Journal of Engineering and Applied Sciences 13 (21): 9029-9037, 2018
ISSN: 1816-949X

A Review of e-Learning Models for Deaf and Hearing Impaired People

Najmuldeen A. Hashim, Nurhizam Safie and Muriati Mukhtar
Research Centre for Software Technology and Management (SOFTAM),
Faculty of Information Science and Technology, University Kebangsaan Malaysia (UKM),
43600 Bangi, Malaysia

Abstract: Hard of hearing and hearing loss are examples of disabilities that affect some individuals. Some of the deaf people use sign language to communicate among themselves as well as the normal people. This language is known as the sign language. The sign language for people with hearing loss depends on the movements of the hand which simultaneously combine facial expression, eyes and body movement and lip patterns. There is a need not with standing for making e-Learning accessible to the hearing impaired and deaf individuals. Now a days, the e-Learning Models for the deaf and hearing impaired individuals are very limited. They in fact are being isolated from getting the benefits from this technology. This study aimed to examine the existing e-Learning Models for the hearing impaired and deaf people in different case studies based on the reviews of previous related studies which are analyzed by using the content analysis approach. From the analysis, ten e-Learning Models were found during 2009-2016. The web-based education for the deaf and hearing impaired people has the highest overall rank according to the other studies related to the previous e-Learning Models. Furthermore, although, the web-based education is important for the deaf people in the e-Learning systems they still have major problems when accessing the e-Learning platforms via the web.

Key words: Deaf, hearing impaired, e-Learning, framework, model, review

INTRODUCTION

One important group of the internet users are people with disabilities which include individuals who are deaf. Hard of hearing and deaf individuals have a special communicating language known as a sign language. The sign language uses signs or actions by the deaf people to communicate with each other instead of sounds (Berry, 2001). The sign language utilizes manual correspondence, non-verbal communication and lip patterns. Simultaneously, it combines hand shapes, head and hand gestures, facial expressions and arms or body movement (Shirali-Shahreza and Shirali-Shahreza, 2008). The bilingual investigations (spoken and signed language) in the schools of the hard of hearing and deaf-mute showed that the utilization of sign language in the classroom upgraded reading competence significantly (Drigas *et al*., 2005).

As indicated by the World Health Organization (Anonymous, 2017) it was estimated that over 5% (360 million) of the total population lose the sense of hearing or are deaf and mute (328 million adults and 32 million kids). Out of this fig 183 million were males and 145 million females as Fig. 1.

It is important to mention here that the first language used by these groups of people is the sign language. The ability to get and have access to an education by children with hearing loss is one of the most established challenged discussions in the history of the deaf people (Haualand and Allen, 2009).

Throughout the previous thousand years the examination on whether deaf individuals or people should be taught using sign language which is also known as the oral method has been persistently discussed for the most part by hearing individuals and those with auxiliary learning about deaf individuals. In Milan, Italy in 1880 the discussion regarding the education of deaf people culminated temporarily at the second International Congress on the Education of the deaf where the participants passed a declaration stating that the oral method should be preferred to that of signs in the education and instruction of deaf people (Haualand and Allen, 2009).

E-learning is a modern entrance to this time of innovation where the deaf people must not be dispersed out from utilizing and taking the benefits of this technology (Soud *et al*., 2010; Fahad *et al*., 2013; Ahmed *et al*., 2016). This new technology touches the

Corresponding Author: Najmuldeen A. Hashim, Research Centre for Software Technology and Management (SOFTAM), Faculty of Information Science and Technology, University Kebangsaan Malaysia (UKM), 43600 Bangi, Malaysia

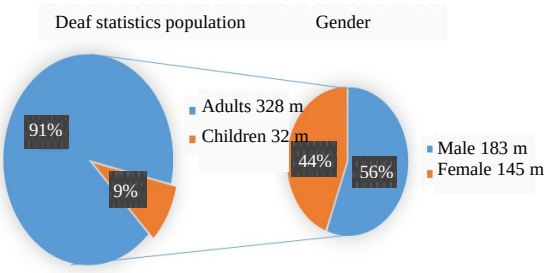

Fig. 1: Worldwide deaf statistics population (Gender)

daily life of the deaf people in the direct and indirect ways which keeps them far from this technology leading to the scarcity of skills and knowledge that will affect their life (Chowdhuri *et al*., 2012).

Deaf people face many difficulties in acquiring adequate skillsboth in reading and writing texts but these can be considered as a "hidden" problem because the normal people are unaware of them. The most popularly used accessibility support for the deaf-mute users consists in the inclusion of national Sign Languages (SLs) videos as an alternative to texts. However, this does not fully address the problem in fact such languages use linguistic structures which are dramatically different from those of the written/spoken languages which are related to a phonetic experience lacking in deaf people (Bottoni *et al*., 2012).

As stated by Ditcharoen *et al*. (2010) the biggest problem with deaf people is that most of the normal people do not understand the sign language. Moreover, the sign language has many limitations. Unfortunately, these are often in the places where they are needed such as learning, training and work.

According to Soud *et al*. (2010) based on the World Federation of the Deaf (WFD) 80% of the deaf people lack education or are uneducated they are unlearned or semi-educated. Due to this reason, deaf individuals face difficulties when accessing written information via. the web as most of the deaf adults did not get a formal education in the sign language and therefore, lack basic reading and mathematical skills needed for further vocational training. Furthermore, children with hearing loss and deafness, specifically in developing countries, hardly receive any education (Soud *et al*., 2010).

According to El-Gayyar *et al*. (2013) the researchers noticed that adults with hearing loss suffer from a much higher unemployment rate. In according to Bueno *et al*. (2007) deaf students in general have poor literacy skills. As well as the teachers for the deaf have little or no experience to teach and use the e-Learning tools for the deaf, the major concern of the teachers on how to enhance the outcome of education, effective education and media use to assist teaching have constantly been sought by the researchers in educational technology (Abdelaziz *et al*., 2014; Safie and Aljunid, 2013).

According to Drigas *et al*. (2004) it was stated that the deaf people also lack materials translated into the sign language. We can conclude from the above studies that individuals with hearing loss are suffering from the communication between them as well as normal people and facing difficulties when using the e-Learning tools via., the web. The e-Learning system with an enjoyable interface and specific tools could solve this problem and make teachers and students more motivated to access and use the technology.

MATEREIALS AND METHODS

This study provides an over view of the literature related to the topic of the present research. The philosophy, underlying concepts of the research related to the previous e-Learning Models and frame works for the hearing impaired and deaf persons, their key features and various theoretical frameworks used for the deaf e-Learning development were underscored. The aim of this intensive literature survey is also to identify the limitations of the present deaf e-Learning Models. In addition, to find the success factors that related to these models. The primary source of the data presented here is based on the recent journal articles, book and online academic citation databases.

The purpose of this study was to analyze the existing e-Learning Models for the hearing impaired and deaf people in different case studies to find the success factors related to the existing models and to provide practical guidelines that could help the researchers and practitioners to design or develop a new one based on the reviews of previous related studies analyzed by using the content analysis approach. The content analysis approach is a qualitative research strategy that has been broadly used to analyze written and oral or visual communication messages (Kadhum and Hasan, 2017). Generally, the main objective of this study was to analyze the existing e-Learning Models and frameworks for the hearing impaired and deaf people in different case studies and compare between the existing models regarding methods used, limitations and future work. In addition, to find the success factors that related to the existing models.

The review considered in this study were journals from high-rank publications related to the research topic

and other related research papers or conferences referring to the successful implementation of e-Learning systems for the deaf, deaf e-Learning Models and e-Learning frameworks. Therefore, our literature review is considered as one of the most important methods to find the gaps where others stopped and catch the problem to start finding the best solution.

The reviews were performed based on many databases used in this research like IEEE, ISI (Web of Science) Science Direct, Scopus, Research Gate, Google Scholar and other authorized websites like the World Health Organization (WHO) and World Federation of the Deaf (WFD) for articles published from 2009 until 2016. A lot of keywords were used in this research like hearing impaired, deaf-mute, e-Learning framework, model and review. Relevant researches were downloaded and archived in a suitable table and folders while the data obtained were coded. It can be concluded from this review that there are ten e-Learning Models proposed in different case studies of the hearing impaired and deaf people. In addition the discussion revolves around the method for each model, findings, limitation and future research.

E-learning Models for the deaf: In this study, we shed light on the various methods used for the hearing impaired and deaf e-Learning Models. The e-Learning for the deaf needs to satisfy different requirements such as factors affecting in utilizing this system, methods used, findings and limitations and future research in these studies.

According to Qiang and Ming (2009) a teaching evaluation model targeting the web-based distance education for deaf students was designed. This study aimed to introduce the model to the aspects of the web teaching characteristics and evaluation process. The method used to collect the factors in the evaluation was qualitative and quantitative. In addition, the limitation of this research separates teaching from learning about time and space and needs a more trusted and secure network transmission system.

Another researcher Soud *et al.* (2010) attempted to produce an e-Learning system which presents the Arabic Sign Language (ArSL) in corresponded to the text in the e-Learning environment which also depicts a bilingual sign language dictionary that can help the Arab deaf students to learn Arabic sign language directly from their first language. The limitation of this study was that a greater part of the hard of hearing adults did not get a formal education in sign language and therefore, they lack the basic reading and mathematical skills. Furthermore, the use of animated sign language for each text block will be the most important feature. As stated by Lan *et al.* (2009) in this research, the researchers expanded a model of the moodle-based platform for the collaborative learning of the hard of hearing students and also provide guidance and reference for carrying out collaborative learning network in the special education teacher's college classroom. Furthermore, it was stated that there is the need for further efforts and real effectiveness to improve the learning ability of deaf students to better adapt to society.

Previously, other researchers, Khwaldeh and Shah (2010) exhibited the possibility of using the current open source Learning Management Systems (LMS) for deaf persons. The researchers evaluated four open-sources LMS and recommended one of them as the most useful for deaf children in Jordan. This recommendation came from the testing of the evaluated LMS against the developed key requirement. The method used was the Internet data collection, likewise mentioned that the successful implementation of this improvement would expose the way to a complete support system for the education of hard of hearing and deaf individuals in Jordan.

On the other hand, a virtual classroom for the hard of hearing individuals was proposed by Nasr (2010). In the study an e-Learning system for the hard of hearing people was adopted to work bilingually (Spoken and Sign Languages). The proposed e-Learning system provided a lot of learning facilities for its users according to their roles in the paradigm and supported implicit scripted collaborative task. The limitation of this research was that the disables or pupils with learning difficulty needs were rarely taken into consideration in developing the e-Learning systems while the hard of hearing people have serious problems in handling this technology.

A theoretical model was proposed by Kozuh *et al.* (2014) for examining the experiences of the deaf and hard of hearing users of SNSs (social networking sites) from the aspects of identity, community building and alliances between communities. The researchers proposed the model to examine the experiences in the informal online spaces and provided a set of guidelines for efficient social and communication support for the deaf and hard of hearing users of the non-formal educational process which will, in particular, serve teachers, designers and developers included in the process. They stated that there was a lack of measures provided to be applied when utilizing the model. The second limitation was that they could not guarantee the reliability and validity of the model which might vitally influence the model performance and its outcomes. The researchers mentioned

that further research is important to help ascertain the usefulness of the developed model, in addition, to guarantee its reliability and validity.

According to El-Gayyar *et al.* (2016), a comprehensive framework was proposed to be constructed upon three fundamental advanced technologies, mobile devices, Cloud resources and social networks to provide a seamless communication between the blind and hard of hearing individuals, especially, for those living in the Arab countries. The modern methodologies such as mobile and cloud computing have an impressive role in enhancing the intercommunication around the people with different disabilities and non-disabilities from one side and among the disabled people themselves who have the same or different impairments. They stated that children with hearing loss or deaf-mute, particularly in developing countries, hardly get any education. On the other hand, adults with hearing loss suffer from a much higher unemployment rate.

By Yeratziotis and Greunen (2013) the discussion was on how to recognize the suitable user experience and interface design guidelines for designing mobile applications for people with hearing loss. The method used was qualitative data collection in a case study. The data collection was done using questionnaires, usability testing and literature review. Likewise, the researchers demonstrated that the future studies would need to incorporate a more extensive scope of people with hearing loss not only in the South Africa.

There are some well-known recommended systems which include the cyber teaching training for deaf people (Ellis *et al*., 2015). The researchers explained that most of the instructors had poor or no experience in teaching deaf students, especially in the online environments. In addition, there are almost no models for the training faculty to design and implement accessible cyber-learning in higher education. Furthermore, they were addressing those limitations by presenting the Accessible Cyber-teaching Training (ACT) Model. The finding of this research was faculty would exhibit knowledge of the challenges faced by those with disabilities in higher education including the cyber-learning environment which case study was focused on the developing countries.

At present, there are a lot of innovations on the e-Learning systems running in the world such as Martins *et al.* (2015) the researchers studied the potential technology solutions for enhancing the communication process for deaf people on the e-Learning systems through the interpretation of Sign Language (SL). The challenges for the deaf people increase because of their reading and writing problems. The researchers have yet some critical challenges to solve and need to provide an effective integration of these technologies in the e-Learning platforms. In addition, there are still no current solutions to solve the communication between the deaf and normal people.

By El-Gayyar *et al.* (2016) the researchers developed a mobile-based framework that translates Arabic speech to the Arabic Sign Language based on cloud computing. The framework used the power of cloud computing for the complex processing of the Arabic text. The researchers attempted to utilize GIF, animated images rather than videos to decrease the size of the database which additionally specified that special need individuals are suffering from segregation and obstacles that limit their participation in different societal activities. Due to the lack of appropriate interaction, they are denied their rights to live independently, work or even move freely. Anyway, these previous studies are classified as follows and as Table 1.

Success factors: Many studies have been conducted in the developing countries on the factors involved in the e-Learning for the deaf and hard of hearing individuals, however, just a set number of studies have been conducted in the developing countries including Arab countries so more studies about e-Learning for the hearing impaired are required. Reviews of the literature on e-Learning models for the hearing impaired have found that a wide range of achievement criteria and case studies have been utilized. The following gives some information gotten from the literature about the success factors in terms of.

LMS (Learning Management System) factors: The assessment of an LMS includes an examination of many factors and aspects identified with LMS and evaluated with key requirements. Throughout the evaluation of the four LMS, the reasearchers recognized the main factors that influence the adaptation such as language support, hardware/software specifications, Relational Database Management Systems (RDBMS) assessment tools, administrative tools, collaboration and communications tools, LMS standards and specifications compliance and customization of LMS (Khwaldeh and Shah, 2010).

Individuals experiences factors with SNS: According to Kozuh *et al.* (2013) the researchers proposed the model to examine the experiences in the informal online spaces and provided a set of guidelines for efficient social and communication support for the deaf and hard of hearing

Table 1: e-Learning models for the deaf

Author	Focus of study	Methodology	Findings	Case study	Limitations/future work
Martins *et al.* (2015)	How to enhance the communication process for deaf persons	Accessible options (review)	Potential technology solutions to enhance the communication process for deaf persons through the translation of Sign Language (SL)	Not clear	There is still no current solutions solve synchronous real time communication between deaf and not deaf
Ellis *et al.* (2015)	Accessible Cyberteaching Training (ACT) program	Multi-phased mixedmethods (pre-pilot training survey)	Faculty will exhibit knowledge of challenges faced by those with disabilities in higher education, including in cyber-learning environments	Developing countries	Limited the amount of interaction and hands-on time participants Instructors have little or no experience teaching such students, especially in online environments
El-Gayyar *et al.* (2013)	To encourage the community disabilities persons especially blind and deaf individuals to join the normal and practice the regular daily life activities	General framework	Mobile-cloud framework	Egypt	ArSL does not have an online documentation system which could be utilized while building a translation part
Kozuh *et al.* (2013)	Examining the experiences of deaf and hard of hearing online users (Social Networking Sites (SNSs))	Graphical scheme (model)	Proposed an examination of deaf user's communication in online spaces with the purpose of improving communication support for users such as distance education	Not clear	There is a lack of providing measures to be applied when utilizing the model. The second limitation is that we cannot ensure the model's reliability and validity
Yeratziotis and Greunen (2013)	Identify appropriate user experience and user interface design guidelines for the design of mobile applications for deaf persons	Qualitative method. (questionnaire)	Providing proper access to ICT services	South Africa	Future studies would have to for the deaf persons include a broader range of deaf people Developing an operating system for Internet browsing for the deaf
Khwaldeh and Shah (2010)	Open source Learning Management Systems (LMS)	Data collection method by the internet	Moodle supported video conferencing and a fully Arabic language support	Jordan	Successful completion of this development will open the way to a complete support system for the education of deaf students in Jordan
Nasr (2010)	Elearning paradigm for deaf pupils was adopted to work Bilingual (Spoken sign language)	An interactive set of tools	Proposes virtual classroom for creating and displaying materials in sign language (proposed e-Learning Paradigm for deaf pupils)	Not clear	Disabilities pupils' needs are rarely taken into consideration in developing e-Learning systems. Likewise, they have serious problems in dealing with learning systems
Qiang and Ming (2009)	Designs a teaching evaluation model for the deaf students on web-based distance education	Qualitative indicator and a quantitative indicator	Evaluation model of web-based distance Education For the deaf undergraduate	China	Making teaching separates from learning about time and space, need anetwork transmission system more trust and secure
Soud *et al.* (2010)	Enhances deaf acceptance and understanding of learning content presented to them	Questionnaire	A dictionary and e-Learning system is adapted to the needs of deaf people	Egypt	Most of the deaf adults did not get school education in sign language and therefore lack basic reading and mathematical skills The use of sign language animation for each text is the most important feature
Lan *et al.* (2009)	Web-Based Collaborative Learning (WBCL) to enhance interaction and self-confidence of deaf students	Evaluation moodle	Web collaborative learning platform for deaf students	China	Need to further efforts and the real effective to improve the learning ability of deaf students to better adapt to society

users of the non-formal educational process which will in particular, serve teachers, designers and developers included in the process. They suggested the following four factors be addressed within the model: hearing loss, educational background and communication situation.

Hearing loss: Hearing loss can consider one of the most important and crucial factors. It can be arranged into the following two sub-factors.

Hearing status: Hearing status can be characterized in accordance with the medical model where hard of hearing is measured in decibels (dB) over the range of frequencies in the being heard spectrum (Kozuh *et al.*, 2013). Researchers have proposed recognizing the definition by the American National Standards Institute where hearing impaired individuals are those with an unaided hearing loss of 17 dB or more while the deaf is individuals with an unaided hearing loss of 91 dB or more.

Self-labels and acculturation: Self-labels and acculturation in hearing society, it is normal to recognize between the hearing loss degrees. A hard of hearing individuals is seen more positively than deaf individuals (Kozuh *et al*., 2013). Not only self-labels but as well as the acculturation process must be addressed when supposing hearing loss inside the model. It is determined by the impact of a deaf and hard of hearing individual background where the special form of expression used with their family at home also, their educational background (the teaching style used in schools for the deaf or popular schools) are included.

Educational background: Educational background factor related to the formal education where the students and a teacher are includes in the educational process at their school. The researchers proposed that the following sub-factors related to the educational background factor.

Level of education: Firstly, the level of education factor is of great significance and may have collaboration on the examination of the deaf/hard of hearing individual's online experiences since, approximately 80% of the deaf people lack education or are uneducated, they are unlearned or semi-educated (Soud *et al*., 2010). The level of education can be characterized as a primary, secondary or higher educational level.

Teaching method (in schools for the deaf or popular schools): Secondly, deaf/hard of hearing individuals can be learned under a different range of teaching methods at schools for the deaf schools. The verbal educational approach underscores auditory training, verbal expression ability and lips pattern since the total communication uses a combination of signs and spoken language for collaboration. Furthermore, the bilingual education uses both the sign language of the deaf society also, the written/spoken language of the hearing society ("No Title," 1996).

Communication situation: Communication situation factor is included in the model, since, the examination of identity, construction of communities and their interaction mainly depend on the situation that a communication process is conducted in. prior studies have illustrated that "every investigation of online communities includes language and communicative practice" (Wilson and Peterson, 2002). Thus, the following sub-factors are related to communication situation.

Language skills: Language skills can be described as an important factor where as the majority of people born hearing loss use sign language as their native language and consider the written language to be their second language ("No Title," 1996). Furthermore, sign language skills also have a great significance when examining the Deaf/Hard of hearing on SNSs (Social Networking Sites). This sub-factor should be carefully considered by the sender and receiver of messages inside the communication process.

Mode of communication: The prevailing importance of sign or written language skills mostly relies on the mode of communication.

Mode of communication factor refers to the language form used such as a sign, spoken or written language. It pertains to the mode of communication through the communication process chosen and preferred by Deaf/Hard of hearing users on SNSs (Social Networking Sites) as well as it is supposed to be agreed upon by the parties in the communication process (Kozuh *et al*., 2013).

Level and type of motivation to communicate: The motivation for communicating on SNSs can be defined as a set of goals and confidence that guide behavior with respect to communication on SNSs (Kozuh*et al*., 2013). Motivation also can be described as an intrinsic internal source or extrinsic external source. In this case the individuals would communicate on SNSs (Social Networking Sites) for their own inherent satisfaction (Kozuh *et al*., 2013; Ryan and Deci, 2000).

RESULTS AND DISCUSSION

Different e-Learning Models were found from the previous literature in different case studies of the hearing impaired and deaf individuals. The most interesting finding was that four models discussed the web-based education and another model discussed Information and Communication Technology where the use of information and communication technology tools plays a crucial role for any organization willing to increase competitiveness, save a lot of time and money and upgrade the effectiveness of the decision-making (Alzaghal and Mukhtar, 2017).

Another important finding was that the two other models were for the sign language translation while others were related to LMS (Learning Management System) ACT (Accessible Cyber Teaching) mobile cloud framework and SNS (Social Networking Sites). Moreover, these studies are categorized as follows and as in Table 2.

Another important findings, the success factors that influence the adaptation of the LMS (Learning

Table 2: The findings of the previous e-learning models for the deaf

Variables	Values
Web-based education	4
ICT (Information and Communication Technology)	1
LMS (Learning Management System)	1
ACT (Accessible Cyber Teaching)	1
SNS (Social Networking Sites)	1
Sign language translation	2
Mobile cloud framework	2

management system) are language support, hardware/software specifications, Relational Database Management Systems (RDBMS), assessment tools, administrative tools, collaboration and communications tools, LMS standards and specifications compliance and customization of LMS. Individual's experiences factors with SNS (Social Networking Sites) are hearing loss, educational background and communication situation. Were the hearing loss factor can be arranged into the following two sub-factors such as Hearing status, Self-labels and acculturation. The following sub-factors related to the educational background factor are level of education and teaching method. Thus, the following sub-factors related to communication situation are language skills and mode of communication.

Prior studies noted the importance of the web-based education for the deaf. Web-based learning includes the content in the web browser with activities and actual learning materials. On the other hand, web-based learning shares similarity with the curriculum or textbooks in a sense that the content determines whether a book is a report, novel or a textbook (Alawamreh and Elias, 2015). In addition the information and communication technology also important.

With respect to the main research objective it was found that numerous studies have attempted to explain the web-based education for people with hearing loss (Wu *et al*., 2009; Qiang and Ming, 2009; Nasr, 2010; Soud *et al*., 2010). As mentioned previously in the literature, although, the web-based education is important for the deaf people in the e-Learning systems, they still have major problems when accessing the e-Learning platforms via. the web. Thus, there is a need to develop an e-Learning system with an enjoyable interface while according to one case study the use of sign language animation in each text will provide ways for the education of students with hearing loss. In spite of those types of models include evaluation, system, architecture and design implemented by previous studies, the solutions to the communication between the hearing loss and normal people was not found.

There is a possible explanation for the deaf students to have problems when accessing the e-Learning platforms, in reading and writing skills and dealing with mathematical matter (Nasr, 2010; Soud *et al*., 2009). It may be due to the lack of experience by the instructor in teaching the deaf students, especially in the e-Learning environment as they might not have enough training to deliver the materials via. the web. The combination of these findings provided some support for the researchers and practitioners to design and develop a new model with specific tools that encourage both the instructors of the deaf and deaf people.

CONCLUSION

This study explained a set of the existing e-Learning Models for the deaf and hearing impaired people in many of the case studies. The final conclusion of this study is that the current e-Learning Models for the hearing impaired and deaf people are very limited. The study analyzed the existing models, frameworks and made the comparison regarding methods used, findings, limitations and future work for the e-Learning systems for the hearing impaired and deaf people. The web-based education for the deaf and hearing impaired people has the highest overall rank according to the other studies related to the previous e-Learning models. Furthermore, we can conclude that people with hearing loss lack access to the e-Learning platforms, lack of education or are uneducated and are unlearned or semi-educated. According to this reason, deaf individuals face difficulties when accessing written information via the web. The e-Learning system with an enjoyable interface and specific tools could solve this problem and make teachers and students more motivated to access and use the technology.

ACKNOWLEDGEMENT

We would like to thank Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia for supporting this research.

REFERENCES

Abdelaziz, M.A., M. Alaa El Din and M.B. Senousy, 2014. Challenges and issues in building virtual reality-based E-learning system. Intl. J. E Educ. E. Bus Manage. Learn., 4: 320-328.

Ahmed, F., H. Zainuddin and S. Zahraa, 2016. Barriers of adopting E-learning in developing countries. J. Eng. Appl. Sci., 11: 2815-2820.

Alawamreh, A.R. and N.F. Elias, 2015. Examining the effectiveness of using web-based learning for gifted students: Jordan as case study. J. Theor. Appl. Inf. Technol., 76: 160-169.

Alzaghal, Q. and M. Mukhtar, 2017. Factors affecting the success of incubators and the moderating role of information and communication technologies. Intl. J. Adv. Sci. Eng. Inf. Technol., 7: 538-545.

Anonymous, 2017. Deafness and hearing loss. World Health Organization, Geneva, Switzerland. http://www.who.int/mediacentre/factsheets/fs300/en/

Berry, D.M., 2001. Requirements for maintaining web access for hearing-impaired individuals. Proceedings of the 3rd International Workshop on Web Site Evolution (WSE'01), November 10, 2001, IEEE, Florence, Italy, pp: 33-41.

Bottoni, P., A. Labella, D. Capuano, S. Levialdi and M. De Marsico, 2012. Experimenting DELE: A deaf-centered e-learning visual environment. Proceedings of the International Working Conference on Advanced Visual Interfaces, May 21-25, 2012, ACM, Capri Island, Italy, ISBN:978-1-4503-1287-5, pp: 780-781.

Bueno, F.J., J.R. Fernandez del Castillo, S. Garcia and R. Borrego, 2007. E-learning content adaptation for deaf students. Proceedings of the ACM SIGCSE Bulletin Vol. 39, June 25-27, 2007, ACM, Dundee, Scotland, ISBN:978-1-59593-610-3, pp: 271-275.

Chowdhuri, D., N. Parel and A. Maity, 2012. Virtual classroom for deaf people. Proceedings of the IEEE International Conference on Engineering Education Innovative Practices and Future Trends (AICERA'12), July 19-21, 2012, IEEE, Kottayam, India, ISBN:978-1-4673-2267-6, pp: 1-3.

Ditcharoen, N., K. Naruedomkul and N. Cercone, 2010. SignMT: An alternative language learning tool. Comput. Educ., 55: 118-130.

Drigas, A.S., D. Kouremenos, S. Kouremenos and J. Vrettaros, 2005. An E-learning system for the deaf people. Proceedings of the 6th International Conference on Information Technology Based Higher Education and Training (ITHET'05), July 9, 2005, IEEE, Santo Domingo, Dominican Republic, pp: T2C/17-T2C/21.

Drigas, A.S., J. Vrettaros, L. Stavrou and D. Kouremenos, 2004. E-Learning environment for deaf people in the E-commerce and new technologies sector. WSEAS. Trans. Inf. Sci. Appl., 1: 1189-1196.

El-Gayyar, M., H.F. El-Yamany, T. Gaber and A.E. Hassanien, 2013. Social network framework for deaf and blind people based on cloud computing. Proceedings of the 2013 Federated Conference on Computer Science and Information Systems (FedCSIS'13), September 8-11, 2013, IEEE, Krakow, Poland, ISBN:978-83-60810-52-1, pp: 1313-1319.

El-Gayyar, M.M., A.S. Ibrahim and M.E. Wahed, 2016. Translation from Arabic speech to Arabic sign language based on cloud computing. Egypt. Inf. J., 17: 295-303.

Ellis, J.T., D.L. Cogburn, M.P. Arnone and N.S. Levinson, 2015. Developing and evaluating an Accessible Cyberteaching Training (ACT) program for faculty via a virtual center for teaching and learning. Proceedings of the 48th Hawaii International Conference on System Sciences (HICSS'15), January 5-8, 2015, IEEE, Kauai, Hawaii, ISBN:978-1-4799-7367-5, pp: 53-62.

Fahad, A., Z. Hassan and Z. Salman, 2013. A study towards using e-Learning based information technology resources for the development of students thinking skills in higher education. Proceedings of the 4th International Conference on Intelligent Systems Modelling and Simulation (ISMS'13), January 29-31, 2013, IEEE, Bangkok, Thailand, ISBN:978-1-4673-5653-4, pp: 331-334.

Haualand, H. and C. Allen, 2009. Deaf People and Human Rights. World Federation of the Deaf, Helsinki, Finland, ISBN:978-952-9648-17-7, Pages: 71.

Kadhum, A.M. and M.K. Hasan, 2017. Assessing the determinants of cloud computing services for utilizing health information systems: A case study. Intl. J. Adv. Sci. Eng. Inf. Technol., 7: 503-510.

Khwaldeh, S. and M. Shah, 2010. The adaptability of an open source learning management system for deaf children in Jordan. Proceedings of the 2nd IEEE International Conference on Information Management and Engineering (ICIME'10), April 16-18, 2010, IEEE, Chengdu, China, ISBN:978-1-4244-5263-7, pp: 34-39.

Kozuh, I., M. Hintermair, M. Ivanisin and M. Debevc, 2014. The concept of examining the experiences of deaf and hard of hearing online users. Procedia Comput. Sci., 27: 148-157.

Lan, W., X. Jiacheng and Q. Xueli, 2009. Exploration of Moodle-based collaborative learning for the deaf. Proceedings of the International Conference on Forum on Computer Science-Technology and Applications (IFCSTA'09) Vol. 2, December 25-27, 2009, IEEE, Chongqing, China, ISBN:978-1-4244-5422-8, pp: 145-147.

Martins, P., H. Rodrigues, T. Rocha, M. Francisco and L. Morgado, 2015. Accessible options for deaf people in E-learning platforms: Technology solutions for sign language translation. Procedia Comput. Sci., 67: 263-272.

Nasr, M.M., 2010. An enhanced E-learning environment for Deaf/HOH pupils. Proceedings of the 2nd International Conference on Computer Technology and Development (ICCTD'10), November 2-4, 2010, IEEE, Cairo, Egypt, ISBN:978-1-4244-8844-5, pp: 724-727.

Qiang, L. and M. Ming, 2009. An evaluation model of web-based distance education for the deaf undergraduate. Proceedings of the International Symposium on Intelligent Ubiquitous Computing and Education, May 15-16, 2009, IEEE, Chengdu, China, ISBN:978-0-7695-3619-4, pp: 254-257.

Ryan, R.M. and E.L. Deci, 2000. Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemp. Educ. Psychol., 25: 54-67.

Safie, N. and S. Aljunid, 2013. E-learning initiative capacity building for healthcare workforce of developing countries. J. Comput. Sci., 9: 583-591.

Shirali-Shahreza, M. and S. Shirali-Shahreza, 2008. Encouraging persons with hearing problem to learn sign language by internet websites. CEUR. Workshop Proc., 345: 40-43.

Soud, E.M.A., A.E. Hassan, M.S. Kandil and S.M. Shohieb, 2010. A proposed web based framework E-learning and dictionary system for deaf Arab students. Intl. J. Electr. Comput. Sci., 10: 56-68.

Wilson, S.M. and L.C. Peterson, 2002. The anthropology of online communities. Ann. Rev. Anthropol., 31: 449-467.

Yeratziotis, G. and V.D. Greunen, 2013. Making ICT accessible for the deaf. Proceedings of the IST-Africa Conference and Exhibition on IST-Africa, May 29-31, 2013, IEEE, Port Elizabeth, South Africa, ISBN:978-1-905824-38-0, pp: 1-9.