

Concepts and Principles of Assistive e-Learning System with Multinary Learning for Hearing-Impaired Students

Thanongsak Sovajassatakul

Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand
Email: ake_tns@hotmail.com

Settachai Chaisanit

School of Information Technology, Sripatum University-Chonburi Campus, Chonburi, Thailand
Email: settachai.ch@gmail.com

Abstract—E-learning is a term used to describe the e-learning systems that delivers the learning content by using the Internet to offer the learning material to students supported by activities, assessments, and guidance. This paper presents an e-Learning concept that offers hearing-Impaired students in correspondence with the content in the learning environment. The system is designed ably for Hearing-Impaired students for the purpose of their lifelong learning. Thus, the purposes of this paper were 1) to develop concept of assistive e-learning system with multinary learning for Hearing-Impaired students and 2) to evaluate the conceptual framework of assistive e-learning system with multinary learning for Hearing-Impaired students. The e-Learning system was developed on a HTML5 platform. A MySQL database management system was used alongside an Apache web server, and PHP language was used as a software tool for development. The e-Learning framework which was designed for the special needs of hearing-impaired students was used to perform multinary information (multimedia, text and sign language). It also provides a menu for users, assisting them in learning how to use the e-learning by themselves. The system was evaluated using the Blackbox method of software evaluation. The result showed that the level of efficiency of the system framework was at an excellent level and could efficiently be used in educational institutions.

Index Terms—assistive e-learning, conceptual framework, hearing-impaired and sign language

I. INTRODUCTION

To accommodate the rapid changes occurring in the 21st century, assistive e-learning system is increasingly utilized in mainstream higher education. This case study describes the concept of assistive e-learning system developed for enhancing hearing-impaired students with computerized instruction, the assistive e-learning system aims to enhance student learning by: acting as a scaffold for reflection, providing an opportunity to create content, teaching tool, education technology, reaching learners-at-

large on the Web and participation in a knowledge building community [1]. A revolutionary learning is formed under online environment, a setting in which students can become totally immersed in the learning process. An assistive e-learning system is a situation or setting of pervasive or omnipresent education. Education is dissolved in all around students but the student may not even be aware of the learning process. Source data is present in the embedded objects and students do not have to do anything in order to learn. By that way, learners can access lessons or useful multilingual information (multimedia, text and sign language) anytime anywhere through their personal mobile devices [2].

Hearing-Impaired (HI) persons are a group that is particularly disadvantaged in obtaining communication, education and information because of the unique limiting aspects of their disability [3]. In generally, a competent educational process will also need to cultivate the students' learning skills. It will emphasize independent, creative thinking and, additionally, a paradigm of collaborative and cooperative, mutual learning and interchange of ideas [4]. Because of their disability, therefore, they have lost an important component of human communication, language and culture and then need a special education in order to bring them in getting communication capabilities. The education of the hearing impaired includes any kind of activities performed within the process of educating the best use of auditory residue, the listening and determination of sounds to hearing impaired persons. The most of these persons have such an auditory residue. Regarding the persons who have not any auditory residue, they use the sign language. The hearing impaired persons also use visual cues in order to understand what is saying. With the methods named as lip-reading or speaking-reading techniques the hearing impaired persons do not only follow the lip movements, they also take attention to the face even body cues, they also benefit from these information to understand the message come from the other person in communication. Taking into consideration the visual needs required during the communication by the hearing impaired

persons, the use of visual materials during the education of these persons is also important. Following the screening of literature, language structures are writing systems that are not alphabetic but more ideogram and pictogram form [5].

Researchers have recognized the importance of Hearing-Impaired education and the concept of assistive e-learning system with multinary learning for Hearing-Impaired students that can be used to solve such problems. The concept of assistive e-learning system was designed for the special need of Hearing-Impaired students was perform multinary information (multimedia, text and sign language). The e-learning framework provides a menu for users assisting them in learning how to use the e-learning by themselves. Moreover, the researcher inserted system design techniques appropriate to the era. Result in conditions that are appropriate to the special needs and learning level of the Hearing-Impaired students and stimulates motivation towards learning by integrating the multimedia technology into the system [6]. Thus, the purpose of this paper was to design and combine assistive e-learning system and special needs of Hearing-Impaired students to create learning innovation for learners. In this paper we will clarify about research conceptual framework, and prototype of assistive e-learning system, and provide cues for possible future work.

II. CHARACTERISTICS, CONCEPTUAL FRAMEWORK AND SCENARIO OF ASSISTIVE E-LEARNING FOR HEARING-IMPAIRED STUDENTS

E-learning, coined by Nichols (2003) is defined as strictly being accessible using technological tools that are web-based, web-distributed, or web-capable. E-Learning covers content and instructional methods delivered via CD-ROM, the Internet or an Intranet [7]. Electronic learning (e-learning) is a revolutionary learning form under online environment, a setting in which students can become totally immersed in the learning process. An e-learning environment is a situation or setting of pervasive or omnipresent education. Education is dissolved in all around the student but the student may not even be aware of the learning process. Source data is present in the embedded objects and students do not have to do anything in order to learn. By that way, learners can access lessons or useful information anytime anywhere through their personal devices. E-learning was defined as a combination of distance-learning and online-learning. Learners can learn anything based on e-learning procedure through wire or wireless devices such as PC, smart device, mobile phones, etc. [8], [9]. Fraser presented the U-learning pattern which was developed from e-learning pattern consisting of common store, filtering criteria and rendering criteria shown in Fig. 1 [10].

However, the e-Learning framework for Hearing-Impaired students which was designed for the special needs of Hearing-Impaired students were performed multilingual information (multimedia, text and sign language). The e-learning framework provides a menu for

users assisting them in learning how to use the e-learning by themselves.

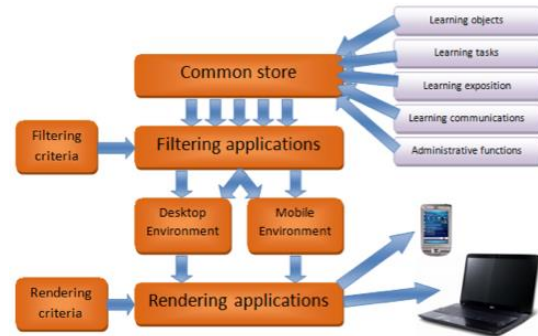


Figure 1. U-Learning developed from e-learning.

III. ARCHITECTURAL DESIGN

The system architectural design adopted a three-tier structure based on the client/server model. A three-tier client/server structure is formed by adding a Client Tier, a Middle-Tier, and a Data-Tier into the conventional Client/Server (C/S) structure model [11]. As shown in the Fig. 2.

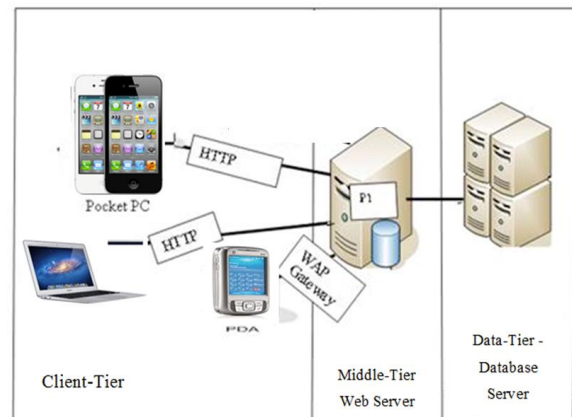


Figure 2. Three-Tier client/server architecture design

Tier 1: Client-Tier: The client-tier technology is the groups of components that run on the user side on the web-based application. Clients have no need to install any software except browser to access media on demand. The client can get the client-tier components by HTTP protocol. The components will be automatically run on the mobile systems.

Tier 2: Middle-Tier Web Server: The middle-tier proceeds to serve the content and provides some prerequisite information required from the client-tier. The components combined at the middle-tier include a media streaming server and a HTML5 platform web server that integrates the streaming technology, the noise reduction algorithm, and the compression software.

Tier 3: Data-Tier Database Server: The data-tier is the group of components that are run to generate the navigator for the mobile learning systems before they are sent to the database. The content of the format consists of navigation specification, and media management. However, the database is the most important component

in this tier. MySQL, which is the most popular open source database, is used. It is a Relational Database Management System (RDBMS) that is based on Structured Query Language (SQL). MySQL has a small file size and fast speed so many small and medium websites choose it for their website databases in order to reduce costs. Because of its advantages, MySQL was chosen to manage the database system in this research.

IV. A CONCEPT AND PRINCIPLES OF ASSISTIVE E-LEARNING SYSTEM WITH MULTINARY LEARNING FOR HEARING-IMPAIRED STUDENTS

The aim of this Issue is to explain how to design concept of assistive e-learning system with multinary learning for Hearing-Impaired students to manage an active learning environment for Hearing-Impaired students. There are at least six key aspects of successfully leading for learning environment of assistive e-learning system with multinary learning for Hearing-Impaired students. These principles were: appropriate e-learning platform for Hearing-Impaired students to learn efficiently. The technologies and techniques used must be in line with these three aspects and among the popular approaches used in all studies mentioned above are video streaming, multimedia, sign language, text adaptation, interactive and social tools. The video streaming application is the core medium for knowledge transfer to happen, mainly by using the sign language. Hence, several specifications like the resolution, frame format, file format, and frame bit rate must be taken into account in ensuring the quality of the sign language video presented to the Hearing-Impaired students are clear enough to be recognized by them. The accessibility of e-learning is also found to be increased when spoken text and other sound information are presented together inside the video. Besides its potential in improving the reading skills among deaf students, it will also enable them to learn independently [12], [13].

Sharing of Learning and feedback: given the nature of many abstract concepts, the instructor can better perceive if he or she is getting the message across when the Hearing-Impaired students feedback those concepts in their own frames of reference. Also, those representations may be more relevant for understanding by other Hearing-Impaired students than the ones the instructor was using to introduce the conference. This is a form of the effective.

The interface of the e-learning environment itself plays a vital role in shaping the contents to be easily understood by the HI students. A familiar and interactive yet effective interface of the e-learning environment could boost up the learning experience of the Hearing-Impaired students hence their performance.

The assistive e-learning system with multinary learning for Hearing-Impaired students was located at <http://www.krusard.com/> as shown in Fig. 3. The system was developed on a HTML5 platform. A MySQL database management system was used alongside an Apache web server and PHP language was used as a software tool for development. Chrome or Internet

Explorer was used as the browser. The system was designed for Hearing-Impaired students with interact in computer to download, search and upload information for their usage. The users were divided into 3 groups, anonymous, students, and administrators who supervised the system operation. The system provides a menu for users assisting them in learning how to use the system by themselves as shown in Fig. 3.

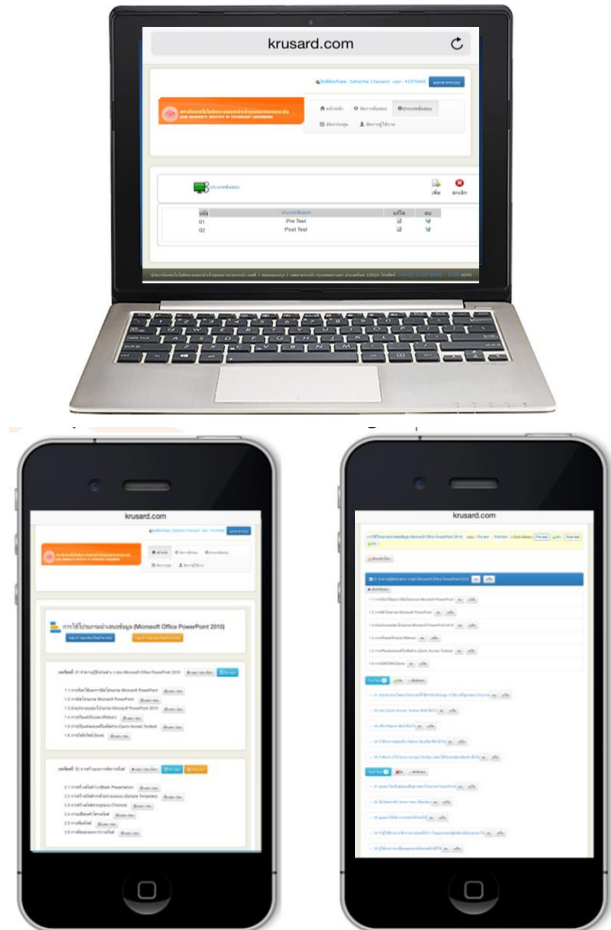


Figure 3. The assistive e-learning system with multinary learning for hearing-impaired students

V. EXPERIMENTAL RESULTS

The system was evaluated by 20 people (5 experts Administrators and 15 anonymous) using the Blackbox method of software evaluation [13]. The data were collected by using questionnaires about the function of an assistive e-learning system with multinary learning for Hearing-Impaired students. Research methods were applied to collect quantitative data using questionnaires. The data were analyzed using basic statistical tools, frequency, mean (\bar{x}), and Standard Deviation (SD). The levels of agreement from respondents were as follows:

Average Score
 4.51 – 5.00 means excellent
 3.51 – 4.50 means good
 2.51 – 3.50 means doubtful
 1.51 – 2.50 means poor
 1.00– 1.50 means very poor

TABLE I. THE ANONYMOUS EVALUATION OF AN ASSISTIVE E-LEARNING SYSTEM WITH MULTINARY LEARNING FOR HEARING-IMPAIRED STUDENTS

Details	\bar{x}	S.D.	Illustrate
1. Functional Requirement Test	4.07	0.46	good
2. Function Test	3.87	0.64	good
3. Usability Test	4.20	0.56	good
4. Performance Test	3.93	0.70	good
Total	4.02	0.60	good

The overall quality of the system was determined against usability criteria, effectiveness, efficiency, and satisfaction following Blackbox method of software evaluation. The user's evaluation of an online knowledge management system to enhance engineering computerized instruction was also conducted to identify a way of evaluating the quality of use. The level of evaluation was determined through four categories, Functional Requirement Test, Function Test, Usability Test, and Performance Test. These showed means of 4.07 (SD = 0.46), 3.87 (SD = 0.64), 4.20 (SD = 0.56), and 3.93 (SD = 0.70), respectively (Table I). The overall quality of the system design was estimated as good level, and the degree of clarity of system was rated higher than target levels.

TABLE II. THE EXPERT ADMINISTRATOR'S EVALUATION OF AN ASSISTIVE E-LEARNING SYSTEM WITH MULTINARY LEARNING FOR HEARING-IMPAIRED STUDENTS

Details	\bar{x}	S.D.	Illustrate
Functional Requirement Test	4.20	0.45	good
Function Test	4.00	0.00	good
Usability Test	4.40	0.55	good
Performance Test	4.00	0.71	good
Security Test	4.20	0.45	good
Total	4.15	0.49	good

The overall of the expert administrator's evaluation was also conducted to identify a way of evaluating the quality of use by Blackbox method of software evaluation. The level of satisfaction was determined through five categories: Functional Requirement Test, Function Test, Usability Test, Performance Test and Security Test. These showed means of 4.20 (SD = 0.45), 4.00 (SD = 0.00), 4.40 (SD = 0.55), 4.00 (SD = 0.71), and 4.20 (SD = 0.45), respectively (Table II). The overall quality of the system design was estimated as good level, and the degree of clarity of system was rated higher than target levels.

VI. CONCLUSION AND FUTURE WORK

An assistive e-learning system with multinary learning for Hearing-Impaired students was a premium-modeling tool. This assistive e-learning system was able to produce high quality and complex system and gave Hearing-Impaired students for good practice information. It has also built-in online based that handles all elements of the constructed scene and contain user database information. As we have seen in this paper, it has built-in objects and

helpers, which are used alone or combined with one another, creating the necessary perceptions of interactions. Thus, it can be concluded that the assistive e-learning system presents an excellent environment for Hearing-Impaired students, which can be produced knowledge to learners.

For further studies, we plan to continue our research, looking for different techniques for innovative system for the online system such as collaboration, participant, and make suitable online learning environment to improve the learning system and motivate learner to use and learn.

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REFERENCES

- [1] K. Valkokari and N. Helander, "Knowledge management in different types of strategic SME networks," *Management Research News*, vol. 30, no. 8, pp. 597-608, 2007.
- [2] C. Wongwatkit and Y. Choib, "A development of ubiquitous learning framework using blended learning system," in *Proc. International Conference on Learning Innovation in Science and Technology*, Pattaya, Thailand, 2010, pp. 396-399.
- [3] Office of the Basic Education Commission, "Core curriculum for basic education," Ministry of Education, Thailand.
- [4] C. Samphan and S. Suksakulchai, "Expectation in collaborative learning for the deaf students in higher education," in *Proc. ICASE Asian Symposium*, Thailand, 2007.
- [5] Y. Bat-Chava and D. Martin, "Sibling relationship of deaf children: The impact of child and family characteristics," *Rehabilitation Psychology*, vol. 47, no. 1, pp. 73-91, 2002.
- [6] S. Chaisanit and S. Suksakulchai, "The Online Participatory DAISY talking book production system (OPDAISYS): A shared information and knowledge system for print disabled students," *Journal of Engineering and Applied Sciences*, vol. 6, pp. 242-249, 2011.
- [7] M. Nichols, "A theory of eLearning," *Educational Technology & Society*, vol. 6, no. 2, pp. 1-10, 2003.
- [8] H. W. Park and J. P. Biddix, "Digital media education for Korean youth," *International Information & Library Review*, vol. 40, pp. 104-111, 2008.
- [9] W. Jun, "The roles and functions of the ULSS (ubiquitous learning supporting system)," *International Journal of Computer Science and Network Security*, vol. 9, no. 8, pp. 169-171, 2009.
- [10] J. Fraser, "Walkabout u-learning," Peninsula School of Information Technology, Monash University, Australia, 2006.
- [11] S. Chaisanit and S. Suksakulchai, "The online digital talking books production system using audio streaming media technology," in *Proc. International Conference on Computer Research and Development*, Perth, Australia, 2009.
- [12] S. Khwaldeh, N. Matar, and Z. Hunaiti, *Interactivity in Deaf Classroom Using Centralised E-Learning System in Jordan*, PGNet, 2007.

- [13] M. Debevc, Z. Stjepanović, and A. Holzinger, "Development and evaluation of an e-learning course for deaf and hard of hearing based on the advanced Adapted Pedagogical Index method," *Interactive Learning Environments*, vol. 22, no. 1, pp. 1-16, 2012.

Dr. Thanongsak Sovajassatakul is an associate professor in the Educational Technology program, at the Faculty of Industrial Education, King Monkut's Institute of Technology Ladkrabang (KMITL), Thailand. With his educational and professional background in Learning and Innovation in Technology, he is currently working as a specialist in Learning Innovation in Technology, and as Head of The Center for

Educational Innovation and Technology, at KMITL. His main research interests are teaching and learning in Educational Technology.

Dr. Settachai Chaisanit is a lecturer in the Multimedia Technology program, School of information technology, at Sripatum University-Chonburi Campus (SPU), Thailand. With his educational and professional background in information technology, computer and education, he is currently working as a specialist in Learning Innovation in Technology, and as Campus Dean for School of information technology, at SPU. His main research interests are multimedia technology and learning innovation.