Guidelines of Assistive Courseware (AC) for Hearing Impaired Students

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ABSTRACT

This paper defines the disabilities and technologies suitable for the disabled which is called assistive technology (AT). Two types of AT are hardware-based and software-based. In this paper, the software-based is focused, specifically in the form of courseware which is referred to as assistive courseware (AC). With concerns to develop an AC for hearing impaired people, proper characteristics should be followed. The aim of this paper is to initiate a study to propose characteristics for developing AC for hearing-impaired (HI) people. This paper starts with an introduction containing the problem statement, scope, and the objective of the paper, followed with reviews of related literature, and methodology utilized which are adapted from the waterfall methodology. The characteristics and the prototype is outlined next, followed with some observation results whish show that the characteristics can make the HI students learn with the AC happily. The final part concludes this paper.

Keywords
Hearing-impaired, assistive courseware, eLearning

1.0 INTRODUCTION

The increasing number of people with disabilities in Malaysia attracts the concerns of researchers to co-operate with the IT expertise to develop various technologies, hoping that these technologies can assist the population in carrying out their tasks in everyday life. This type of technology is known as Assistive Technology (AT). Unluckily, most of the ATs available in the market are very expensive, whereby disabled people have to a big amount of money to afford for the AT. It is also observable that the availability of AT in Malaysia for this population is still lacking. AT can be designed in terms of hardware (such as a wheelchair) and software (such as courseware). This paper discusses on designing a software-based AT, particularly on the design of the interface for Assistive Courseware (AC) for education. The development will be tailored for HI people. In designing the interface of AC, guidelines are needed to ensure users' requirements are adapted in the AC. It is a hope that the guidelines help developers in developing the AC and that the AC can help HI students in their learning process.

Rooney et al., (1994), found that there is strong interest from teachers of the deaf people to teach with technology aids and more research is needed on the interface design. Murniwati (2007) identified that hearing impairment can occur in the outer, middle, or inner ear along the pathway to the brain. Table 1 lists and classifies the degrees of hearing loss in dB (Decibel). This study considers all hearing loss types.

Table 1: Hearing loss according to dB range

Degree of hearing loss	dB range
Normal Hearing	0-20dB
Mild Hearing Loss	20-40 dB
Moderate Hearing Loss	40-65 dB
Severe Hearing Loss	65-90dB
Profound Hearing Loss	95 and up dB

Meanwhile, the Ministry of Education's policies of "Democratization of Education" and the international policy of "Education for All" acknowledges the rights of children with disabilities to quality education comparable to mainstream students (APCD, 2009). The purpose of AT is to help compensate for a disability or to provide accessibility to information and services and to improve quality of life of the disabled. According to Liffick (2003), law and regulation such as the Americans with Disabilities Act of 1990 place significant requirements on employers, educators, and industry to provide reasonable accommodations to assist the disabled.

So towards a brighter future, equipping persons with disabilities through education and life skills training can help them improve their quality of life. Education and training are often regarded as an important tool to prepare every individual for better work prospects and a brighter future. It becomes even more imperative in the case of persons with

disabilities as education and training help to open doors to more life-long opportunities.

According to Cooper (1995) AT can be defined as any device that assists a person with any impairment or disabilities in performing a task. Dawe (2006) agreed with Cooper and defined AT as technological devices or software that are designed to assist people with disabilities. AT includes wheelchairs, hearing aids, and screen readers for the blind and special educational software for people with learning disabilities.

As mentioned in Hearing Impairments Module (1999), being hard of hearing or deaf should be considered as impairment rather than a handicap. It becomes a handicap only if the living environment doesn't deal with the impairment. Hearing impaired person is a person who has diminished or defective sense of hearing or completely deaf (Murniwati, 2007).

Jintavee (2008) emphasizes that the implication of developing the pedagogical-based courseware design, guidelines for how to design multimedia courseware learning environments plays vital role to the effectiveness of courseware development. In addition, UNDP (2008) clarifies that *g*uidelines are the minimum standards used for references in design, development, and delivery. In courseware development, the guidelines can be categorized into courseware development benchmarks, teaching/learning process benchmarks, and course structure benchmarks. Kurniawan et al., (2005) concluded that guidelines is any statement ensuring some adequacy of a particular user interface of a software with respect to a particular context of use where a given user population has to fulfill interactive tasks with a given system.

1.2 Problem Statement

Department of Social Welfare in Malaysia (2009) reported that registered HI people with the agency are approximately 21,981 as of June 2002. It increased to 31,715 in 2007 (see Table 2).

Table 2 : Registered disabled people according to types of disability, 2002-2007

Types of Disability	**Year**					
	2002	**2003**	**2004**	**2005**	**2006**	**2007**
Visual Impairment	14,738	14,154	15,364	16,211	18,258	20,039
Hearing Impairment	**21,981**	**22,728**	**24,712**	**26,470**	**29,522**	**31,715**
Physical Impairment	41,311	45,356	51,090	58,371	66,250	73,559
Mental*	43,042	49,340				
Learning Problem			57,483	66,906	76,619	85,812
Cerebral Palsy			34	623	887	1,787
Other	1,017	1,077	1,934	4,335	5,983	7,338
TOTAL	122,089	132,655	150,617	172,916	197,519	220,250

* Mental Impairment terminated, separated into 2 categories: Learning Problem Disability or Cerebral Palsy

According to the facts in Table 2, it is deduced that the number of VI people in Malaysia is increasing as the country's population increases and they are not well-support. In education the disabled are neglected compared with normal students in accessing knowledge and information. Nowadays, ATs are available in the market for the HI includes Speech Recognition and SeeBeep (error screen flash notification), but they are expensive**.** Furthermore, most developers and experts put very little concern on the interface of the AT. Despite, usable interface can help the HI people a lot in accessing the information and services independently. Brown (1992) mentioned that the visually oriented nature of a computer display can dramatically reduce the impact of auditory disabilities. This also helps students to access knowledge in their learning process (Wald, 2002). Lack of courseware for HI persons in Malaysia caused a gap between normal students with HI students.

1.3 Objective

The main aim of this study is to propose guidelines for AC for HI students. In achieving this aim, the following objectives are planned:

i. To identify positive and negative interface characteristics of AC.
ii. To develop prototype of AC for HI students.
iii. To observe HI students' experience using the prototype.

For the purpose of this paper, the test was carried out with HI students of Sekolah Menengah Kebangsaan Tasek Damai in Ipoh, Perak. The results will be convincing because in terms of characteristics, the HI people are homogeneous. Content of the prototype was discussed with the teachers.

Lefevre (1999), commend that there are a number of PC-based software and courseware for HI students already on the market, but they have major problems including their cost, their unreliability in some cases, and the need for constant supervision

by a therapist. These factors can mean that the system do not get used as often as required or enough to justify the expense of purchase.

Shaw et al., (1996) stated that by using multimedia technology, it is possible to amplify the efforts of the teachers and students for improving the quality of speech. Research shows a multimedia visualization system that augments the limited hearing capabilities of HI persons using visual and tactile feedback approaches and provides alternate representations of sound for increasing speech capabilities and reduced learning time. Dawe (2006) agreed with Phantachat and Parnes (2007) whereby a high percentage of assistive technology devices (35% or more) are purchased, but not successfully adopted.

3.0 METHODOLOGY

To achieve the listed objectives, there are three phases involved in this study which are adapted from Waterfall Methodology (Jayaratna, 1994); Phase one is User Requirement, next, Prototype Development phase, and finally the Testing and Evaluation phase as depicted in Figure 1.

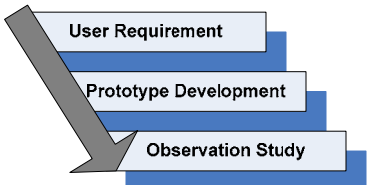

***Figure 1**: Research methodology*

3.1 Phase 1 : Users Requirement

Two activities will involve in phase 1 of the study as outlined in Figure 2. It starts with document study which includes article in journals, conference proceedings, and books. Other reliable sources for current initiatives on AC are reports of government and non-government agencies. Besides that, interviews were also carried out, to gather relevant information from the real subjects of study.

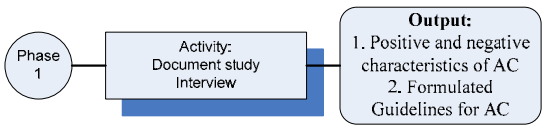

***Figure 2:** Activities of Phase 1*

3.1.1 Document Study

This activity will be carried out to study current problems occurred among hearing impaired people in terms of their learning process. This will include the AC and the AC guidelines available in the market. Besides, this study will also investigate whether the AC for hearing impaired people are affordable.

3.1.2 Interview

Interview is one of the famous techniques used in collecting information about users' requirements (Preece, Rogers, & Sharp, 2007). In this study, this technique was with the HI students of Sekolah Kanak-kanak Khas in Ipoh and their teachers. Data regarding positive and negative characteristics of AC for HI students are the output. Then, the characteristics were based-on to formulate and propose guidelines for AC. It was accomplished through analyzing the content obtained from both activities.

3.2 Phase 2 : Prototype Development Phase

Guidelines obtained in Phase 1 were applied into a prototype (Figure 3). The prototype development was based on a methodology which was developed suitable for small scaled courseware named IntView which has been tested and found that it improves courseware quality (Grũtzner, Angkasaputra, & Pfahl, 2002; Grũtzner, Pfahl, & Ruhe, 2002; Grũtzner, Weibelzhal, & Waterson, 2004).

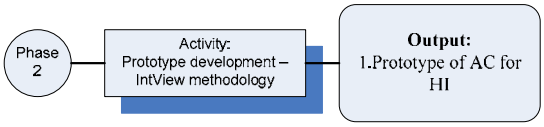

***Figure 3:** Activities of Phase 2.*

Figure 4 illustrates the steps involved in the adapted IntView which are divided into pre-development phase and development phase. In addition, detailed activities and expected output of the steps are provided in Table 3.

Table 3: Activity and output of steps in adapted IntView

Stage	Activity / Output
1	HI students' learning profile including their special needs for on-screen elements.
2	• The interface must be suiting the HI. • Skills in composing courseware (intermediate fidelity prototype).
3	As stated by the teachers.
4	Must meet the requirements in the course objectives.
5	Less audio cue, more visual cue.
6	Learners use the AC with their teachers in classroom.
7	• Interactivity between user and AC is required. • Tool-tip texts are used when necessary.
8	Hybrid navigation style among modules. Within modules are linear navigational to support next-and-next task sequences. The storyboard will be outlined at this stage.
9	There is no special component. The details of

	the instructional and navigational structures are used to determine the components required. The development activities could begin at this stage.
10	Some templates are drafted, and the most desired is obtained here.
11	**The development phase begins here.** The contents of the courseware are determined as the modules. All detailed information for activities in pre-development phase was used as the pre-requisites in this stage.
12	Each module is presented in an exclusive page. If the information to deliver is not enough, then sub-pages are used.
13	Text, picture, graphic, and other media elements were composed.
14	The pages were developed. All details in the activities previously were considered.
15	The pages were arranged as intended, as designed in the storyboard. All navigational elements were made working.
16	This study adapts testing procedure to ensure the courseware quality from the work of Grũtzner et al. (2004).
17	The courseware is not publicized, used only for this study.

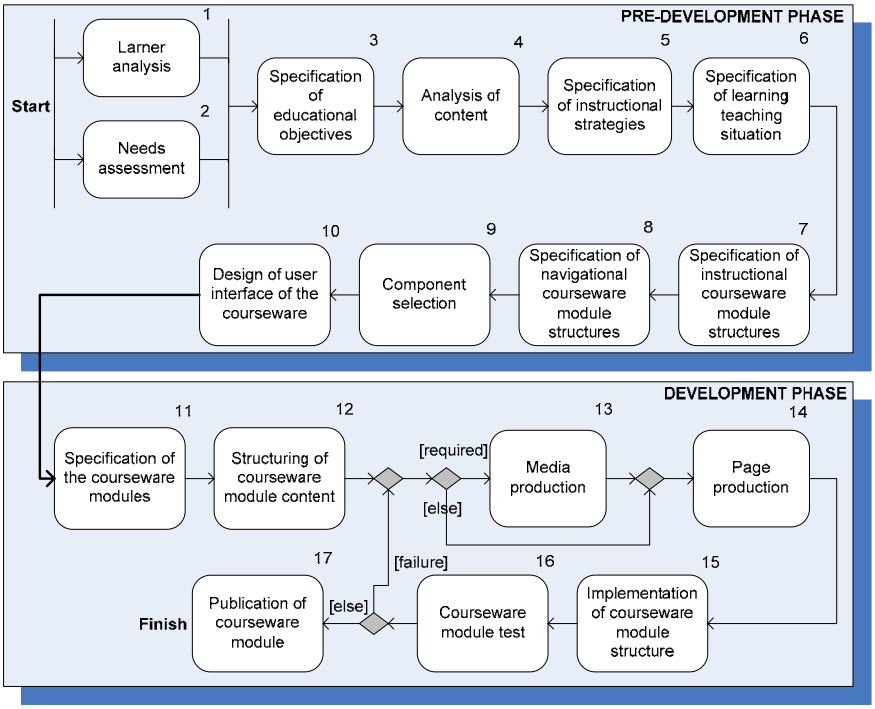

Figure 4: Courseware development methodology

4.0 CHARACTERISTICS OF AC FOR HI

Characteristics of HI which were gathered through document study and interview as discussed in Section 3 are listed in Table 4.

Table 4: Characteristics of AC for HI

Characteristics	Good	Bad
Concept	Graphical information.	Full with text.
Colors	Bright and contrast colors.	Dull.
Placing	Interactive, motivating, use of captions.	No feedback over user action.
Labels and Naming	Identical, include objective, title, and	Use of different labels
	heading for each page and topic.	for similar purpose.
Navigation	Linear: Button, icon menu and link – flashy, three dimensional shading for the buttons.	Complex, using hypertext in non-standard locations.
Language	Native language, Simple, clear, concise, and unbiased.	English language Bombastic language.
Flow of Content	Simple structure.	Complicated with multiple flow and non-linear.

The characteristics in Table 4 are utilized in the prototype. Figures 5, 6, and 7 depict snapshots of the prototype.

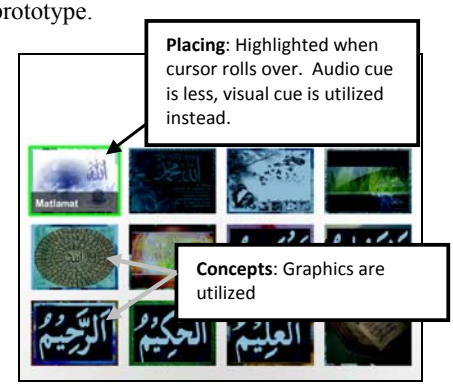

Figure 5: List of available modules

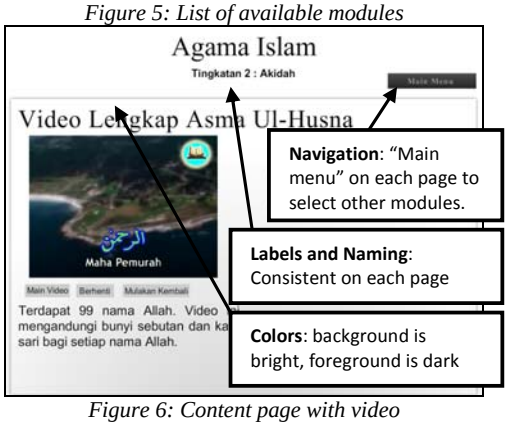

Figure 6: Content page with video

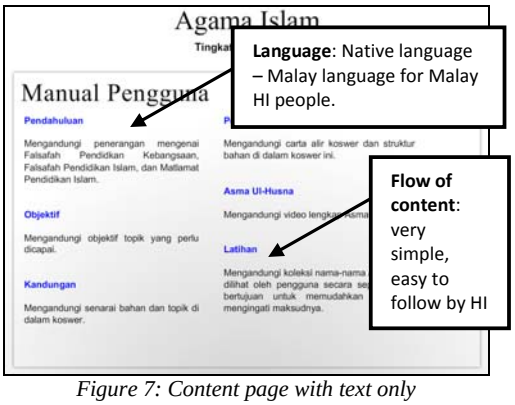

Figure 7: Content page with text only

5.0 OBSERVATION RESULTS

The observation study was carried out to analyze how HI students learn with the AC. This study hypothesized that if the HI students enjoy the AC; that means the characteristics of AC for the HI are workable.

During the observation, it was found that all students were enjoyed learning with the prototype. They actively navigated the prototype, discussing about the contents, exchanging ideas, laughing, and chatting. From the observation, it was found that the characteristics applied in the prototype help the HI learners to learn enjoyably suiting with their needs.

In addition, all characteristics are affecting the HI learners. However, the most affecting characteristics are concept, navigation, language, and flow of content. This is because they are disabled people, which can be easily discouraged by silly influence. Moreover, computer applications are new the HI learners.

6.0 CONCLUSION

At the end of the research, it is hoped that the proposed characteristics for AC can help developers in developing AC for HI students and this AC can bridge the 'access gap' between normal students and the HI in learning process. AC for the HI must be very simple, less audio cue to maximize the visual cue, and use contrast colors. Besides, the navigation must be as simple as possible, assuming the HI as novice users, in which linear navigation is the best. As courseware for normal people, labeling for each page is important. Native language should be used in the AC for the HI, so that the learners can easily grasp the content. Empirical data is important to support the implementation of AC for the HI. This will be the next step of this study.

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