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Towards a Perspective of Information and Communication Technology (ICT) in Education: Migrating From Electronic Learning (E-Learning) to Mobile Learning (M-Learning)

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ABSTRACT

Information and Communication Technology (ICT) in the educational sector of both developing and developed countries has proliferated in recent years. The involvement of ICT in the educational sector introduces challenges of using ICT tools and facilities for both teaching and learning. The involvement of ICT in education has paved way for the migration of learning beyond the traditional classroom to learning through desktop computers normally defined as Electronic Learning (E-Learning) or learning everywhere and anytime through Wi-Fi equipped mobile devices such as mobile phones, Smartphones and Personal Digital Assistant (PDAs) normally defined as Mobile Learning (M-Learning). Both E-Learning and M-Learning require the use of ICT to accomplish a learning process/task and have advantages and disadvantages over each other. This paper focuses on the various factors to be considered and challenges encountered to educationally transform e-learning to m-learning in an ICT perspective.

Keywords: *Education, ICT, Electronic Learning (E-Learning), Mobile Learning (M-Learning), Migrating*

I. INTRODUCTION AND BACKGROUND

Information and Communications Technology - or Technologies ICT) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them. ICTs are often spoken of in a particular context, such as ICTs in education, health care, or libraries [1].

In the context of education ICT provides tremendous opportunities and advantages in teaching and learning. Delivery and facilitation of teaching methods by teacher/trainers/instructors/lecturers and learning by students/learners are done through ICT tools and facilities and this make both teaching and learning more collaborative and interesting as opposed to traditional learning/education. There are various factors and challenges to be considered when incorporating ICT in teaching and learning. Some of these major and notable challenges include technology usage of ICT equipments by teachers and learners, costs involved in setting up ICT facilities for teaching and learning, computer/ICT self-efficacy, personal characteristics, teaching attitudes, ICT competence, gender, teaching experience, teaching workload, institutional characteristics, professional development, ICT accessibility, technical support, leadership support and technological characteristics (*Buabeng-Andoh, 2012*) [2].

As enumerated above, ICT in education encompasses both e-learning and m-learning. Electronic Learning usually called 'E-Learning' is defined by the New Zealand Ministry of Education as "learning that is enabled or supported by the use of digital tools and content. It typically involves some form of interactivity, which may include online interaction between the learner and their teacher or peers". Concepts such as distance learning, telelearning and computer supported learning cover a wide range of similar learning methodologies. The Danish Ministry of Science and Innovation defines E-Learning as "teaching that is all done in the classroom and where computers are used as learning tool". The European Union (EU) E-Learning Action from 2001 also defines E-Learning as "the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration" (*Falch, 2004*) [3].

Mobile Learning is the use of wireless technology-enabled mobile devices for learning at anytime, anyplace and anywhere. Mobile Learning is advancement in terms of technology in comparison to Electronic Learning and Distance Education/learning. Research in Electronic and Mobile Learning focuses on: Technical Feasibility Analysis, System Terminal Software Development, Curriculum Development, Teaching/Learning Modes, Standard of Learning System and Theoretical Study (*Zhong et al., 2010*) [4].

It can be realized that e-learning is of course different from m-learning and each of these educational modes have advantages and disadvantages over each other. Furthermore, to migrate from e-learning to m-learning as an educational objective requires the consideration of various factors. This paper firstly outlines the various advantages and disadvantages e-learning and m-learning have over each other and secondly focuses on the various factors to be considered and challenges encountered to educationally migrate from e-learning to m-learning in an ICT perspective.

The paper is organized and structured as follows: Sections II and III respectively elaborate on the Research Objectives and Research Methodology of the paper. Section IV presents the Advantages and Disadvantages E-Learning and M-Learning have over each other. Section V discusses the general factors to be considered when Migrating from E-Learning to M-Learning. Section VI presents a Discussion and Summary of the paper. The paper is finally Concluded with a Recommendation in Section VII.

II. RESEARCH OBJECTIVES

The main objectives of this research paper are to:

1. Analyse ICT in education perspectives of e-learning and m-learning.
2. Focus on the factors and challenges to be considered when migrating from e-learning to m-learning.

III. RESEARCH METHODOLOGY

- **Literature Review**: The author adopted integrated and exploratory literature about electronic learning (e-learning) mobile learning (m-learning), ICT in education as well as mobile devices.

IV. ADVANTAGES AND DISADVANTAGES OF E-LEARNING OVER M-LEARNING & M-LEARNING OVER E-LEARNING

E-Learning has various advantages and disadvantages over M-Learning. Some notable factors that constitute to these advantages and disadvantages include cost, input capabilities, output capabilities, processing power, memory, freedom of learning, location and portability. As enumerated in Section I, e-learning is usually done through desktop computers while m-learning involves the use of mobile devices for learning. The description of some of the advantages and disadvantage e-learning and m-learning have over each other are presented below:

A. Advantages of E-Learning Over M-Learning/ Disadvantages of M-learning Over E-Learning

- **Cost:** Most desktop computers used in e-learning are usually less expensive than fully and modern-Wi-Fi equipped mobile devices used in m-learning. The connectivity and technological issues involved in a mobile computing wireless networks are also more expensive than that of cable/wireline Local Area Network (LAN) usually used in e-learning.
- **Input Capabilities:** Input devices such as keyboards and mice connected to desktop computers used in e-learning are more user friendly in comparison to input capabilities of mobile devices used in m-learning.
- **Output Capabilities:** Output devices such as screens/monitors of desktops used in e-learning have a more user friendly size as compared to mobile device screens.
- **Processing Power:** Most desktop computers used in e-learning have a higher processing power and Central Processing Unit (CPU) speed in comparison to that of mobile devices used in m-learning.
- **Memory:** In terms of memory and storage most desktop computers used in e-learning store more data in comparison to mobile devices used in m-learning.

B. Advantages of M-Learning Over E-Learning / Disadvantages of E-Learning Over M-Learning

- **Freedom of Learning:** Learning cannot be done anywhere and anytime in e-learning as opposed to m-learning which allows learning to take place any time and at anywhere.
- **Location:** In e-learning education cannot be provided through Global Positioning System (GPS) as opposed to m-learning which can provide education through GPS.
- **Portability:** E-Learning devices are not as portable as m-learning devices, resulting in restriction of moving learning devices and equipments from a particular location.

V. MIGRATING FROM E-LEARNING TO M-LEARNING

There are many properties that differ when comparing a mobile device and a desktop PC (the usual medium to deliver e-learning). Some of these properties which have already been described above are the output (i.e. the screen size and resolution capabilities, etc.); input (i.e. keypad, touch-screen, voice input); processing power and memory; expected applications and media types. When we try to transfer services provided by an e-learning platform into services in an m-learning platform we can see that some of them should change to fulfill the limitations of the small mobile devices, some are impossible to be delivered in a certain context, but also new services appear, provoked by the mobility (*Trifonova, 2006*) [5]. With reference to the advantages and disadvantages enumerated above, a comparison of E-learning to M-Learning is depicted below in Table 1.

Table 1: Comparison of E-Learning to M-Learning

Comparison	E-Learning	M-Learning
Portability (easy to carry)	Desktop PCs are not portable	Mobile Devices are Portable
Flexibility	Not Flexible	Flexible
Freedom of Learning	Not Anywhere and Anytime	Anywhere and Anytime
Cost of Devices	Less Expensive	More Expensive
Cost of Technology	Less Expensive	More Expensive
Location Education	Cannot Provide Through GPS	Can Provide Through GPS

Trifonova, 2006 [5], elaborated and discussed various factors to be considered when changing/transforming from e-learning to m-learning include:

A. The Connectivity Involved in E-Learning and M-Learning

Contrary to e-learning, which is supported by always-on connection, m-learning could be delivered in three different ways. We can schematically call them "***Pure Connection***", "***Pure Mobility***" and mixture of the previous two (***Intermitted Connection***).

"***Pure Connection***" is when the mobile device is always connected to internet. Nowadays there are quite a lot of technological ways of having access to the World Wide Web (WWW) and other services available for small mobile devices. Mobile device access of the internet can be done through technologies such as Wireless Application Protocol (WAP), General Packet Radio Service (GPRS), Universal Mobile

Telecommunications System (UMTS), Bluetooth, etc. On the other hand "***Pure Mobility***" is when no connection is available and so all the data and applications needed for learning should be uploaded on the mobile device and used offline (*Trifonova, 2006*) [5].

In the case of case "***Pure Mobility***" mobile phones which still have very limited memory, cannot be used. However, this situation has quickly changed with the new generation of cell phones. New generation of cell phones have more processing power, memory and embedded software. PDA's and Smartphones can be used now but they also have memory limitations that should be considered though they can be evaded by using extension packs with extra memory. In such a situation, delivering sound/video-lectures offline could be possible (*Trifonova, 2006*) [5].

B. The Devices' Hardware/Software Characteristics in E-Learning and M-Learning

Access to the web through personal electronic devices, with their small screen size, has been an interesting problem for lots of researchers. Some of these researchers include (*Zhang, 2011*) [6], (*Vavoula* and *Sharples, 2009*) [7] and (*Ting, 2005*) [8]. Unfortunately, today most web pages are designed to be displayed on desktop computers with color monitors having at least 800x600 resolution. This leads to at least 2-to-1 (often greater) ratio of designed vs. available screen area, making direct presentation of most pages on the small mobile devices aesthetically unpleasant, un-navigable, and in the worst case, completely illegible as opposed to desktops computers used in e-learning. Depending on the devices used the delivery format and the needed transformations on it could differ. In some cases if we think about WAP devices some transcoding techniques could be used to transform from one presentation language to another (WAP-HTML-WAP) (*Trifonova, 2006*) [5].

Although it is possible to deliver content to WAP phones the reading is rarely easy enough and the *interaction* is quite a difficult task. One can also think of delivering the contents in a non textual media type (e.g. voice, video). In the case when a PDA or Smartphone can be considered as a mobile device/tool for such wider possibilities. It still remains a challenge and a problem in m-learning to convert/adapt/transcode general purpose learning content in mobile devices (*Trifonova, 2006*) [5].

C. The New Context (Location-awareness) in E-Learning and M-Learning

The mobility of the devices used in m-learning scenarios involves a new context data to be considered – location. One possible service, which involves location context and thus differs from the services offered in e-learning case, is a location-aware printing of the learning content. Other services involving location-discovery are for example a student/teacher receiving directions how to get to a certain room or alerts for seminars/lectures that can be triggered while taking into consideration the current place and the time to get to the needed venue/area (*Trifonova, 2006*) [5].

In the implementation of a location-aware system different techniques for determining position can be considered. Usually they have different parameters, properties and accuracy (from few meters to few centimeters). Some of them are suitable only for finding the position of the device outdoors (Global Positioning System GPS), while other only work indoors. Additional infrastructure and/or equipment is necessary for some of the location-determining systems (special tags and basis/stations or additional hardware on the client machine), while in other systems the only requirement is to add an additional software layer (e.g. system that uses IEEE 802.11b wireless standard network for determining location). It must also be noted that information about the locations might be "raw" (e.g. expressed in latitude/longitude/height coordinates), or converted to a semantically more meaningful expression (*Trifonova, 2006*) [5].

VI. DISCUSSION AND SUMMARY

ICT in education has introduced different modes of education other than traditional education. Some of these major modes of education which this paper identified are e-learning and m-learning. Both forms of education require ICT tools and facilities and the various factors and challenges that users have to consider and overcome before successful implementation have been acknowledged in this paper. In terms of advantages and disadvantages over each other and migration from e-learning to m-learning critical issues identified in Sections IV and V of this paper should be adhered to and addressed for a successful educational and academic objective.

VII. CONCLUSION AND RECOMMENDATION

A. Conclusion

This paper focused on an ICT in education perspective of e-learning and m-learning in terms of the advantages and disadvantages they have over each other as well as the factors to be considered when migrating from e-learning to m-learning. The paper also identified and noted the differences between e-learning and m-learning in terms of implementation, cost, technological issues and cognitive issues.

B. Recommendation

Both e-learning and m-learning have disadvantages but are also very advantageous in the area of education. This paper therefore recommends educational establishments to introduce ICT in education by overcoming the challenges enumerated in Section I of this paper which will result in the introduction of either e-learning or m-learning as part of their educational objectives and goals. The paper also recommends that when educational establishments that want to migrate from e-learning to m-learning should use the factors enumerated in section V of this paper as a guide to accomplish such a task.

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