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E-Readiness Assessment Model for Low Bandwidth Environment

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Abstract

This paper reports on assessment of an e-readiness model for low bandwidth environment. The main focus of the model is on technological (bandwidth) related critical factors that are barrier to the adoption of technology mediated learning in developing countries, among others. The study used three survey questionnaires; Institutional Survey Questionnaire, Lecturers Perception Questionnaire, and Student Perception Questionnaire, aimed to explore the factors relating to e-readiness in low bandwidth environment in university settings. Research findings indicated that Low Internet speed, inadequate telecommunication infrastructure, high cost of bandwidth, non-existent or inadequate Bandwidth Management Policies and accessibility were the technological related challenges faced by the organizations seeking to implement e-learning solutions in their systems.

Keywords: E-learning, Blended e-learning, E-readiness Model, Low Bandwidth Environment, Multiple Case Study.

1. Introduction

The developments in Information Technology have changed the form of acquiring and transferring knowledge in the society. Universities in the developing countries are exploring the cost effective and efficient means of educational content delivery to the learners, leading to the establishment of e-learning environments. However, achievement of such objectives requires assessment of e–readiness [1] to gain the richer understanding of the contextual environment. In literature, numerous definitions of e-readiness exist. The e- readiness definition used in this research is "the ability of an organization or capacity of other stakeholders involved for some e-learning experience". Therefore, e-readiness assessment is the evaluation of an organization's ability and other stakeholders' capacity to accept and use Information Technologies solutions to study the strengths and weaknesses that abound the context [4]. Assessment of e-readiness is worthwhile in the context of Least Developed Countries (LDCs) that fall under the category of low bandwidth environment. Low bandwidth environment is constituted by insufficient bandwidth as compared to demand. In LDCs low bandwidth environment is also coupled with other constraints such us high cost of technology, ineffective or non–existent bandwidth management policies leading to misuse and mismanagement of the available little institutional useful resource. The assessment process would lead to concrete planning and can be seen as starting point for developing a coherent achievable strategy, tailored to meet the needs of beneficiaries [2], [3].

E-readiness comprises of many dimensions such as technical infrastructure (availability of sufficient bandwidth, cost of technology, network speed, bandwidth management policies, and Internet service providers), human resource, e-learning initiatives, legal aspects, perspective of lecturers and students regarding adoption of technology enhanced teaching and learning methods, all are to be examined, with an emphasis on university settings.

The concept of e-readiness assessment has been explored in many studies [4], [5]. However, there is little empirical based research in the area related to low bandwidth environments.

Based on this background, this paper sought to study the readiness of organizations seeking to implement blended e-learning in low bandwidth environment.

2. Research Methods

The aim of this study was to understand the dynamics of the readiness factors in low bandwidth environment for adoption of e-learning. In such situation the exploratory case study method that supports the research objective is more appropriate [7]. However, to conduct an in-depth investigation and to enhance the richness of experiences, multiple-case study method was used [7]. In multiple case study approach, there is no restriction of number of cases to be considered for research [6], [7].

This study is based on multiple sources of data collected from 3 major cases using 3 survey questionnaires; Institutional Readiness Questionnaire (IRQ), Lecturers' Perception Questionnaire (LPQ), and Students' Perception Questionnaire (SPQ), to examine the factors contributing to assessment of e-readiness in low bandwidth environment. Research design of the study is shown in the following section.

3. Research Design

Fig.1 below presents the research design of the empirical investigation that shows the multiple case study, data collection process, and data analysis leading to E-Readiness Model. The investigation identified the technological (bandwidth or network related) challenges and stakeholder's perspectives about adoption of e-learning in the context of developing countries.
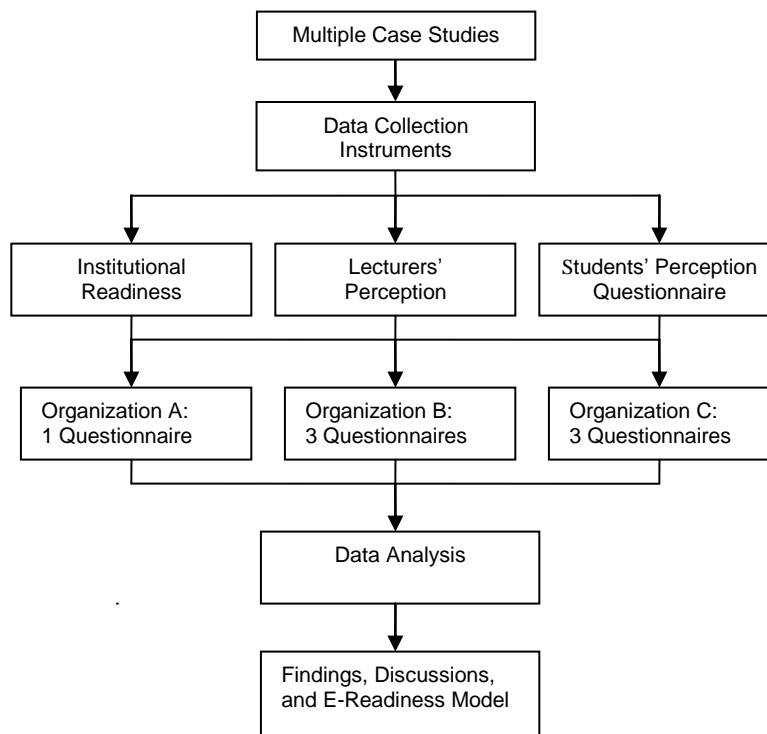
Fig. 1: Research Design Framework

4. Data Collection Tools

This study used a multiple case study method, an appropriate research approach when the intent of the study is theory building [8], in order to achieve the objective of the empirical investigation. Three universities in Uganda were selected, in line with guidelines in [9] and three survey questionnaires; Institutional Readiness Questionnaire, Lecturers' Perception Questionnaire, and Students' Perception Questionnaire were developed to explore factors influencing to e-readiness assessment in low bandwidth environment.

4.1 Institutional Readiness Questionnaire

The focus of Institutional Readiness Questionnaire (IRQ) (synthesized from [10]) was mainly to gather information about the following areas; Technological Infrastructure (network or bandwidth related data), Human resource (technical expertise), National policy and Implementation of blended e-learning (mix of face-to-face learning and e – learning) initiatives.

4.2 Lecturers' Perception Questionnaire

The Lecturers' Perception Questionnaire (LPQ) (synthesized from [11]) comprised of two sections; Lecturer's background information, and their perception about blended learning to assess their self- reported readiness for the innovation. The background information about the lecturers was included in the questionnaire, aimed to get rich and sufficient data about them. The Questionnaire focused on identifying lecturers' online teaching experience, their preferences, their general perception about e-learning or blended e-learning and its expected benefits.

4.3 Students' Perception Questionnaire

The Students' Perception Questionnaire (SPQ) was also subdivided into two sections. First section aimed to capture background information of students and second section was meant to assess their perception and readiness for e-learning or blended e-learning. SPQ was also synthesized from [11].

5. Reliability

Responses from various respondents were coded into the Statistical Package for Social Sciences (SPSS) to run the reliability test for data collection tools, using Chronbach's alpha coefficient, in line with suggestions of [12] that computed the average correlation of various constructs in the survey questionnaires. The Chronbach's alpha coefficient value for Institutional Readiness Questionnaire and Students' Perception Questionnaires were both above 0.7 which is acceptable. The reliability test for Lecturer's Perception Questionnaire could not run because most of the questions were open ended, designed to extract information from respondents rather than seeking their opinion.

6. Research Participants

For the purpose of study, this research identified three universities, namely, Makerere University, Kampala University and Kampala International University all located in the country Uganda, a Least Developed Country. Among the selected organizations, Makerere University is a main public university in the country and one of the most popular universities in East Africa, whereby other two universities are private with a network of upcountry campuses spread across the country. Henceforth, these three universities made a good representative sample of Ugandan Universities and developing countries at large, for better understanding of the context.

7. Sampling

Among the two most popular probability and non probability (convenient) sampling approaches, later was found more appropriate and used, as it has achieved wide recognition by researchers at International level (e.g., see [13], [14], [15]. In convenient sampling, a researcher can select participants conveniently available who are ready to participate in the research. More importantly, the core part of data in all the questionnaires was concerning information about network or bandwidth related issues. At Makerere University there is only one server that is used by all faculties and departments. Therefore, information could not differ significantly even if all deans or heads of departments, lectures and students were included in the survey, instead of the one selected. Same applies to other universities in the study.

8. Procedures

Researcher distributed the paper based designed Institutional Readiness Questionnaire, among 10 Deans/Heads of departments in three identified universities. In a similar manner, 12 Lecturers Perception Questionnaires were also distributed. In addition to that a total of 47 Students Perception Questionnaires were distributed among various groups of students at Makerere University and Kampala University, no student from Kampala International University was included in the survey. The rationale of selecting these groups of people was mainly because that they had rich practical experience of network or bandwidth related issues and challenges. Researcher distributed the questionnaire to students at time when they were sitting free after their lectures.

9. Data Analysis and Results

9.1 Institutional Readiness Questionnaire

The provision of appropriate technological infrastructure, administrative, technical, and logistic support is crucial for the successful implementation of e-learning in an organization. Out of 10 IRQs which were distributed to various Dean/ Head of departments of various universities, only 8 responded. The universities include; Makerere university, Kampala university, and Kampala International university in Uganda. The main areas covered were on Infrastructure, Human resource, National policy and Implementation of blended learning initiatives as shown in Tables 1, 2, and 3.

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Table 1: Statistics for the items relating to technical (bandwidth) infrastructure

Domain	Constructs	No. of respondents	Responses				
Technological Infrastructure	Internet Service Providers (ISPs)	8	**3 ISPS** 12.5%	**2 ISPS** 25%	**1 ISP** 37.5%	**None** 25%	
	Available Bandwidth	7	**4mb/s** 25%	**512kb** 12.5.%	**100kb** 12.5	**Amount not known** 25%	**Non existent** 25%
	Bandwidth Management System (BMS)	8	**Ineffective BMS** 12.5%	**Non Existent** 87.5%			
	Technology cost	8	**Dial-up 56 K/month** US$590	**Leased circuits 64K/month** US$290			
	Adoption of e-learning initiative	8	**Yes** 70%	**No** 30%			
	Student access to their PCs and Internet services	8	**Access to computer network at faculty /institution** 100%	**Access to their PCs** 0.0% Low percentage	**Internet Service at home** 0.0%		
	Learners capacity to purchase hardware and meet cost of Internet connection	8	**No** 100.%	**Yes** 0.00%			
	Computer-Student ratio		**1: 5 -1:100** 62.5%	**No computer** 37.5%			

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Table2: Statistics for the items related to human resource

Domain	Constructs	No. of Respondents	Responses	
Human Resource	Availability of IT professionals	8	**Good** 75%	**Bad** 25%
	Level of computer literacy	8	**High** 25%	**Low** 75%
	ICT training facility	8	**Yes** 100%	**No** 0.00%
	Attitude of the academic staff and students towards e-learning/ blended learning implementation	8	**Positive** 75**%**	**Not known or not good** 25%

Table 3: Statistics for the items relating to National policy & e- learning implementation initiative

Domain	Constructs	No. of Respondents	Responses	
National policy	Government authority in charge of ICT	8	**Yes** 100%	**No** 0.00%
	e- learning readiness a national priority	8	**Yes** 62.5%	**Don't Know** 37.5%
	Partnership between NGOs and Government	8	**Yes** 100%	**Don't know** 0.00%

9.2 Lecturers' Perception Questionnaire (LPQ)

The Lecturers' Perception Questionnaire had two sections; Background of the lecturers and their perception about implementation of blended e learning.

9.2.1 Background of the respondents

Table 4 presents the background information of identified lecturers. According to the table, 33.3% of lecturers were in the age range of 20-30 years, 33.3% in the range 30-40, while 33.3% were found above 40 years.

Table 4: Lecturers background information

Age range	Frequency	Percentage
20-30 years	4	33.33%
30-40 years	4	33.33%
40 years and above	4	33.33%

9 9.2.2 Lecturers' perception about e- learning

The participating lecturers' perception about e- learning is presented in Table 5.

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Table 5 Lecturers' perception about e-learning

Domain	Constructs	No. of Respondents	Responses		
Perception — Lecturers' Perception	Accessibility(computer and network)	8	**Office / Faculty** 33.33%	**Internet Café** 33.33%	**Home** (**Computer only**) 33.33%
	Computer usage skills	8	**Yes** 100%	**No** 0.00%	
	Internet related issues	8	**Low speed** 90%	**Unreliable Internet service** 10%	
	Blended learning teaching experience	8	**1-10 years** 33.33%	**<1year** 33.33%	**No** 33.33%
	Preferred Instructional mode	8	**Traditional face -to –face learning** 0.00%	**Fully online learning** 0.00%	**Blended e-learning** 100%
	Blended e- learning embraces numerous benefits such as; Cost effectiveness, Quality, Interactivity, and Flexibility	8	**Yes** 100%	**No** 0.00%	
	Contribution of blended e-learning to education system of Uganda and LDCs at large	8	**Yes** 100%	**No** 0.00%	

9.3 Students' Perception Questionnaire (SPQ)

The survey included the students from various universities belonging to the following faculties: Faculty of Computer Science and Information Technology, Faculty of Education, Faculty of Arts, Faculty of Social Sciences, Faculty of Business Management, Faculty of Art and Interior Designing. More samples had been taken from the Faculty of Computer Science and Information Technology because of the assumption that their degree is more related to the e-learning systems. The Questionnaire also had two sections like Lecturers' perception Questionnaire.

9.3.1 Students' Background Information

Table 6 presents the background information of students participating in the survey.

Table 6: Students' background information

Age range	Frequency	Percentage
< 2 0 years	10	21.28%
20-30 years	34	72.34%
>30 years	3	6.38%

As revealed by the survey, majority of participating students were in the age range of 20-30 years, 21.28% fell below 20 years, while 6.38% were above 30 years of age, as shown in Table 6. Our survey included students ranging from Certificate, Diploma, Bachelors, and Doctorate degree programmes. However, there was no Masters degree programme student in the sample.

9.3.2 Students' perception about e-learning

This section describes the students self reported perception about e-learning or blended e-learning environment presented in Table 7.

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Table 7: Students perception about e-learning

Domain	Constructs	No. of respondents	Responses		
Students' perception	Computer usage knowledge	47	**Yes** 23.40%	**Little Knowledge** 70.22%	**No knowledge** 6..38%
	Internet surfing knowledge	47	**Yes** 29.79%	**Little Knowledge** 48.93%	**No knowledge** 21.28%
	Intention to undergo training in computer applications	47	**Yes** 91.49%	**No free time** 8.51%	**No** 0.00%
	Knowledge of e-learning or blended learning	47	**Yes** 19.16%	**Not sure** 40.42%	**No idea** 40.42%
	Experience in e-learning or blended learning	47	**Used many times** 10.64%	**Used once** 19.15%	**No** 70.21%
	Implementation of blended e- learning can enhance students' learning skills	47	**Yes** 65.96%	**Not sure** 29.78%	**No** 4.26%
	Accessibility to PC and Internet connection	47	**PC & Internet** 4.26%	**Only PC** 29.78%	**No** 65.96%
	Preferred learning environment	47	**Traditional face-to-face learning** 21.28%	**Fully online learning** 12.76%	**Blended e-learning** 65.96%
	Implementation of blended e-learning can make contribution to education system of Uganda and LDCs at large	47	**Yes** 65.96%	**Not sure** 29.78%	**No** 4.26%

10. Discussion of findings and E-Readiness Model

The technology integration process in an organization requires a strategy, and the success of the strategy is based upon its assessment of the e- readiness level [16]. The e-readiness for an organization can be conceptualized by considering two factors; capacity of key stakeholders (lecturers and students) and ability of Higher Education Institutions to obtain benefits from the use of ICT [17]. Therefore, an e- readiness tool (model) measures the ability of organizations to take advantages of e-learning. However,

the e-readiness assessment does not stand as a main objective in itself; rather it leads to the design of a strategy that will address the issues identified in the readiness assessment of organizations in a country, from the perspective of ICTs [18]. Henceforth, it is imperative that e readiness is determined before the design of e- learning strategy in any organization [19]. From learners' perspective, the variables that can contribute to the effectiveness of e-learning or blended e-learning process are their learning ability by acquiring computational skills and developing positive attitude towards new instructional media [17]. The study results from SPQ indicate that most

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students do not have computational skills but they have a positive attitude towards blended e-learning mode.

On the other hand, lecturers should also have the necessary skills in delivering blended learning courses, in addition to their interest and positive attitude towards the new teaching and learning method. According the results from LPQ, majority of lecturers are experienced and they have a positive attitude towards implementing blended learning solutions. However, the experience and interest in the new innovation can be influential towards its adoption [20]. To introduce technology enhanced teaching and learning methods, organizations must be e-ready. The factors that assess their e-readiness include: adoption of blended learning and bandwidth management policies, necessary technological infrastructure, access to high speed (sufficient bandwidth), reliable and guaranteed Internet services, ICT training to faculty members and students, accessibility of technological resources, putting in place a

mechanism to motivate lecturers and student to adopt blended learning policy, and legal protection to intellectual property. However, IRQ results point towards some critical issues that include: lack of sufficient bandwidth, low speed Internet, high cost of bandwidth, and ineffective or non-existent Bandwidth Management Policies (BMP) leading to mismanagement of available little bandwidth, impeding the technology integration process in LDCs

Above discussion led us to propose an e-readiness model for this study that is constituted by three components; Administration, Lecturers, Students, and their relationship that determines the e-readiness level in line with taxonomy of [21] shown in Fig. 4.2. This e-readiness model serves as a set of benchmarks or requirements for design of a framework for introducing blended learning process in low bandwidth environment.
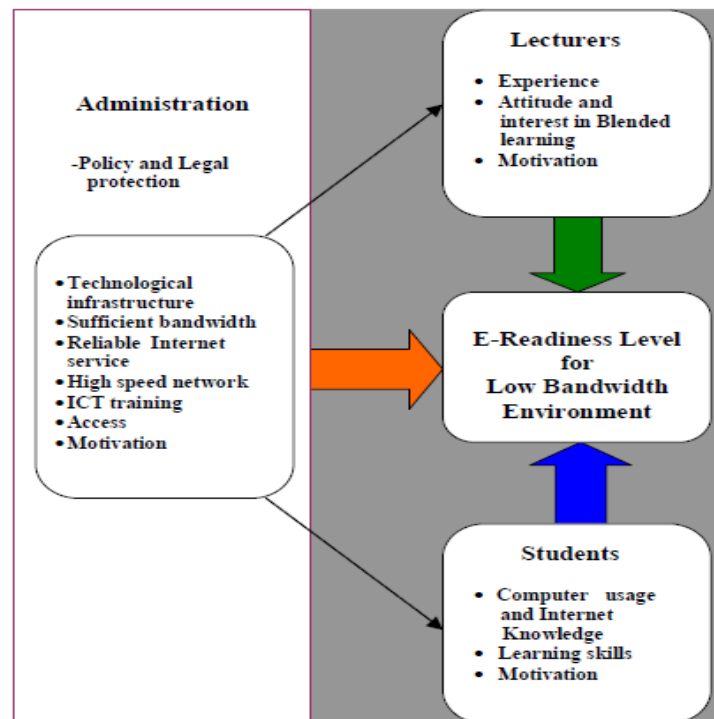

Fig. 2: E-Readiness Assessment Model for Low Bandwidth Environment

11. Conclusions

The goal of this research was to develop a formal e-readiness assessment model appropriate for low bandwidth environment. The study developed a comprehensive e-readiness model for low bandwidth environment, based on a battery of questionnaire instrument through the multiple case study of some selected institutions of higher learning, and achieved this main objective. By utilizing bended learning solutions effectively and thoughtfully, universities' ability to transfer knowledge to the potential learners can be

enhanced in developing countries. Before that, it is necessary to understand the issues that may confront during the complex process of integrating blended e-learning with multimedia tools, as blended learning relies heavily on technologies. Also, collaboration with other government and organization is important to overcome the high cost of technology. Technical support in form of experienced personnel with technical skill is also needed to implement blended learning in an institution. However, according to survey, the implementation of blended learning is tough in the universities in LDCs as they are facing a number of challenges such as low bandwidth environment, irregular power supply, inadequate telecommunication infrastructure, high cost of technology, and accessibility. This study has provided the researcher an opportunity to understand the concern of stakeholders which in turn will lead to successful design of blended learning adoption framework adaptable in low bandwidth environment. And the framework will be based upon realities and constraints that abound the context. It is important to understand the concern of stakeholders, whereby 'ability', and 'capacity' are the key factors leading to e-readiness measurement tool [17] in the context emerging environments. The ability and capacity are measured through assessing 'Institutional Readiness' and 'Perceptions of Lecturers and Students, respectively. Further study that involves a wider spectrum of population of study in different contexts, aimed to test theoretical validity of the model is required. Further test of the reliability of the data collection tools is also suggested, using different relevant statistical methods other than those used in the current study. However, this research constitutes a contribution to guide such further studies in some particular context.

Acknowledgments

References

[1] B. Darab, G.A. Montazer, "Evaluating e-learning readiness in the Iranian Universities", Journal of Technology of Education, Vol. 4, No. 1, 2009, pp.81-90.

[2] Infodev, "E-Readiness as a Tool for ICT Development", 2001. URL: http://www.infodev.org/library.

[3] A. Sife, E. Lwoga, and C. Sanga, "New technologies for teaching and learning: Challenges for higher learning institutions in developing countries", International Journal of Education and Development using ICT, Vol. 3, No. 2, 2007, pp. 57-67.

[4] R. Boateng, A. Molla, R. Heeks and R. Hinson,"Advancing E-commerce Beyond Readiness in a Developing Economy: Experiences of Ghanaian

[5] D Danish.., "E-readiness for developing countries: Moving the focus from the environment to the users", EJISDC, Vol 27,No.6, pp. 1-14.

[6] R. Boateng, R. Heeks, A. Molla, and R. Hinson, " Advancing E-Commerce Beyond Readiness in a Developing Country: Experiences of Ghanaian Firms", Journal of Electronic Commerce in Organizations, Vol. 9, No. 1, 2011, pp. 1-16.

[7] R. K. Yin, "Case Study Research: Design and Methods", 3rd Edition Newbury Park: Sage Publications, 2003.

[8] R. K. Yin, "Case study research: Design and methods" Newbury Park, CA: Sage Publication, 1984.

[9] J. Creswell, 'Educational research: Planning, conducting, and evaluating quantitative and qualitative research", 2002, Upper Saddle River, NJ: Merrill Prentice Hall.

[10] N. K. Badri, "Higher Distance/Virtual Education in The Anglophone Caribbean (A Report on the Evolution, Present Status and Future of Higher Virtual Education in the Anglophone Caribbean)", October/-November, 2002.

[11] A. Kamsin, "Is E-Learning the Solution and Substitute for Conventional Learning?", International Journal of the Computer, the Internet and Management Vol. 13, No. 3, September-December,2005, pp.79-89.

[12] D. M. Gabrielle, "The effects of technology-mediated instructional strategies on motivation, performance, and self-directed learning", A Dissertation submitted to the Department of Educational Psychology and Learning Systems in partial fulfillment of the requirements for the degree of Doctor of Philosophy, Florida State University College of Education, 2003.

[13] N. A. Suhail, "Assessing Implementation of Blended learning in Constrained Low Bandwidth Environment", In Aisbet, J., Gibbon,G., Anthony, J. R., Migga, J. K., Nath, R., Renardel, G. R. R.: Special Topics in Computing and ICT Research. Strengthening the Role of ICT in Development, August, 2008, Vol. IV, pp. 377-390.

[14] M.C. Wesley, "Family and Child Characteristics Associated with Coping, Psychological Adjustment and Metabolic Control in Children and Adolescents with Type 1 Diabetes" A PhD Thesis report The University of Guelph, April, 2012.

[15] Y. Yin, "Investigation of a Design Performance Measurement Tool for Improving Collaborative Design during a Design Process" A thesis submitted for the degree of Doctor of Philosophy, Brunel University, 2009.

[16] K. Kaur,. and Z. Abas, "An Assessment of e-Learning Readiness at the Open University Malaysia. International Conference on Computers in Education (ICCE) 2004, Melbourne, Australia

[17] C. Machado, "Developing an e-readiness model for higher education institutions: Results of a focus group study", British Journal of Educational Technology,Vol.38, Issue1, 2007, pp.72-82.

[18] e-readiness Guide, "How to develop and implement a national e-readiness action plan in developing countries", GeoSINC International, April 2002.

[19] P. Engholm," What determines an organization's readiness for e-learning?", An independent research report submitted in partial fulfillment of the requirements for the Bachelor of Commerce Degree, Monash University, 2001.

[20] E. M. Rogers, "Diffusion of innovations" 2003 (5th Ed.), New York, NY: Free.

[21] T. M. Connolly, M.H Stansfield, and E. McLellan, "Towards a Framework for Exploring Success Factors in Online Learning", European Distance and e-Learning Network Annual Conference (EDEN), Budapest, Hungary, June 2004.

[22] F. S. Ranjbarzadesh, M. H. Biglu, S. Hassanzadeh, N. Safaei, and P. Saleh, "E-Readiness Assessment at Tabriz University of Medical Sciences", Res Dev Med Educ, 2013,(1), pp.3-6.