Journal of Engineering and Applied Sciences 14 (Special Issue 5): 9095-9100, 2019
ISSN: 1816-949X

Information Accessibility Strategies for Supporting User Experience of Hearing-Impaired Learners

[1]Ariffin Abdul Mutalib, [1]Sobihatun Nur Abdul Salam, [1]Mazida Ahmad,
[1]Massudi Mahmuddin and [2]Sharifah Nadia Syed Yahaya
[1]School of Multimedia Technology and Communication, Universiti Utara Malaysia,
06010 Sintok, Kedah, Malaysia
[2]Politeknik Tuanku Syed Shiratuddin, Pauh, Perlis, Malaysia

Abstract: This study reports an ongoing project that determines the information accessibility in electronic learning Contents (e-Contents) among Hearing-Impaired (HI) learners. In current situation, the HI learners struggle dealing with e-Contents because they are not specifically designed for them or designed for them but with little regards on information accessibility. Hence, this study aims at addressing the information accessibility for that. Elicitation from literatures interview and observation have been carried out in gathering requirements and data. Then, prototypes were developed. Further, they were tested with real users. Findings show that the proposed concept, through the prototypes are experienced positively by the real users.

Key words: Hearing-impaired information, accessibility, usability, e-Contents, prototypes, learners

INTRODUCTION

Many study are on infrastructure such as hand gloves (Rajam and Balakrishnan, 2011; Ghotkar and Kharate, 2014; Pandey and Jain, 2015) which is regarded as an expensive and non-usable by many hearing-impaired people. Besides that studies are also focused on e-Learning for deaf people (Villani, 2007; Cuhadar *et al*., 2009; Ameiri *et al*., 2012). However, certain dimensions including accessibility have not been deeply studied (Yeratziotis and Greunen, 2013). Also, studies on fun among the hearing-impaired is too shallow and there has been no model for it (Coursaris and Kim, 2011; Weaver and Starner, 2011). It is a loophole because it very important (Korte *et al*., 2012; Zhou *et al*., 2012).

While the technology gets advanced, researchers design mobile applications for the hearing-impaired (Cuhadar *et al*., 2009; Ameiri *et al*., 2012; Zhou *et al*., 2012). In the mobile applications which mostly adapted the models by Nielsen *et al*. (2002), media technology was found very important for the hearing-impaired. It is true because now sign language is possible to be incorporated in e-Contents (Weaver and Starner, 2011; Osaimi *et al*., 2009; Wheatley and Pabsch, 2010). Although, technology assists, too advanced application such as 3D Avatar and virtual reality are not usable (Villani, 2007; Lin *et al*., 2010). So, the technology should be accommodating the ability of the hearing-impaired people in accessing information (Kelly *et al*., 2004; Bandeira *et al*., 2010; Hassan, 2011). They view this as very important in supporting usability (Coursaris and Kim, 2011; Ariffin *et al*., 2014).

In current situation with the issues discussed in the previous paragraphs it is clear that the hearing-impaired learners have been struggling with e-Content. While usability is its issue information accessibility is a major part that this study looks into. Hence, this study aims at discussing an ongoing initiative in bridging it. Following this study is a description on the methods this study has gone through. Then, the results and findings are addressed, before it is followed with a discussion. Then, everything is concluded.

MATERIALS AND METHODS

This study has gone through the stages of works illustrated in Fig. 1. It involves conceptual development, prototypes development and user testing. Techniques for gathering data include elicitation of works in the literatures interview and observation. In the beginning, having the problem and requirement determined, the appropriate concept of a learning material for the HI learners as illustrated in Fig. 2 was obtained. Then, the first prototype (Fig. 3) was developed and confirmed the concept. Next, the second prototype (Fig. 4) was designed and developed. Later, the third prototype

Corresponding Author: Ariffin Abdul Mutalib, School of Multimedia Technology and Communication, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia

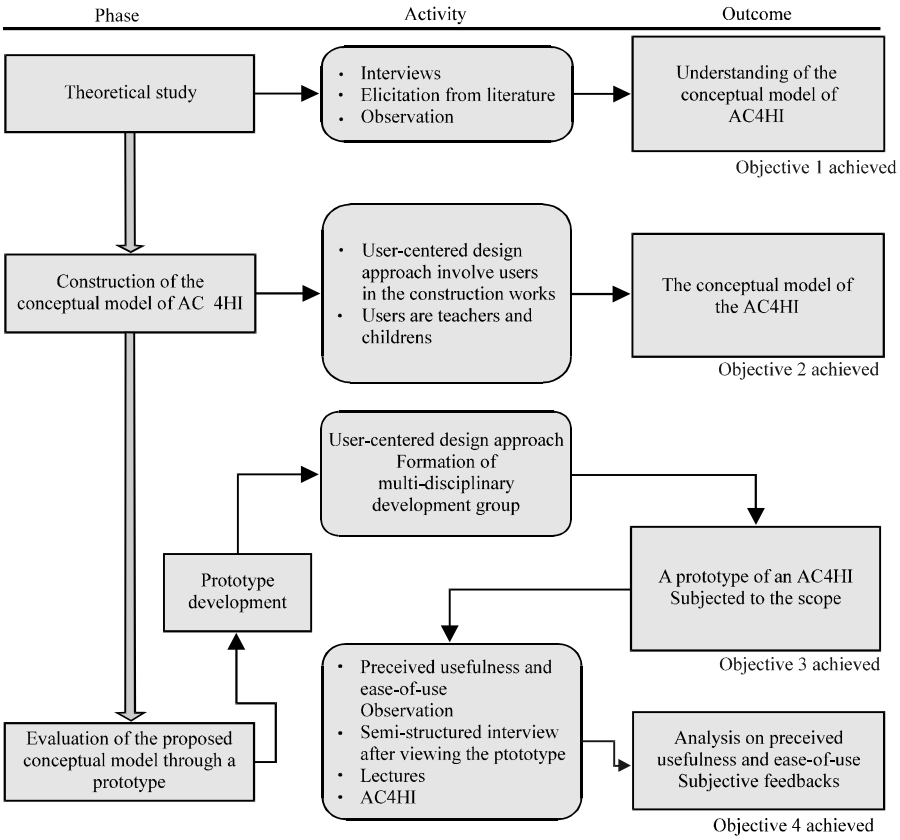

Fig. 1: Research methodology

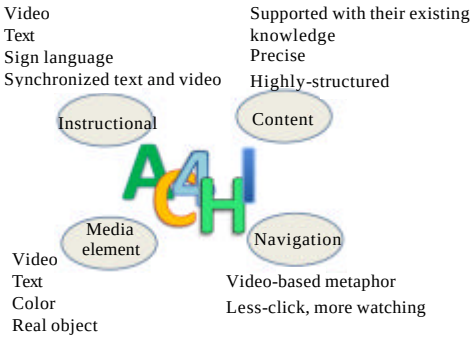

Fig. 2: The concept for e-Content for hearing-impaired

(exhibited in Fig. 5) was developed. All prototypes were developed using User-Centered Design (UCD) approach. This means real users involved directly in all stages, obviously requirement analysis, designing and developing. Eventually, they also involved in the user testing. Through, their involvement, this study manages to gather very convincing results of every stage (as inputs for the next stage). As they involve from the beginning, this study managed to develop a good relationship with them. As a result such relationship

Fig. 3: First prototype-KOSPIT

Fig. 4: Second prototype AV4HI

Fig. 5: Third prototype AC4HI

demolishes any possible biasness caused by negative feelings between this study and the HI learners. For this study it is part of the very convincing factor contributing to clear inputs. With that, all processes took place very smoothly. The content in KOSPIT is different than those in AV4HI and AC4HI. This is because the AC4HI was developed later, to study HI learner's experience between assistive video and assistive courseware. Hence, to avoid any bias caused by the content, they remained identical. Every prototype has been tested with users. In user tests, data were collected through observation interview and questionnaire. This study managed to gather data from the same HI learners and their teachers who involved in the requirements gathering, designing and developing phases. Accordingly, this study discovers some interesting findings. While findings from quantitative techniques are too lengthy, this study discusses findings from observation and interview as it serves the aim of study nicely.

RESULTS AND DISCUSSION

This study discusses the information accessibility aspect. The four dimensions in the concept are very much contributing to the ability of HI learners to access information in e-Contents. The prototypes developed in this study are designed with special approach to cater the needs of HI people. It is very important because without that, they will not be able to appreciate it (Preece *et al*., 2016; Schneiderman, 1998). They incorporate the concept illustrated in Fig. 2. As a result, they are happy when interacting with the prototypes. From KOSPIT to AV4HI-AC4HI, the HI people are sure of how to interact with them respectively in which they learn very quickly and memorize what they have learned deeply. Without any doubt, they feel safe while interacting with the prototypes. This is because the prototypes give feedback very swiftly upon their actions. For them, the prototypes are very efficient in doing their effective jobs in explaining them about the subject matter. Between video metaphor and courseware metaphor, they do not prefer one over the other. However, courseware has an added value because it contains notes. If video could contain video too, they both similarly efficient in that sense (Table 1 and 2; Fig. 6). This is like so because all the developed prototypes incorporate sign language in delivering the contents. As mentioned by Osaimi *et al*.

Table 1: Elements in the prototypes

Element instructional	Description
Text	Text are minimized with short sentences in easy language, andsynchronized with the video and sign language
Video	Are incorporated with sign language
Sign language	Are located at the easiest point to see, together with the video
Synchronization of text and video	Video and text appear together. Text appear word by word parallel with the video and sign language
Content	
Support of existing knowledge	The content is provided based on the knowledge that the users already have. The use of terminologies is critically considered for user's understanding
Precise	The content is precise, straight to the point this applies to the whole display, including the background, the text, the video, and the sign language
Highly structured	Besides precise, the contents are highly structured. The flow of the content is made easy, straight-forward and standardized
Navigation	
Video-based	The HI people work slowly on clicking mouse, hence, they prefer to click less. Accordingly, the interaction requires minimal clicks
Less click, more watching	That does not mean that they do not want to click the mouse at all but they prefer to minimize their physical and cognitive efforts while watching the contents
Media element	
Video	The video in delivering the contents are made clear
Text	Are obvious between background and foreground
Color	Plain green and blue are used as the background to support their motivation. Not many colors on one display and they are standardized
Real objects	The video demonstrate real objects

Table 2: Information accessibility

Dimension	Findings
Instructional	The HI learners were found happy with the synchronization between text and video. The sign language enables HI learners absorb contents easily. Throughout the user testing, they were observed engaged with the prototypes deeply in which every one of them was nodding, jotting and such the like while interacting the prototypes
Content	The HI learners absorb the contents easily when it is chunked into small pieces in a highly-structured representation Text alone is not enough but pictures help a lot. This was seen through the AC4HI. The language which is very straight forward accelerate their content access
Media element	HI people read slowly, hence, information is represented in visual form. Pictures of real objects are extensively used Processes are visualized in video form. This supports their learning tremendously
Navigation	Between video-based and less-click interaction, the HI people mind nothing. But, too much mouse-click distracts them

Fig. 6: Sign language interpreter

(2009), Wheatley and Pabsch (2010), Weaver and Starner (2011) HI people prefer sign language to learn things. This has also been proven by Mutalib *et al.* (2012) and Amilah *et al.* (2011). Fundamentally, the concept proposed in this study has been proven able to change the experience of learning among the HI people. However, this study believes that it could still be made better as experienced by normal people. One of the opportunities for that is providing some personal customization, so that, the HI people could have a design that aesthetically follow their preferences. Hence, future studies could also look into that.

CONCLUSION

While this study is carried out to determine the information accessibility for e-Contents for HI learners it has achieved what it should. The same people involved in this study from the beginning to the end (from requirement analysis through the user test). Throughout, the process, the changes in the subject's behavior was significant. Basically, they were not able to co-operate with this study well because of the physical barrier. Obviously, they were not confident to work with this study because they are deaf, thinking that communication is complicated. However, after a series of meetings with help of sign language interpreter such feeling was successfully moderated. Then, they slowly get the confidence and all tasks were carried out very smoothly.

The engagement of the same subjects throughout the study also ensures confidence in the gathered data. In future, the discovered concept would be further refined, to further analyze the HI learner's requirement for virtual

learning environment. It is necessary because we realize that now learning is moving into digital environment. Accordingly the HI learners should be prepared to face that.

ACKNOWLEDGEMENT

This study was funded by Universiti Utara Malaysia through its High-Impact Group Research. Appreciations to Universiti Utara Malaysia.

REFERENCES

Ameiri, F.A., M.J. Zemerly and A.M. Marzouqi, 2012. M-learning and chatting using indexed Arabic sign language. Intl. J. Inf., 5: 575-582.

Amilah, S.Z., A. Nurulnadwan, A.M. Ariffin and J.M. Saifullizam, 2011. Assistive courseware for hearing-impaired learners in Malaysia based on theory of Multiple Intelligence (MI). Intl. J. Comput. Sci. Emerging Technol., 2: 370-377.

Ariffin, A.M., S.S. Nadia, A.S. Nur, A. Mazida and M. Massudi, 2014. Assistive contents for hearing-impaired people. Proceedings of the Conference on Knowledge Management International Conference, August 12-15, 2014, Universiti Utara Malaysia, Johor Bahru, Malaysia, pp: 885-888.

Bandeira, R., R. Lopes and L. Carrico, 2010. Towards mobile Web accessibility evaluation. Appl. FOSS. AMA. Colocated ETAPS., 1: 27-28.

Coursaris, C.K. and D.J. Kim, 2011. A meta-analytical review of empirical mobile usability studies. J. Usability Stud., 6: 117-171.

Cuhadar, C., H.F. Odabasy and A. Kuzu, 2009. M-learning for hearing impaired learners: Dimensions of evaluation. Intl. J. Educ. Inf. Technol., 3: 179-186.

Ghotkar, A.S. and G.K. Kharate, 2014. Study of vision based hand gesture recognition using Indian sign language. Intl. J. Smart Sens. Intell. Syst., 7: 96-115.

Hassan, R.S., 2011. Mobile communication for people with disabilities: A case study on iPhone technology usage for deaf and mute Qatari adults. Intl. Congress Commun., 5: 587-596.

Kelly, B., L. Phipps and E. Swift, 2004. Developing a holistic approach for E-learning accessibility. Can. J. Learn. Technol., Vol. 30,

Korte, J., L.E. Potter and S. Nielsen, 2012. Designing a mobile video game to help young deaf children learn Auslan. Proceedings of the 26th Annual BCS Interaction Specialist Group Conference on People and Computers, September 10-14, 2012, British Computer Society, Swindon, England, UK., pp: 345-350.

Lin, Y.C., J.J.Y. Leu, J.W. Huang and Y.M. Huang, 2010. Developing the mobile 3D agent sign language learning system. Proceedings of the 6th IEEE International Conference on Wireless, Mobile and Ubiquitous Technologies in Education (WMUTE), April 12-16, 2010, IEEE, Taiwan, ISBN:978-1-4244-6427-2, pp: 204-206.

Mutalib, A.A., S. Yahya, S. Nadia, A. Salam and S. Nur, 2012. Learning object for the hearing-impaired: Design and development of Koswer Pendidikan Islam Tunakerna (KOSPIT). Proceedings of International Conference on Knowledge Management International Conference (KMICe 2012), July 4-6, 2012, Universiti Utara Malaysia, Johor Bahru, Malaysia, pp: 248-252.

Nielsen, J., T. Clemmensen and C. Yssing, 2002. Getting access to what goes on in people's heads?: Reflections on the think-aloud technique. Proceedings of the 2nd Nordic Conference on Human-Computer Interaction, October 19-23, 2002, ACM, Aarhus, Denmark, ISBN:1-58113-616-1, pp: 101-110.

Osaimi, A.A., A.H. Fedaghi and A. Alsumait, 2009. User interface requirements for e-learning program designed for deaf children. Proceedings of the 1st Kuwait Conference on E-Services and E Systems, November 17-19, 2009, ACM, Kuwait, ISBN:978-1-60558-797-4, pp: 1-7.

Pandey, P. and V. Jain, 2015. Hand gesture recognition for sign language recognition: A review. Intl. J. Sci. Eng. Technol. Res., 4: 464-470.

Preece, J., Y. Rogers and H. Sharp, 2016. Interaction Design: Beyond Human-Computer Interaction. 4th Edn., John Wiley& Sons, England, UK.,.

Rajam, P.S. and G. Balakrishnan, 2011. Real time Indian sign language recognition system to aid deaf-dumb people. Proceedings of the IEEE 13th International Conference on Communication Technology (ICCT), September 25-28, 2011, IEEE, Trichy, India, ISBN:978-1-61284-306-3, pp: 737-742.

Schneiderman, B., 1998. Designing the User Interface: Strategies for Effective Human-Computer Interaction. 3rd Edn., Addison-Wesley, Reading, Massachusetts,.

Villani, N.A., 2007. A virtual learning environment for deaf children: Design and evaluation. Intl. J. Hum. Soc. Sci., 2: 123-128.

Weaver, K.A. and T. Starner, 2011. We need to communicate!: Helping hearing parents of deaf children learn American Sign Language. Proceedings of the 13th International ACM SIGACCESS Conference on Computers and Accessibility, October 24-26, 2011, ACM, Dundee, Scotland, UK, ISBN:978-1-4503-0920-2, pp: 91-98.

Wheatley, M. and A. Pabsch, 2010. Sign language legislation in the European Union. European Union of the Deaf, Brussels, Belgium.

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.

Zhou, Y., K.C. Sim, P. Tan and Y. Wang, 2012. MOGAT: Mobile games with auditory training for children with cochlear implants. Proceedings of the 20th ACM International Conference on Multimedia, October 29-November 02, 2012, ACM, Nara, Japan, ISBN:978-1-4503-1089-5, pp: 429-438.