

# **An Investigation on the Relationship Between e-Learning Usability Attributes Towards Motivation to Learn**

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# An Investigation on the Relationship Between e-Learning Usability Attributes Towards Motivation to Learn

## ABSTRACT

*This paper reports the research of the empirical evaluation of e-learning usability attributes towards motivation to learn among Open University Malaysia (OUM) learners.*

*Factors such as learners' diversity, technological variety and learners' knowledge gap in using e-learning are some of the significant universal usability challenges need to be considered when conducting the e-learning usability evaluation. Pedagogical usability also need to be considered while developing e-learning application. Traditional usability measures of effectiveness, efficiency, satisfaction and cognitive learning factors are no longer adequate for newer contexts of e-learning usage. It is critical that e-learning developers assess affective dimension, in which the learners may experience while interacting with e-learning. To this end, motivation to learn, which is one of the affective aspect, has been identified as a new usability measurement. A theoretical framework has been developed to investigate the relationship between e-learning usability attributes and learning motivation.*

**Keywords:** usability, usability attributes, e-learning, motivation to learn

## 1. Introduction

In the digital age, the speed of learning has become vital differentiator for organizations and individuals in the pursuit of knowledge. The advent of the Internet has greatly influenced the way knowledge is transmitted. An exponential growth of knowledge also has made it imperative for learning to happen quickly. This fact has increased the necessity for learning and in combination with the new technology opportunities, has led to the emergence of e-learning.

E-learning has been identified as the enabler for individuals and organizations to keep up with changes in the global economy that now occur in Internet era and it is one of the most significant recent developments in the Information System (IS) industry (Wang, 2003). E-learning solutions facilitate the delivery of the right information and skills to the right people at the right time (Ruttenbur, Spickler, & Lurie, 2000).

However, without a usable and effective interface, an e-learning system cannot be efficient. A properly designed interface is able to draw the learners' attention, motivate them toward interaction with the system and help them achieving their goals without confusion and fatigue (Faiola, 1989, Galitz, 1989; Jacques, Preece, & Carey, 1995). Providing learners with a usable environment can lead to improved performances (Donahue, et Al., 1999; Nielsen, 2003).

## 1.2 Research Problem

Despite of the advancement and usage of e-learning, e-learning systems needs to be developed in a manner that will support the quality of learning effectiveness. The issue is that, the focus of e-learning is so far has been more on technology problems rather than on quality of learning, mainly it is focus on the "e" and not on the "learning" part (Zaharias, 2003; Lohr, 2000). The problem with e-learning design originated from two main causes: the first has to do with techno-centric design (Lohr, 2000) where pedagogical design elements are not clearly reflected in e-learning design and the second refers to poor usability of e-learning courses (Zaharias, 2003).

Techno-centric design currently is the dominant approach; in such designs, software orientations that often make more sense to a computer programmer rather than to a learner are mostly represented in e-learning interfaces. In addition, many current e-learning interfaces are also poor examples of graphic design featuring fussy background fills and distracting animations that ultimately direct the learners' attention to the elements that surround the core learning information, rather than the core information itself (Lohr, 2000). Effective pedagogical considerations and key tenets of latest developments in learning theories are usually neglected or not effectively implemented in techno-centric e-learning design.

The above mentioned problems significantly, adds to the e-learning quality level (Bonk, 2002; Massy, 2002; Notess, 2001; Smulders, 2002) resulting in non-motivated learners (O'Regan, 2003). High drop-out rates for e-learning courses reflect that learners fail to complete e-learning courses (Clark & Meyer, 2003, Ganzel, 2001; Svetcov, 2000), low levels of learners' satisfaction and motivation (Piccoli et al., 2001) and learners' frustration (Nielsen, 2001) have been associated with poor design and usability of e-learning courses.

The problem with drop out rates is a critical matter concern for e-learning designers (Clark and Mayer, 2003; Diaz, 2002). Figures on the drop out rates for e-learning courses vary. Between 30-75% of learners fail to complete e-learning courses (Ganzel, 2001; Hill, 2000). Poor usability compounds this attrition problem by causing frustration or creating unnecessary barriers to completing e-learning courses. Although usability in e-learning design can play a key role in creating a positive learning experience, it is usually neglected or misused in e-learning system development life cycle. In short, a motivating environment is particularly important in the case of distance students to help keep attrition rates low (Abas, Z.W., 2003).

A study conducted in US by American Society for Training & Development (ASTD), examined several issues for the future of e-learning, where the issue of quality is in a prominent position (ASTD and NGA, 2001). According to this study, quality means that an e-learning experience provides just the right content at just the right time, helps learners master needed knowledge and skills, in a manner so they are motivated to learn and apply their learning to improve individual and organizational performance (ASTD and NGA, 2001).

Findings from a European survey (Massy, 2002) on quality and e-learning also reveal the importance of such problem and directly associates it with the design of e-learning courses. In the same vein WR Hambrecht + Co (2000) in its influential market report states that quality of e-learning courses and technologies is the first key trend and suggests that organizations and companies should invest in guidelines for finding and choosing quality in e-learning courses, services and providers in the e-learning marketplace.

### **1.3 Research Questions**

Thus, this study seeks to answer the following research questions:-

1. Is there a relationship between Usability Attributes and Motivation to Learn?
2. Is there a relationship between Web Usability and Motivation to Learn?
3. Is there a relationship between Pedagogical Usability and Motivation to Learn ?
4. Is there a relationship between Universal Usability and Motivation to Learn ?

### **1.4 Research Objectives**

Based on the research questions above, the primary aim of the study are set out as follows:-

To investigate the relationship between Usability Attributes and Motivation to Learn.

1. To examine the relationship between Pedagogical Usability and Motivation to Learn.
2. To examine the relationship between Web Usability and Motivation to Learn.
3. To examine the relationship between Universal Usability and Motivation to Learn.

## **2. Background Literature**

Electronic learning (e-learning) has been identified as the enabler for individuals and organizations to keep up with dynamic changes in the global economy that now occur in Internet era (Zaharias,2004). Current e-learning systems development only focuses on cognitive factors s (e.g., perception, memory and problem solving, etc.) that affect learning.

These primarily cognitive designs often overlook other sources for individual learning differences of affective nature, such as motivation and emotions. Modern cognitive science has stressed the importance of affective learning factors, especially motivation to learn. (O'regan, 2003). Horton (2000), states that for students to succeed in distance learning, motivation and self-discipline plays a key role.

Currently, there are lack of e-learning studies which focus on the affective dimension of individuals (Zaharias, 2004). Zaharias (2004) had conducted a study based on an established methodology in HCI research and relied upon a conceptual framework which integrates web usability and instructional design parameters and associates them with a main affective learning dimension, intrinsic motivation to learn.

Alavi and Leidner (2001) stress the need for future research to focus on the interactions between technology, instructional methods and psychological processes of the learners. They state that studies examining the internal psychological processes, through which learning occurs, are missing. Psychological processes refer to states within the learner that are involved in learning, such as learner’s cognitive and information processing activities, cognitive structures (memory), and *affective* states.

Several sets of recommendations for the evaluation of technical usability have been developed over the last twenty years (e.g., Shneiderman, 1998; Chin, Diehl & Norman, 1988; Nielsen, 1993; 1994; Lin, Choong, Salvendy, 1997; Preece, Rogers & Sharp, 2002; Chalmers, 2003; Tognazzini, 2003). However, pedagogical aspects of designing or using digital learning material are much less frequently studied than technical ones.

Nokelainen (2006) had done a study on the criteria for evaluating the pedagogical usability of digital learning material. The purpose of the criteria is not to brand any learning material as “good” or “bad,” but to help learners to choose the most suitable alternative for any particular learning situation.

According to Shneiderman (2000) study on Universal Usability, supporting a broad range of hardware, software, and network access, accommodating individual differences among users, such as age, gender, disabilities, literacy, culture, income, and so forth as well as bridging the knowledge gap between what users know and what they need to know about a specific system are the three main challenges faces by computer system developers.

Apparently, the traditional usability measures of effectiveness, efficiency and satisfaction are inadequate for new contexts of technology assisting learning (Soloway et al., 1994). A major challenge of current usability research is to address user affect. It is critical that systems designers assess the range of possible affective states, in which users may experience while interacting with the system (Hudlicka, 2003).

Therefore, new measures need to be established (Hornbaek, 2005). In the context of e-learning, affect has recently gained considerable attention. It has been argued that affect is the energy which learners bring to the learning environment connecting them to the “*why*” of learning. New developments in learning theories such as constructivism heavily emphasis on the affective domain of learning; new thinking in adult learning theory and practice stresses the need to enhance learners’ internal priorities and drives that can be best described by motivation to learn. The latter, a concept intimately linked with learning (Schunk, 2000), is the most prominent affective learning factor which can greatly influence learners’ interaction with an e-learning application.

Based on the research conducted by Zaharias (2004), Nokelainen (2006) and Shneiderman (2000), shown there is a research gap in which web usability, pedagogical usability and universal usability aspects grouped as usability attributes might has relationship towards motivation to learn. In this study, ARCS Model of Motivational Design (Keller, 1983,1984, 1987) had been choose to be the focus of motivational design of e-learning. The following table presents a summary of usability attributes of e-learning.

**Table 1 presents a summary of usability attributes**

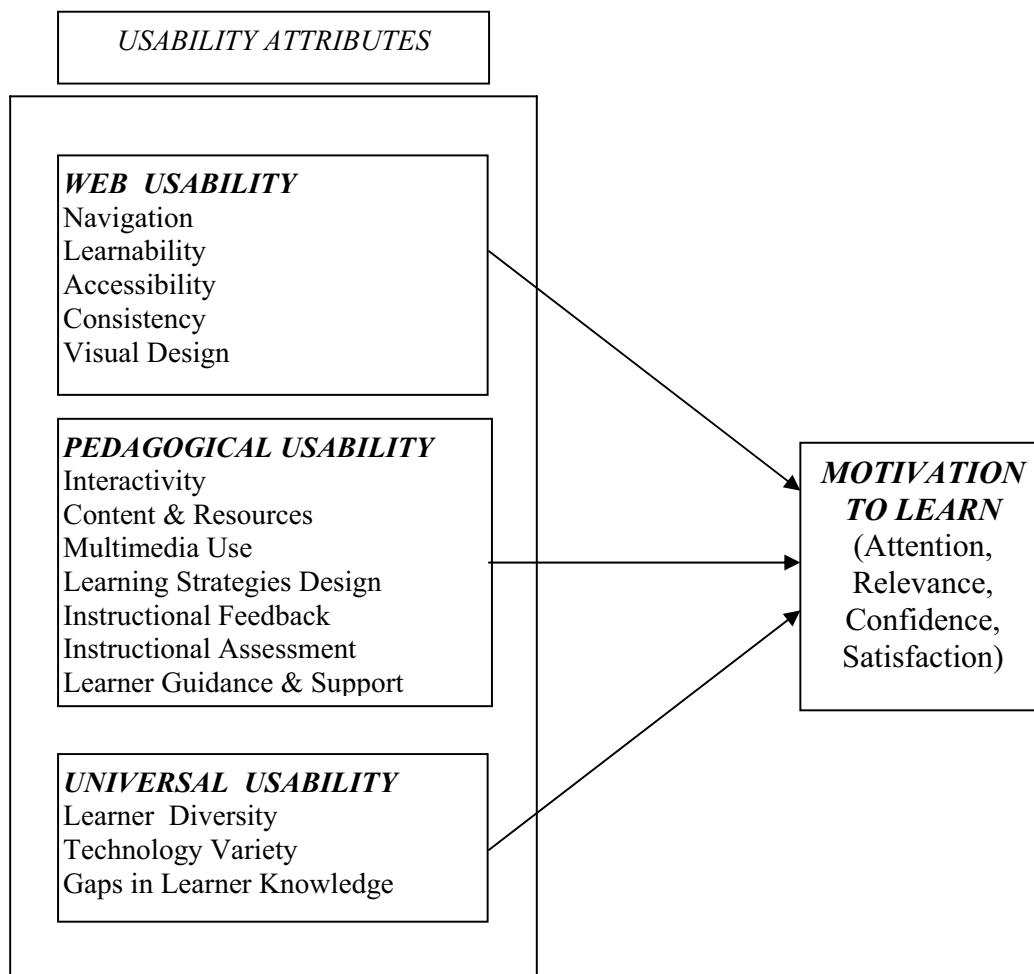
Previous Research	E-learning Usability Attributes
Powell (2000); Lynch and Horton (1999); Nielsen (2000); IBM (2000); Weston et al. (1999); Evans and Edwards (1999); Stanton et al. (1992); Stoney and Wild (1998); Reushle et al. (1999); Ford and Chen (2000); Reeves et al. (2002); Shiratuddin and Hassan (2001)	<b>Navigation</b> : Supports the way learners move through the instruction and how the instruction is designed to facilitate understanding of <i>organization</i> and <i>structure of content</i> .
IBM (2000); Lynch and Horton (1999); Shiratuddin and Hassan (2001); Weston et al. (1999); Nielsen (2000); Horton (2001); Khan (2002)	<b>Accessibility</b> : It refers to loading time, browser compatibility, visual preferences etc.
Powell (2000); Reeves et al. (2002); Shiratuddin and Hassan (2001); Lynch and Horton (1999); Miller (2002); Khan (2002)	<b>Consistency</b> : It is about the consistent use of fonts, text, and various design features’ placement (navigational aids, menu bar etc.)
Powell (2000); Shiratuddin et al. (2003); Nielsen (2000); Horton (2000); Shirley (1999); Morkes and Nielsen (1998); Stoney and Wild (1998)	<b>Visual Design</b> : It is about the design features’ placement in order to minimize cognitive overload, attract learner’s attention etc.

Weston et al. (1999); Reushle et al. (1999); Reeves et al, (2002); Hiltz and Turoff (2002); Laurillard (1995); Stoney and Wild (1998); Powell (2000)	<b>Interactivity:</b> It is about content-related interactions and tasks that support meaningful learning.
Lingaard (1994); Quinn et al. (1993); Guillemette (1995); Feldstein (2002); Al-Hunaiyyan et al. (2001); Reeves et al. (2002); Horton (2001)	<b>Learnability :</b> It refers to the ease with which new or occasional learners may accomplish some learning task using the interface.
Silius et al. (2003); Reushle et al. (1999); Weston et al. (1999); Jonassen (1998); Smulders (2002); Reeves et al. (2002); Nielsen (2000); IBM (2000); Keeker (1997); Horton (2000)	<b>Content and resources:</b> It is about the design of learning content and resources necessary to support effective learning.
Herrington et al. (2000); Weston et al. (1999); Nielsen (2000); Keeker (1997); IBM (2000); Shiratuddin et al. (2003); Driscoll (2002); Wild and Quinn (1998); Clark and Mayer (2003); Horton (2000)	<b>Multimedia Use :</b> It is about the use and inclusion of several media in the e-learning design; must serve clear pedagogical and/or motivational purposes.
Brown et al., (1989); Tam (2000); Squires and Preece (1999); Jonassen (1994); Clark and Mayer (2003); Roschelle and Teasley (1995); Dillenbourg (1999); Jonassen (1998); Horton (2000)	<b>Learning strategies design :</b> It is mainly about interactions in that have been designed in accord with sound principles of learning theory.
Driscoll (2002); Spitzer (1996); Laurillard (1996); Merrill et al. (1992); Johnson and Aragon (2002); Horton (2000)	<b>Instructional Feedback :</b> It is about the provision of feedback that is contextual and relevant to the problem or task in which the learner is engaged.
Dick and Carey (1996); Smith & Ragan (1999); Govindasamy (2002); Weston et al. (1999); Twomey (1996); Brown et al. (1989)	<b>Instructional Assessment :</b> It is about the design of assessment opportunities that are aligned with the learning objectives and content.
Alexander et al. (1998); Horton (2000); Driscoll (2002); Jones and Farquhar (1997) Govindasamy (2002); Clark (2002); Clark and Mayer (2003); Wade (1994); Herrington et al. (2000)	<b>Learner Guidance and Support :</b> It is about the design of online help, documentation, and other tools that support and may guide the learner.
Shneiderman (2000), Nielsen (1991), Horton (2005), (Khan, 1997)	<b>Technology Variety :</b> It is about the need to provide learners with flexible and compatible hardware, software and networks equipment.
Shneiderman (2000), Nielsen (1991), Horton (2005); Khan (1997), Horila, Nokelainen, Syvanen & Overlund (2002)	<b>Learner Diversity:</b> It is about consideration on individual peculiarities such as skills, age, gender, income and culture.
Shneiderman(2000); Nielsen (1991); Horton (2005); Baecker et al. (2000) Benyon (1993)	<b>Gaps in Learner Knowledge :</b> It is about how to overcome a certain gap in knowledge which occurs due to novel ways of manipulating e-learning system

### 3. Research Model

An extensive review on literature was conducted in search of a research model. Despite the growing profusion of the e-learning research, nevertheless there has been little exploration of affective learning dimension of learners. A research model was developed taking into consideration the needs of the user as a learner. This was achieved through examining the literature relating to web usability, universal usability, pedagogical usability with a special emphasis on motivation to learn aspect as the most important affective learning factor, Zaharias (2004), Nokelainen (2006), Shneiderman (2000).and Keller (1983,194,1987). Based on the above discussion, the enhanced research model is in Figure 1.

**Figure 1 : Enhanced Research Model**



## **Research Hypotheses**

Eighteen (18) research hypotheses were formulated .

According to (Zaharias, 2004), the following hypotheses were proposed.

H<sub>1</sub> There is a positive relationship of Web Usability attributes with Motivation to Learn

Therefore, five individual hypotheses which are forwarded as the following:

H<sub>1a</sub> There is a positive relationship of Accessibility with Motivation to Learn

H<sub>1b</sub> There is a positive relationship of Consistency with Motivation to Learn

H<sub>1c</sub> There is a positive relationship of Learnability with Motivation to Learn

H<sub>1d</sub> There is a positive relationship of Navigation with Motivation to Learn

H<sub>1e</sub> There is a positive relationship of Visual Design with Motivation to Learn

Collectively, the second main research hypothesis is proposed:

H<sub>2</sub> There is a positive relationship between Pedagogical Usability with Motivation to Learn

Thus, the following individual research hypotheses are proposed:

H<sub>2a</sub> There is a positive relationship between Content & Resources and Motivation to Learn

H<sub>2b</sub> There is a positive relationship between Interactivity and Motivation to Learn

H<sub>2c</sub> There is a positive relationship between Instructional Assessment and Motivation to Learn

H<sub>2d</sub> There is a positive relationship between Instructional Feedback and Motivation to Learn

H<sub>2e</sub> There is positive relationship between Learning Strategies Design and Motivation to Learn

H<sub>2f</sub> There is a positive relationship between Learner Guidance & Support and Motivation to Learn

H<sub>2g</sub> There is positive relationship between Multimedia Use and Motivation to Learn

According to Shneiderman (2003), there is a positive relationship between Universal Usability variable and motivation to learn. Collectively, the third main research hypothesis is proposed.

H<sub>3</sub> There is a positive relationship of Universal Usability with Motivation to Learn

Therefore, three individual hypotheses which are forwarded as the following:

H<sub>3a</sub> There is a positive relationship between Technology Variety adaptability with Motivation to Learn

H<sub>3b</sub> There is a positive relationship between Learner Variety adaptability with Motivation to Learn

H<sub>3c</sub> There is a positive relationship between reduction of Gaps in Learner Knowledge with Motivation to Learn

## **Research Methodology**

The method extends the current practice by focusing not only on cognitive but also affective considerations that may influence e-learning usability. The latter is proposed as a new usability measure that is considered more appropriate to evaluate e-learning designs. Based on the research questions to be answered, the research would be exploratory and cross-sectional with quantitative research being the main approach. This study adopted a self-administered procedure. The sampling frame was drawn from learners who use Open University Malaysia (OUM) e-learning system. The study used stratified random sample method based on the number of learners from six OUM Regional Centres selected, namely Kuala Lumpur, Penang, Johor Bahru, Kuantan, Kuching and Kota Kinabalu.

### **4.1 Item Sampling**

The usability parameters included in the conceptual framework were the main constructs included in the questionnaire. These constructs were measured with items adapted from prior research. Items were carefully selected so that to cover all parameters included in the conceptual framework. The items in the questionnaire were presented in groups relating to each parameter; the aim of the questionnaire was to capture usability parameters that seem to have an effect on motivation to learn when measuring the usability of e-learning rather than to develop an equal scale of each parameter (i.e. parameters represented by an equal number of items). The items were examined for consistency of perceived meaning by getting 5 experts to allocate each item to content areas. Some items were eliminated when they produced inconsistent allocations.

### **4.2 Pre-Test**

Prior to completion of the questionnaire, a pre-test was undertaken to ensure that items were adapted and included appropriately in the questionnaire. A self-administered questionnaire was distributed to 20 respondents which had some prior experience with e-learning. Data obtained was analyzed mainly for response completeness; some adjustments were made and subsequently some items were reworded.

The whole procedure led to the development of pilot-test questionnaire, which consisted of 68 items: 58 items measuring usability attributes and 10 items measuring motivation to learn. Criteria corresponding to each usability parameter were assessed on a 5 point Likert-scale, where the anchors were 1 for strongly disagree and 5 for strongly agree. There was also space for free-form comments.

### 4.3 Pilot Test

60 survey questionnaires were distributed among learners of Faculty of IT and Multimedia Communication, Open University Malaysia during the pilot test. The survey exercise was conducted in Semester May 2007. The respondents were asked to evaluate the e-learning courses which had already used and interacted with. They self-administered the questionnaire and for each question, were asked to circle the response which best described their level of agreement with the statements. Only 53 survey questionnaires were fully completed. 7 were not return or have missing data. 29 male and 24 female were involved in this pilot test.

### 4.4 Pilot Test Analysis and Results

For the pilot test, a factor analysis was conducted, in order to identify the underlying dimensions of usability attributes of e-learning, as perceived by learners. 74 items representing 15 usability attributes as shown in Table 2 were factor analyzed using the principal components method with a Varimax rotation procedure to delineate the underlying dimensions of usability of e-learning.

The Kaiser-Mayer-Olkin (KMO) Measure of Sampling Adequacy was 0.889, which is comfortably higher than the recommended level of 0.6 (Hair et al., 1998).

The following criteria were used in extracting the factors: a factor with an eigenvalue greater than one would be selected (Hair et al., 1998). A principal components extraction with Varimax rotation was used. Using a criterion of eigenvalues greater than one, a 15-factor solution was extracted explaining 83.82% of the variance (Table 2). In order to assess the internal consistency of the factors scales, Cronbach's Alpha was utilized.

As Table 2 exhibits all factors show high internal consistency as indicated by high Alpha coefficients (ranges from 0.717 to 0.879), which exceed the recommended level of .70 (Lewis, 1995, Hair et al., 1998). In addition the composite variable *Motivation to Learn* shows a very high internal consistency as Alpha coefficient indicates ( $\alpha = 0.873$ ).

Factors	Reliability Cronbach Alpha	Eigenvalue	Percentage of Variance Explained
Navigation	$\alpha = .822$	24.155	37.742
Learnability	$\alpha = .862$	4.913	7.677
Consistency	$\alpha = .812$	3.921	6.127
Visual Design	$\alpha = .784$	3.249	5.077
Interactivity	$\alpha = .717$	2.976	4.650
Content & Resources	$\alpha = .835$	2.254	3.521
Multimedia Use	$\alpha = .879$	2.202	3.440
Learning Strategies Design	$\alpha = .862$	1.877	2.933
Instructional Feedback	$\alpha = .870$	1.789	2.796
Instructional Assessment	$\alpha = .784$	1.571	2.370
Learner Guidance & Support	$\alpha = .855$	1.340	2.094
Learner Diversity	$\alpha = .753$	1.283	2.005
Technology Variety	$\alpha = .850$	1.108	1.732
Gaps in Learner Knowledge	$\alpha = .847$	1.056	1.650
Percentage of total variance explained			83.815

**Table 2**

Data analyses led to the refinement of the questionnaire and a more parsimonious solution has been reached with 15 factors representing usability parameters of e-learning : Accessibility, Navigation, Learnability, Consistency, Visual Design, Interactivity, Content & Resources, Multimedia Use, Learning Strategies Design, Instructional Feedback, Instructional Assessment, Learner Guidance & Support, Learner Diversity, Technology Variety and Gaps in Learner Knowledge.

The next step is to conduct the main survey during Semester January 2008.



## Current Stage of the Research

I have completed almost 2 years of part-time studies during my PhD candidature. This research is expected to be completed by end of 2008. Thus, according to the timeframe design, the thesis will be ready for submission for external examination date by early January, 2009. Following Table presents the timeline and milestones of this research:

Year	Milestones	Status
2006	Literature Review	Done
	Formulation of Hypothesis	Done
	Development of Enhanced Research Framework	Done
2007	Development of Research Questionnaire (Instrument)	Done
	Conducted Pre-Test	Done
	Conducted Pilot Test	Done
	Data Analysis of Pilot Test	Done
2008	Conduct the Main survey (Data Collection)	Jan-March
	Data Analysis	April- Sept
	Write- Up	Oct – Dec
2009	Draft version thesis by resulting from the research	January
	Completed version of thesis and submit thesis for viva voce examination	

## Published & Presentation of Research Outcome

1.	Does e-Learning Usability Attributes Correlate With Learning Motivation?	21 <sup>st</sup> AAOU Annual Conference in Kuala Lumpur, Malaysia (October 29 <sup>th</sup> – 31 <sup>st</sup> , 2007)
2.	A Study on the Relationship between LMS Usability Attributes towards Motivation to Learn	International E-learning Workshop organised by Widyatama University, Bandung, Indonesia (April 1 <sup>st</sup> – 4 <sup>th</sup> , 2007)
3.	e-Learning Interface Usability and Open Distance Learner's Motivation to Learn: A pedagogical consideration	20 <sup>th</sup> AAOU Annual Conference in Kunming, China (11 <sup>th</sup> - 14 <sup>th</sup> October, 2006)
4.	Web Usability attributes of e-learning system platform in Malaysia: A progress report	IEEE Computer Society Learning Technology Newsletter, Volume 8, Issue 3, July 2006. Special Issue on Innovative in Distance Learning Technologies in Developing Countries (ISSN 1438-0625),