionary approach.

Researcher would sincerely like to thank Committee of Rangsit University for their valuable comments and suggestion.

REFERENCES

Baker, M.J., 2000. The roles of models in Artificial Intelligence and Education research: A prospective view. Int. J. Artif. Intell. Educ., 11: 122-143.

Davies, D.K., S.E. Stock and M.L. Wehmeyer, 2002. Enhancing independent time-management skills of individualswith mental retardation using a palmtop personal computer. Ment. Retard., 40: 358-365.

Duan, Y., Q. He, W. Feng, D. Li and Z. Fu, 2010. A study on e-learning take-up intention from an innovation adoption perspective: A case in China. Comput. Educ., 55: 237-246.

Lipman, M., 1991. Thinking in Education. Cambridge University Press, New York.

Milrad, M., J. Perez and U. Hoppe, 2002. C-Notes: Designing a mobile and wireless application to support collaborative knowledge building. Proceedings of the International Workshop on Wireless and Mobile Technologies in Education, Aug. 29-30, Vaxjo, Sweden, pp: 117-120.

Moore, G.C. and I. Benbasat, 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. Inform. Syst. Res., 2: 192-222.

Office of the National Education Commission, 1999. National Education Act of B.E. 2542. Kurusapa Ladprao Press, Bangkok.

Rogers, E., 1995. Diffusion of Innovations. The Free Press, New York.

Rogers, M.E., 2004. A prospective and retrospective look at the diffusion model. J. Health Commun., 1: 13-19.

Ryan, S., 2001. Is online learning right for you. Am. Agent Broker, 73: 54-58.

Seppala, P., J. Sariola and H. Kynaslahti, 2002. Mobile learning in personnel training of university teachers. Proceedings of the IEEE International Workshop on Wireless and Mobile Technologies in Education, Aug. 29-30, Vaxjo, Sweden, pp: 136-139.

Steinberger, C., 2002. Wireless meets wireline e-learning. Proceedings of the 14th World Conference on Educational Multimedia, Hypermedia and Telecommunications, Aug. 29-30, Denver, CO., USA.