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The Perceptions of Learners on the Effectiveness of E-learning in Higher Education: An Empirical Study

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Abstract - This paper examines the critical dimensions of the effectiveness of e-learning from the perspective of e-learners within the framework of pedagogy, technology and management of learning resources in higher education. A survey is conducted in an Australian University for exploring the association between the critical dimensions of e-learning and the learners’ perceived impact of these dimensions on the e-learning effectiveness using multiple regression analysis. The results show that technology, management of learning resources, metadata and management effectiveness of learning resources positively influence the effectiveness of e-learning in higher education.

Keywords: E-learning, empirical research, e-learning effectiveness, multiple regressions

I. INTRODUCTION

E-learning is the application of information and communication technologies for improving teaching and learning [1]. To enhance the effectiveness of e-learning, adequately considering pedagogy, technology and management of learning resources (PTM) is critical [2, 3]. This is because of (a) predominance of content-based delivery of e-learning [4] (b) lack of integration of technologies supporting diverse pedagogies [5], and (c) lack of effective management of learning resources [3] generated from diverse pedagogies and associated technologies for creating reusable learning resources.

Effectively integrating pedagogies, technologies, management of learning resources is critical for the success of e-learning [3]. For example, [2] emphasizes the need for a complex blend of technologies, pedagogies and organizational components for sustainable e-learning. [6] proposes a better articulation of different pedagogical processes, tools and techniques for developing a pedagogical approach that is more reflexive and consistent with the theoretical perspective of learning and teaching. There is, however, a dearth of empirical research on examining the influence of these dimensions on the e-learning effectiveness from the perspective of learners.

Multiple pedagogical strategies have been proposed in the literature for enhancing the student-centred e-learning [6]. Some popular constructivist strategies include active learning [7], collaborative learning [8], explorative learning [9] adaptive learning [10], concept mapping for representing knowledge [11], and blended learning [12]. Successfully adopting these pedagogies for enhancing the effectiveness of e-learning, however, requires (a) technologies supporting these pedagogies [13] such as collaborative discussion forums, search engines and (b) learning resources supporting these pedagogies such as multimedia resources, interactive learning resources, hyperlinks, and virtual lectures. Adopting various pedagogies leads to the creation of valuable tacit and explicit learning resources. As a consequence, adequately managing these valuable learning resources is crucial for creating reusable learning object repositories. In this regard, two critical factors are the management issue and the metadata ontology supporting the management of learning resources.

Effectively managing learning resources involves in acquiring, eliciting, organizing, representing and retrieving information and knowledge [14]. To facilitate the management of learning resources, metadata which is “any data which conveys knowledge about an item without requiring examination of the item itself” [15] is widely used. Metadata ontologies are “the meta data schema providing a controlled vocabulary of concepts” [16]. They are a document or file that formally defines the relationship among terms.

There has been much research in exploring various dimensions contributing to the effectiveness of e-learning [3, 6]. However, little empirical research is available in examining their influence on the effectiveness of e-learning from the perspective of learners. To fill this gap, this paper examines the critical dimensions of the effectiveness of e-learning from the perspective of learners within the PTM framework in higher education. A survey is conducted in an Australian university for exploring the association between the critical dimension of e-learning and the learners’ perceived impact of these dimensions on the e-learning effectiveness using multiple regression analysis. The results show that technology, management of learning resources, metadata and management effectiveness of learning resources positively influence the effectiveness of e-learning.

II. A CONCEPTUAL MODEL OF SUSTAINABLE E-LEARNING

A conceptual model for sustainable e-learning is developed following a four-stage approach including review of relevant literature, interviews with major stakeholders, questionnaire development and pilot testing of the questionnaire. The model consists of the preferences for pedagogical strategies, supporting technologies,
learning resources, management factors, metadata ontologies, management effectiveness and e-learning effectiveness. Examining the influence of these dimensions on the e-learning effectiveness is essential.

The items for the pedagogy dimension are examined based on student-centred and teacher-centred strategies for enhancing the e-learning effectiveness. Towards this, several pedagogical strategies [6] have been identified. For example, explorative learning are suggested for facilitating meaningful learning process by providing access to rich, authentic and alternative sources of information. This aids in uncovering inconsistencies in understanding and experience [18] through reflection [17] and active exploration. Active learning strategies [6] are proposed for encouraging active participation of learners in knowledge acquisition through interaction with domain experts or through ‘hands on’ learning. Collaborative learning [8] through sharing ideas and responding are proved to improve thinking and deeper understanding. Recognizing the static nature of e-learning which amounts to “one size fits all” [10], adaptive learning systems are proposed for meeting the need of different levels of learners in regard to their styles and preferences. Concept maps [11] are visual representations of subjects, which facilitate the sharing, exploring, acquiring and synthesizing of knowledge. This shows that various pedagogical strategies have been identified to enhance e-learning effectiveness.

Nevertheless technologies supporting the above mentioned pedagogies are critical for successfully adopting pedagogies in e-learning. In this regard, several studies have examined various technologies for supporting diverse learning strategies for enhancing e-learning [19]. Information retrieval technologies such as Google search, Wikipedia, open source content and others have been developed to support explorative learning. Encouraging active learning methods, tools and technologies like computer assisted self assessment quizzes [20], problem-based learning, case-based learning and others have been identified [7, 20]. Inclusion of latest technologies facilitating knowledge sharing such as e-mail, chat, computer-supported collaborative learning, Wikipedia, weblogs, bookmarks (del.icio.us, diigo), multimedia (YouTube), how to (youteach, howcast), news (Digg.com, truemrs.com), source codes (sourceforge), have been proposed [14, 19, 20]. Technologies supporting adaptive learning such as streaming media, PowerPoint, adaptive intelligent tutoring system, adaptive curriculum, audio/video based lectures with participation facilities (Lectopia, ellumiunate live) have been suggested [10, 13]. Technologies supporting concept maps, mind maps such as SmartDraw, CMap, and extended topic maps have been developed for providing visual representation course concepts [9]. In a nutshell, adopting diverse technologies supporting various pedagogies have been developed for improving the effectiveness of e-learning.

Besides the technologies, it is equally critical to provide multiple learning resources [21] embracing pedagogies and technologies. Supporting explorative learning methods authenticated relevant external learning resources such as open courseware materials, simulation exercises, and Wikipedia resources [22] have been suggested. Interactive multimedia resources, online quizzes, simulation exercises and others have been proposed for encouraging active learning [21]. Reuse of valuable tacit and explicit knowledge generated from collaborative learning such as common misconceptions, frequently asked questions, difficult concepts have been suggested. Adaptive learning resources based on the individual learner’s level (basic, intermediary and advanced, styles) virtual lectures (Visual, auditory, hands-on etc.) and constraints (bandwidth, software restriction etc.) have been proposed [10]. Diagram-based resources supporting concept mapping have been identified for enhancing the comprehension ability of learners [11].

Effectively managing learning resources is critical for sustainable e-learning due to the problem of information overload and the need for reusing the learning resources [3]. It usually involves in capturing, eliciting, organizing, retrieving [23], authenticating, and reusing various learning resources. A reuse of existent learning resources necessitates the identification of critical characteristics describing learning resources. Various elements to describe the characteristics of learning resources are adapted from standards such as Dublin Core, IEEE learning object metadata and learning resource meta-data. In addition, ontology-based elements [24] to describe content, context and structure of learning resources have been proposed. Identified critical items in the aspect of management effectiveness include availability, accessibility, relevancy, [22], quality [25], and reusability of learning resources.

To fully understand the influence of the critical dimensions on the e-learning effectiveness, identifying the relevant indicators for measuring the e-learning effectiveness is necessary. Through a comprehensive literature review, several e-learning effectiveness indicators are identified including learning outcomes [26], enjoyment [27], satisfaction [28], stimulation and critical thinking skills [29].

Numerous studies investigate the association between various e-learning dimensions and the e-learning effectiveness [27, 30]. For example the study in [27] reports a positive association between student enjoyment and multiple e-learning scales such as instructor support, active learning, student interaction and collaboration. The research in [30] supports the criticality of task-technology fit on the success of learning management systems in higher education. Nevertheless, there is a paucity of empirical research in considering the association between management impact and various dimensions of the PTM model. This research examines the association between six perceived e-learning dimensions and the e-learning effectiveness.

Based on the above identified dimensions the following hypotheses are proposed in this research as shown in Fig. 1: (H1) preferred pedagogies positively influence e-learning effectiveness; (H2) technologies supporting pedagogies positively influence e-learning effectiveness; (H3) learning resources supporting pedagogies positively influence e-learning effectiveness;
III. METHODOLOGY

To assess the contribution of the proposed conceptual model towards the e-learning effectiveness, data was gathered from 210 respondents from an Australian University using an online survey. A seven point Likert-type scale was used, where 1 = least preferred and 7 = most preferred. There was no discarded data as various validation procedures were incorporated. Therefore the final data analysis was based on 210 samples.

Before the data analysis various tests including tests for normality and sampling adequacy were conducted. The skewness and kurtosis are the two aspects to test for normality of a distribution. Skewness describes how the data is evenly or unevenly distributed. Kurtosis describes how “peaked” or “flat” that a distribution is [31]. Skewness and Kurtosis statistics values less than 1 indicate normality and values from 1 to 10 indicate moderate non-normality, while values greater than 10 indicate a severe lack of normal distribution [32].

Cronbach’s alpha is the most well known measure for describing the internal consistency. A lenient cut off alpha value of 0.6 is used as a guideline for this research [33]. Furthermore, the item-total correlation and the inter-item correlation are also used for this purpose. Values exceeding 0.5 for the item-total correlation and 0.3 for the inter-item correlation are recommended for internal consistency [33]. A value of the item-total correlation less than 0.3 indicates that very little correlation with overall scale and a good candidate for dropping.

Finally bivariate correlations were calculated based on the summative scales [31] for examining the strength and the direction of the relationship between dependent and independent variables [34]. A stepwise multiple regression analysis was used to evaluate (a) how well a set of independent variables predict the dependent variable, (b) which independent variable is the best predictor of the dependent variable, and (c) if a particular predictor variable is able to predict the outcome when the effects of other variables are controlled [34]. The Durbin-Watson test statistic is used for examining the autocorrelation of error terms. A value close to 2 indicates that the residuals are uncorrelated [35].

IV. RESEARCH FINDINGS

A. Accuracy and normality of data

To prevent errors arising from data entry and outliers, various validation checks were incorporated in the data collection process. To avoid data entry errors, an online data collection procedure was followed with automatic transfer of data files without any need for data entry. To avoid respondents entering an invalid entry, validation checks were incorporated, as they had to choose a value between 1 and 7. To overcome the respondents missing a question, the online survey was designed to prompt requesting them to fill-in the response. As a consequence all the 210 responses were used for data analysis. Normality assumption was not violated with an acceptable range of Skewness and Kurtosis statistics with the value ranging from 0.10 to 2.29.

B. Demography of the data

A total of 210 respondents involved in an e-learning environment have responded to the survey. Out of the 210 respondents 63% of them were bachelors, 33% post graduates and 4% of them were others such as diploma, double degree etc. In regards to the area of specialization of respondents, the highest number of respondents was from computer science (65%), followed by economics (17%) and others (13%).

C. Reliability

The Cronbach alpha reliability coefficient is used to test the reliability of the construct and the internal consistency. All the reliability coefficients of the measures as shown in Table 1 are reasonably acceptable with the
The coefficient of multiple determination (R square) measures the proportion of variance in the e-learning effectiveness accounted for by the set of six e-learning dimensions. The results indicate that the six dimensions of perceived e-learning effectiveness explain 52% of the proportion variance in the perceived e-learning effectiveness. The Durbin-Watson test statistic suggests an absence of autocorrelation between the residuals, as the value is close to 2.

The results of the stepwise multiple regression coefficients as shown in Table 3 indicate the support for a positive impact of four e-learning dimensions on the effectiveness of e-learning. In other words, the results suggest that metadata, technology, management, and pedagogical strategies are positively associated with the e-learning effectiveness. However, the hypothesis that pedagogies and learning resources positively associated with e-learning effectiveness is not supported. This indicates that there is a need for policy measures to augment the management of learning resources, management effectiveness and metadata ontologies for improving the effectiveness of e-learning.

**TABLE 3. SUMMARY OF THE RESULTS**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>B</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: Preferred pedagogies positively influence e-learning effectiveness</td>
<td>-0.04</td>
<td>No</td>
</tr>
<tr>
<td>H2: Technologies supporting pedagogies positively influence e-learning effectiveness</td>
<td>0.21**</td>
<td>Yes</td>
</tr>
<tr>
<td>H3: Learning resources supporting pedagogies positively influence e-learning effectiveness</td>
<td>0.03</td>
<td>No</td>
</tr>
<tr>
<td>H4: Management of learning resources positively influence e-learning effectiveness</td>
<td>0.17*</td>
<td>Yes</td>
</tr>
<tr>
<td>H5: Metadata ontologies positively influence e-learning effectiveness</td>
<td>0.31**</td>
<td>Yes</td>
</tr>
<tr>
<td>H6: Management effectiveness positively influence e-learning effectiveness</td>
<td>0.20**</td>
<td>Yes</td>
</tr>
</tbody>
</table>

V. CONCLUSION

This study examines the association between the summed six e-learning dimensions and the learners' perceived impact on the e-learning effectiveness. It suggests that the effectiveness of e-learning is highly influenced by metadata ontologies, technologies, management effectiveness followed by management of learning resources. The studies also suggest a lack of influence of pedagogies and learning resources on enhancing the e-learning effectiveness. This implies the need for policy measures to augment management related issues of learning resources such as metadata ontologies, management activities and management effectiveness in order to enhance e-learning effectiveness.

This study shed light on the preferences for individual pedagogical strategies, associated technologies, resources and management factors by learners in a single University educational setting in Australia. This, however, also means that the generalizability of this research is limited. A larger sample with a diverse educational setting and learners from multiple universities may have revealed better insights in
this regard. To overcome the limitations of multiple regression analysis, structural equation model will be used for further understanding the specific contribution of the PTM model towards enhancing effective e-learning in higher education.

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