Structural Equation Modelling for Web 2.0 Based Interactive E-learning in Sri Lanka

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Abstract:

This paper presents results of an empirical study for validating a conceptual framework on web 2.0 based interactive e-learning in Sri Lanka. Using Structural Equation modeling techniques on the survey data collected from Sri Lanka this paper reveals that web 2.0 technology could support four critical success factors of interactive e-learning from an e-learning systems' perspective including management of learning resources, personal knowledge management, instructional support and collaboration. It also shows that using web 2.0 technology in interactive e-learning has a positive indirect influence on the effectiveness of e-learning.

Keywords- structural equation modelling; web 2.0 technology; interactive e-learning

I. INTRODUCTION

Interactive e-learning is referred to as learning by communicating and sharing information, and accessing resources using information and communication technologies [1]. In contrast to teacher-centered learning where the learners are passive participants in learning, interactive e-learning enables learners to proactively participate in learning in particular by interacting with learning resources, instructors and peer learners. Such learning leads to development of learners' knowledge and skills such as critical thinking, reflecting, writing, communicating and negotiating [2, 3].

There are numerous critical success factors for interactive e-learning from an e-learning systems' perspective. These factors including management of learning resources, personal knowledge management, instructional support and collaboration are in particular important in facilitating the interactions among learners and learning resources, instructors and peer learners [4]. Management of learning resources refers to managing learning resources in an attractive and usable manner to enable learners to actively interact with course learning resources [5]. Personal knowledge management refers to maintaining non-course resources and interacting with them to meet learning goals and develop knowledge [6]. Delivery of instructional support refers to instructors' interactions with learners to provide them with a wide range of support including feedback, encouragements and content expertise [7]. Collaboration refers to active interactions among learners with the aim of achieving learning objectives and developing knowledge [3].

Facilitating interactive e-learning is very much dependent on the adequate use of technologies. Numerous technologies such as artificial intelligence, semantic web and web 2.0 technology are used for developing interactive e-learning [8]. Among such technologies web 2.0 technology has caught special attention due to its ease of use, cost effectiveness and readily availability [9]. Web 2.0 technology refers to a portfolio of web based tools that promote creating information, sharing information, communicating and networking [10]. Existing literature discusses how web
2.0 tools such as blogs, wikis and social bookmarking could be used for interactive e-learning worldwide. How web 2.0 technology could be used for interactive e-learning in Sri Lanka however is not clear in existing literature.

This paper proposes and validates a web 2.0 based e-learning success model for interactive e-learning in Sri Lanka. Structural equation modeling (SEM) is used to validate the proposed framework using the survey data collected from learners in five universities in Sri Lanka. The results reveal that web 2.0 technology positively support management of learning resources, personal knowledge management, instructional support and collaboration. It further shows that using web 2.0 technology for interactive e-learning has a significant indirect impact on the effectiveness of e-learning. Such findings are useful for understanding how web 2.0 technology could be effectively used for interactive e-learning in Sri Lanka.

In what follows, the related literature for this research is reviewed and a conceptual framework for developing web 2.0 based interactive e-learning in Sri Lanka is proposed. The proposed framework is validated using SEM. Finally the research findings and their implications are presented.

II. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Interactive e-learning is being used in universities worldwide for providing effective learning [11]. The universities in Sri Lanka also have recognized the potential of interactive e-learning and numerous initiatives are being taken to improve the interactivity in e-learning in Sri Lanka [12, 13]. However, the implementation of interactive e-learning in Sri Lanka is challenging due to lack of infrastructure and limited funds available [12, 13]. As a result, adopting web 2.0 tools for e-learning in Sri Lanka is more attractive for facilitating interactive e-learning.

Web 2.0 tools could be used for personal knowledge management, collaboration, delivering instructional support and managing learning resources. For example, Hsu, Ching and Grabowski [14] state that web 2.0 tools such as blogs, social bookmarking and YouTube are helpful for learners to manage their personal knowledge in particular by creating e-portfolios and managing online bookmarks. Similarly, Dabbagh and Kitsantas [15] discusses how web 2.0 applications such as blogs, YouTube and social bookmarking could be used to create personal learning spaces where learners can create, organize and store their personal information and resources.

Web 2.0 tools are suitable for facilitating collaboration between learners. For example, Hsu, Ching and Grabowski [14] state that web 2.0 tools such as wikis, social bookmarking, YouTube and instant messengers are suitable for collaborative writing, managing and sharing bookmarks, sharing video content and synchronous communication between learners. Dabbagh and Kitsantas [15] and Wheeler, Yeomans and Wheeler [16] also suggest that wikis could be used for collaboratively adding and editing content, and social bookmarks could be used for creating a shared list of bookmarks related to e-learning courses.

Instructors could use web 2.0 tools to support learners in e-learning. In particular, instructors can use web 2.0 tools to support active and self-directed learning of learners. For example, instructors could introduce activities such as e-portfolio development to curricular and monitor their work and provide feedback [2, 17]. Furthermore, instructors
could use web 2.0 tools such as blogs and wikis for authentically assessing learners [17]. In particular, the instructors could include learning activities such as developing wikis and e-portfolios in curricular and track how the learners progress with the activities which enable instructors to assess the learners’ process of learning as well as product of learning [17].

Recent initiatives are also seen on using web 2.0 tools for managing learning resources. TeacherTube and MERLOT are examples for web 2.0 based repositories of learning resources used to manage learning resources effectively. Ability to maintain learning resources of multiple types, attractive presentation of resources, facilitating learners to easily share and reuse resources are attractive features of these repositories compared to other popular learning resources management systems. Tools such as social bookmarks and YouTube could also be used for managing learning resources. Content shared with the above tools enable learners to easily access, share and reuse resources. Based on the above discussion following hypotheses are formulated.

H1: Web 2.0 tools positively support management of learning resources

H2: Web 2.0 positively supports managing personal knowledge

H3: Web 2.0 tools positively support instructors to deliver support

H4: Web 2.0 tools positively support collaboration of learners

Existing literature reveals that management of learning resources, personal knowledge management, collaboration and instructional support are the critical factors of interactive e-learning. For example, Sridharan, Deng and Corbitt [5] show that effectively managing learning resource positively influences the effectiveness of e-learning. This is because adequately managing learning resources in a manner that learners could search, reuse and share learning resources develops the ability of learners to learn independently. Liu [6] and Hsu, Ching and Grabowski [14] state that effectively managing personal knowledge influences the effectiveness of e-learning as managing personal knowledge categorizing resources and organizing information assist learners to develop knowledge and skills such as critical thinking [14]. Selim [11] shows that delivering instructional support in forms of providing feedback and encouragements assists learners to better meet their learning outcomes. Such interactions also positively influence learners’ satisfaction with e-learning. Alavi [3] and Selim [11] show that collaboration between learners is in particularly important for improving the effectiveness of e-learning. In particularly, such interactions enable learners to increase the satisfaction with e-learning and meeting their learning outcomes. Based on the above discussion following hypothesis are formulated. H5: Management of learning resources positively influences the effectiveness of e-learning H6: Personal knowledge management positively influences the effectiveness of e-learning.

H7: Delivering instructional support positively influences the effectiveness of e-learning

H8: Collaboration of learners positively influences the effectiveness of e-learning.
III. RESEARCH METHODOLOGY

This study aims to investigate how web 2.0 technology could be effectively used for interactive e-learning in Sri Lanka. To fulfill this aim, research question for this research is formulated as “what is the theoretical model that show how web 2.0 technology supports critical factors of interactive e-learning which lead to effective e-learning?”.

A quantitative research strategy is used to answer the research question for this research. The quantitative strategy is considered suitable for this research since it enable evaluating specific hypothesis formulated in this research by analyzing collected data from the target population. To validate the proposed model, data are collected using the survey method. The survey questions are prepared using a seven point Likert scale where 1 represents ‘Strongly Agree’ and 7 represent ‘Strongly Disagree’. The development of the survey instrument is done by referring to existing research instruments and obtaining expert feedback.

The developed survey in the above manner is printed and distributed among 600 higher educational learners in five universities in Sri Lanka namely University of Kelaniya, University of Colombo, University of Moratuwa, Open University of Sri Lanka and Sri Lanka Institute of Information Technology. A total of 227 learners responded to the survey with a response rate of 38%. 63% of the respondents are undergraduate learners whereas 37% of the respondents are postgraduate learners. Furthermore, 36% of the respondents are female and 64% of the respondents are male learners. Majority of learners who had responded to the survey is aged between 20 and 29. The respondents to the survey represented different fields of studies such as arts, computer science, business studies, and health and medicine. This shows that the sample considered in this research fairly represents the population of higher educational learners in Sri Lanka.

The analysis of the data is done using structural equation modeling techniques using analysis of moment structures software (AMOS). SEM is a statistical technique that enables determining the nature of dependent relationships...
between theoretical constructs and measured variables, and among theoretical constructs [18]. SEM involves developing and accessing two models namely measurement model and structural model. Measurement model shows how measured variables are related to theoretical constructs [18]. It is assessed using confirmatory factory analysis (CFA) to understand how well the measured items used to measure theoretical constructs actually measures the theoretical constructs. The assessment provides empirical measures indicating how well the relationships specified by the researchers is represented by the sample data [18]. These measures are known as goodness-of-fit indices. In this research, the fitness of the measurement model is assessed by referring to several goodness-of-fit indices such as normed chi-square (χ²/df), GFI, CFI, RMSEA. Such a combination of goodness-of-fit indices is considered more suitable to assess fitness of measurement models rather than a single fit index [14]. As a rule of thumb, a normed chi-square value lesser than 3, a GFI value greater than 0.9, a CFI value greater than 0.95 and a RMSEA value less than 0.08 are considered as suitable for demonstrating adequate fitness of a measurement model[18].

Once the measurement model shows appropriate fitness, the structural model is developed and assessed. Structural model shows the structural relationships between theoretical constructs as specified in the conceptual model. It is assessed to determine how well the structural relationships specified among theoretical constructs are supported [18].

IV. DATA ANALYSIS

As the first step of data analysis using SEM, the measurement model is developed and assessed. The assessment resulted a Normed Chi-square value of 2.250, a GFI value of 0.754, a CFI value of 0.876 and a RMSEA value of 0.074. The aforementioned goodness-of-fit values of the initial measurement model showed that the fitness of the model is inadequate. To obtain a better fitting measurement model, the initial measurement model is modified through an iterative process where measurement items adversely affecting the fitness of the model are deleted. In particular, measurement variables with factor loadings lower than 0.5 are deleted. Furthermore, several measurement variables are deleted considering the modification indices and standard residuals. The resulted final measurement model has shown adequate fitness with a Normed Chi-square value of 1.337, a GFI value of 0.928, a CFI value of 0.977 and a RMSEA value of 0.039 which are all in the accepted value range for the indexes.

Numerous steps are also taken in this research to assess reliability of the survey instrument and validity of the constructs. In particular, Cronbach’s Alpha is used for assessing the internal consistency of the measurement items measuring constructs. As a rule of thumb, a Cronbach’s alpha value exceeding 0.7 is considered as demonstrating adequate internal consistency [18]. The measurement items selected to measure constructs in this research has shown adequate internal consistency based on the above criterion.

Validity of the constructs is assessed by examining the convergent validity and the discriminant validity of the constructs. Convergent validity refers to the extent to which the measurement items measuring a construct converge [18]. Convergent validity of the constructs is assessed by examining the standardized factor loadings (SFL) of measurement variables and average variance extracted (AVEs) of the constructs. SFLs of measurement variables exceeding 0.5 and AVEs of constructs exceeding 0.5 are considered as indicators of adequate convergent validity [18].
Discriminant validity of the constructs refers to how constructs in a theoretical model differs from each other [18]. The constructs in a theoretical model is considered having adequate discriminant validity when the AVEs of each constructs are above than the squared correlation between the constructs [18]. The theoretical constructs in this research have demonstrated adequate convergent and discriminant validity based on the above criterion.

Figure 2. The structural model

Following obtaining appropriate fitness for the measurement model, the structural model is developed as shown in Figure 2. The structural model also demonstrated adequate fitness. Furthermore, SEM analysis revealed that all the structural paths in the structural model are positive and significant. In particular, the support for H1, H2, H3, H4 and H5 is strong with regression weights 0.882 (p<0.001), 0.763 (p<0.001), 0.783 (p<0.001), 0.852 (p<0.001) and 0.511 (p<0.001) respectively. Comparatively H6, H7 and H8 are less supported but still significant with regression weights 0.253 (p<0.01), 0.323 (p<0.001) and 0.277 (p<0.01) respectively.

V. DISCUSSION & CONCLUSION

The aim of this study is to investigate how web 2.0 technology could be effectively used for interactive e-learning in Sri Lanka. To meet this objective, SEM is used to validate the proposed model on web 2.0 based interactive e-learning. The hypothesized model showed positive relationships between web 2.0 technology, and management of learning resources, personal knowledge management, instructional support and collaboration. The research finds strong support to the four aforementioned relationships. Such results indicate that web 2.0 tools could be used for management of learning resources, personal knowledge management, instructional support and collaboration leading to interactive e-learning in Sri Lanka. Few existing research by Du and Wagner [2] and Dabbagh and Kitsantas [15] also find similar findings on the relationships between web 2.0 technology, and personal knowledge management. Furthermore, similar to this research Wheeler, Yeomans and Wheeler [16] also find that web 2.0 technology could be used for effective collaboration of learners.

SEM analysis also shows a strong support for H5 which indicate that management of learning resources positively influences the effectiveness of e-learning. Furthermore, moderate support is shown for H6, H7 and H8 which indicate personal knowledge management, instructional support and collaboration are also important for effective e-learning.

There is no direct relationship between web 2.0 technology and the effectiveness of e-learning in the theoretical model. However, the SEM analysis shows that there is a positive indirect effect of 0.567 of web technology on the effectiveness of e-learning. This implies that web 2.0 technology indirectly support the effectiveness of e-learning in particular, when they are used for managing learning resources, managing personal information and resources, delivering instructional support and collaboration of learners.

Two important implications are made by the above results. The first major implication of this research is that the web 2.0 technology could be used for facilitating interactions between learners and learning resources, instructors and peer learners in interactive e-learning in Sri Lanka. The second major implication is that the use of web 2.0 technology for interactive e-learning in Sri Lanka could positively influence the effectiveness of elearning. In particular web 2.0 technology could influence the effectiveness of e-learning when they are used for interaction among learners and learning resources, instructors and peer learners.

There are several limitations of this study. Firstly, this study considers a small sample of higher educational learners in Sri Lanka. As a result, the results of the research may not be generalizable to the population of higher educational learners in Sri Lanka. Secondly, this research does not consider several other factors that would influence effective use of web 2.0 technology for interactive e-learning in Sri Lanka including psychological factors such as attitude towards technology and motivation and other factors such as ease of use of technology and previous use of technology. Thirdly, this research only considers the learners’ perceptions on using web 2.0 technology for interactive e-learning. The perceptions of other stakeholders of e-learning including instructors are not considered in this investigation.

As future research, the learners who participated in this research will be interviewed to understand how they think that web 2.0 technology could be used for interactive e-learning in Sri Lanka in detail. Furthermore, instructors will also be interviewed to understand what they think of using web 2.0 technology for interactive elearning and how they think web 2.0 technology could be used for effective interactive e-learning.

REFERENCES


