Development of DAISY-WIBORD as computer assisted learning facilities for children with visual impairment

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Abstract. The objective of research aimed to 1) developing of DAISY-WIBORD audio books program on Text-to-Speech Synthesis Technology: TTS for visually impaired students 2) comparing the learning outcomes between the DAISY-WIBORD audio book program and normal method of social studies subject for visually impaired students Grade 4 of the Bangkok Blind School 3) studying the satisfaction of visually impaired students Grade 4 of the Bangkok Blind School to use DAISY-WIBORD audio books. The participants were separated 2 classrooms of 30thenth genders in each group consisted of 15 students from Bangkok Blind School grade 4. The students were randomly assigned to a classroom as a control group and experimental group. The students were randomly assigned to a classroom as a control group and experimental group. The research instruments are 1) quality evaluation DAISY-WIBORD audio books program 2) the learning achievement 3) student's questionnaire satisfaction with DAISY-WIBORD audio books program. Statistics in this research used statistics for data analysis consisted of average value, Standard Deviation (S.D.), and t-test dependent. The result reveals that the development of TTS on DAISY-WIBORD audio books for the visually impaired is divided into 5 modules. The examination of the developed DAISY-WIBORD audio books was conducted by the researcher following the procedures with the test result. 1) The finding test of reading errors indicated that an average is 97.47% has the accuracy of reading Thai words from testing three times, on other sides 2.53% of the errors were caused by misprints and abbreviations. Moreover, the test of reading errors revealed that an average of 97.55% has accuracy of reading English words from testing three times and approximately 2.45% of the errors were caused by misprints. 2) Audio book creating speed tests displayed that the average time is approximately 1.50 milliseconds in Thai words and approximately 1.43 milliseconds in English words. 3) The comparing test of domestic and foreign audiobooks with DAISY-WIBORD audio book program showed that the program has used foreign synthesis technology, the sound created by the computer has many TTS sounds that is a new technology with a more natural and clear tone, keeping in html format as easily to find any part of a book, searching for particular words, and using with all versions of Windows. The comparing between the DAISY-WIBORD audio book program and normal method of social studies subject for visually impaired students Grade 4 of the Bangkok Blind School found that mean score of control group students had 16.67 and the experimental group had 16.53 which were not statistically significant at the 0.05 level. Studying the satisfaction of visually impaired students Grade 4 of the Bangkok Blind School to use DAISY-WIBORD audio books revealed that social studies subject: learning group was the high level, furthermore students had the highest level of satisfaction with learning content from the DAISY-WIBORD audio books with convenience, there are a variety of sounds to choose for lessons, and more understanding of content respectively.

Keyword: audio books   visually impaired students   DAISY-WIBORD
1. Introduction

Computer assisted learning (CAL) provides facilities in learning and teaching because it allows teachers to provide any learning content, time and environment [1][2][3][4][5][6]. The CAL can provide a greater range and more up-to-date learning materials for various kinds of students’ abilities. The literatures suggested that CAL facilities have been created for different educational needs and environments in various types and levels. CAL, therefore, was recognized as more powerful innovations for helping people learning with computer interaction and knowledge transfer [7][8]. It also supports advantages of learning for learners with different backgrounds, cognitive levels and learning capabilities [8]. However, there are some difficulties of children with visual impairment in using CAL. The CAL facilities need to be provided friendly for visually impaired children [9][10].

Visually impaired people lacking the senses need to develop other sensory skills instead of visual perception. On the other hands, listening and touching are important perceptions to gain more news and learn more information from publications Books or textbooks that stand for visual senses that their unable to access these media due to lacking senses in this field. Therefore, accessing to certain types of media so as textbook, fiction, newspapers, magazines, and journals which is quite difficult for the visually impaired. That is the barrier to access the information and knowledge to them which is different ways from normal people or other disabilities [11] format of learning for the visually impaired was designed from listening to the news more than other methods. From the study, the condition and the requirements for using educational media of the visually impaired students in Bangkok and perimeter schools found that visually impaired students want to use Braille books in their curriculum and formal education, and use audio books to review after school. Audiobooks are an important and necessary option to help the visually impaired to access the information needed as well as a source of news, information, knowledge, entertainment, and edification also facilitating media. Nowadays, an advances telecommunication and electronic technology allow the visual impairment to access information such as Computers for the visually impaired, Screen reader, Electronic books, and Daisy system book as devices help reduce obstacles and increase the potential for the visual impairment able to access information.

The production of audiobooks requires volunteers to read within the scope of knowledge, capabilities, and equipment that lead to the different quality audiobooks and the evaluation of audiobooks donated to the library.

The donating audiobooks were useful for courses with a lecture class but unsuitable for mathematics. Moreover, there are detailed descriptions as images and accompanied by audio to create students’ interesting. It can be seen that the improving uneven tone of the voice weight - lightweight should be read the page number so that students are able to choose the role to listen or continue the subject as well as should describe the accompanying pictures and should read the numbers of all illustrations [12]. In addition, There are also many problems in the production process of audiobooks which Pongsawat [13] has studied the application of the audiobooks process for the visually impaired. The study reported the problems in the development of audiobooks are (1) the audiobook application has unclear sound quality and ineffective to listen (2) the content is not complete because the composition has more long content lead to the production process of audiobooks spend a long production time (3) the application does not support the visually impaired that has complex commands through sensory. The above limitations are causing delay in audio media production process. The educational institutions cannot produce information resources for the visually impaired thoroughly.

Digital accessible information system (DAISY) is a technical standard for digital audiobooks, periodicals, and computerized text. DAISY is designed to be audio for print material in order to use by person with print disabilities including blindness, impaired vision, and dyslexia. DAISY multimedia can be a book, magazine, newspaper, journal, computerized text, or a synchronized presentation of text and audio. It offers six embedded "navigation levels" for content, including embedded objects such as images, graphics, and MathML [14]. DAISY marks an important progression in the creation of talking books for people who are blind or have a print disability. The standard and the new technology
offer a better reading capability and have the possible to get several more books to the ears and fingertips of the blind [15].

The researcher interested in developing the program to solve the above problems by developing DAISY audio book program or audio book program without a reader for the visually impaired students. Because of supporting technology of without book reader for the developing DAISY audio book program, this computer assisted learning facilities for children with visual impairment could be called DAISY-WIBORD audio books. Consequently, the audio book program is developed can support Thai and English version for the visually impaired students, the aged as well as people who have reading problems also have access to educational opportunities and enhance learning potential for increase learning resources with a suitable program needed. The audio book program was developed be able to apply with children in many sakes for instance of spelling Thai and foreign languages for greater convenience in learning.

2. Objectives

1) The development of DAISY-WIBORD audio books for the visually impaired students by Text-to-Speech Synthesis Technology: TTS on DAISY-WIBORD audio books
2) The comparing between the DAISY-WIBORD audio book program and normal method of social studies subject for visually impaired students Grade 4 of the Bangkok Blind School
3) Studying the satisfaction of visually impaired students Grade 4 of the Bangkok Blind School to use DAISY-WIBORD audio books

3. Methodology

This research is divided into 2 phases as follows:

Phase 1: The study of the requirements for use audiobooks that was designed and developed from DAISY-WIBORD audio books for the visually impaired by the speech synthesis technology (Text-to-Speech Synthesis Technology: TTS).

Phase 2: The comparing of learning outcomes of social studies subject for the visually impaired students Grade 4, Bangkok Blind School by using the DAISY-WIBORD audio book program and learning activity by normal method. This research is an experimental research method. The data analysis was compared learning outcomes between the experimental group by the DAISY-WIBORD audio book program and the groups that were taught normally. Moreover, there are study the satisfaction of visually impaired students Grade 4, Bangkok Blind School that has to use DAISY-WIBORD audio books.

3.1 Phase 1

The first group is participants and samples for study of problems and requirements of audiobooks of the visually impaired students.

3.1.1 Participants

The population in this study is 184,080 visually impaired people in Thailand (Ministry of Social Development and Human Security, 2016)

3.1.2 Sample

100 samples were selected by stratified random sampling based on the ratio of the population of the visually impaired in Thai population. Furthermore, researcher determined the sample size using Yamane's formula.

3.1.3 Phase 1 Data analysis and statistical analysis

Phase 1: There is a collection of information on problems and requirement of the visually impaired and people who experts on the information. Moreover, analyzed data stage with average and standard deviation.
3.2 Phase 2

The second group is participants and samples for analysis a comparison of learning outcomes on social studies subject of visually impaired students Grade 4, Bangkok Blind School by using the DAISY-WIBORD audio book program and normal method (Phase 2)

3.2.1 Participants

The population in this study is visually impaired students Grade 4, school year 2016, Bangkok School for the Blind, consisting of 2 classrooms 15 students in a total of 30 people. The researcher determined simple random sampling of one classroom was a control group and another is an experimental group.

3.2.2 Experimental plan

This research is experimental research. The study of the experimental group and the control group by random and pre-post-experiment (The Randomized Pretest-Posttest Control Group Design) by pre-testing in both groups with the same measurement tools. The experiment was carried out by the experimental group receiving treatments while the control group received different treatments from the experimental group. After that used post-tested in both groups with the same measuring tools.

3.2.3 Phase 2 data analysis and statistical analysis

There is compares the mean values between the experimental group and the control group by using t-test statistics.

4. Findings

1) The GUI module (Graphic User Interface) is an intermediary to connect and handle the operations of various modules to ensure the program’s performance is effective working 2) Menu Bar Module (Menu Bar) is a command to operate all programs 3) Tool bar module is facilitates operation and speed 4) The status bar module is a bar with details within the window and 5) The working area module is the printed part of the book, it has the function to display texts and message checking. The development of websites of DAISY-WIBORD audio books for the visually impaired is divided into functional modules consisting of 1) The HTML 5 (Hyper Text Markup Language) is the central language for linking and supervising the operations of various modules to work with good efficiency 2) Voice control module 3) Control Module for book pages and 4) Program description module that illustrated the program version such as date, financier and researcher.

The examination of the developed DAISY-WIBORD audio books was conducted by the researcher following the procedures with the test results as follows:

1.1. The finding test of reading errors indicated that an average of 97.47% has the accuracy of reading Thai words from testing three times and 2.53% of the errors were caused by misprints and abbreviations. Moreover, the test of reading errors revealed that an average of 97.55% has accuracy of reading English words from testing three times and approximately 2.45% of the errors were caused by misprints.

1.2 Audio book creating speed tests displayed that the average time is approximately 1.50 milliseconds in Thai words and approximately 1.43 milliseconds in English words.

1.3 the comparing test of domestic and foreign audiobooks with DAISY-WIBORD audio book program showed that the program has used foreign synthesis technology, the sound created by the computer has many TTS sounds that is a new technology with a more natural and clear tone, keeping in html format as easily to find any part of a book, searching for particular words, and using with all versions of Windows.

The advantages of the DAISY-WIBORD audiobook program are as follows: 1) Installation of DAISY-WIBORD audio book creation programs is easy-to-used and be able to be apply with all types of computers 2) The audiobook file is not too large that can put in a USB flash drive 3) Audio book files can be opened immediately without having to install the program on the computer 4) The accuracy of reading Thai and English books 5) The speed of creating Thai and English audio books 6) There are various function buttons which convenient for creating books such as recorded button, added page button, deleted page, previous page, next page, and audio play etc. 7) There are various
function buttons to use for reading audio books for example stop reading function 8) There is no large audio file as the original audiobook. Therefore, there is no need for disk space to store.

The limitation of the DAISY-WIBORD audio book program cannot play audiobook files if it is not connect to the internet because there is requires an audio reader API that are on the internet. Furthermore, the companies that produce API libraries may charge in the future.

1.4 The effectiveness test of the DAISY-WIBORD audio book program by a group of blind students found that the percentage of the average score during the study was 80.70 and the average post-test was 82.65. The result show that DAISY-WIBORD audio books learning has the average score is 80.70 / 82.65 which is accordance with the assumptions of the efficiency criteria of not less than 80/80.

2. The comparing between the DAISY-WIBORD audio book program and normal method of social studies subject for visually impaired students Grade 4 of the Bangkok Blind School found that mean score of control group students had 16.67 and the experimental group had 16.53 which were not statistically significant at the 0.05 level.

3. Studying the satisfaction of visually impaired students Grade 4 of the Bangkok Blind School to use DAISY-WIBORD audio books revealed that social studies subject: learning group was the high level ($\overline{X} = 4.35$), furthermore students had the highest level of satisfaction with learning content from the DAISY-WIBORD audio books with convenience ($\overline{X} = 4.73$), there are a variety of sounds to choose for lessons ($\overline{X} = 4.60$), and more understanding of content ($\overline{X} = 4.47$) respectively.

5. Discussion

There are various issues from the researcher brought to discuss about the results as follows:

1. The result of developing the audio book program has been developed step by step which begins by studying the information of software development concepts from documents, books, textbooks, literature reviews to design the audiobook system. Then, the researcher carried out the proceeded with the program development process and reading web development which especially suitable for the visually impaired people. Development of DAISY-WIBORD audio books consists of the development of audio books system web-based audio books, and the researcher conducted the correctness (Correction Test) as follows:

1.1) the testing for reading errors found that the accuracy of reading Thai words has an averaged at 97.47% and the accuracy of reading English words is 97.55% respectively. In addition to conducted the speed test of audiobooks (Speed Test) found that the number of speed in Thai words has the average total is 1.5 milliseconds. On the other hand, the number of speed in English words is 1.43 milliseconds. This research is used speech synthesis technology from text (Text-to-Speech) which is more modern technology and more intelligent in reading messages. Moreover, the researchers have used the technology to apply the development of an audio book program for the daisy-whiteboard system that does not require audio recording. The resulting revealed that it is increase more speed in the production as well as reduce reading errors. Rattananoraset [16] said about the efficiency of the software when considering the efficiency of the accuracy and number of characters that can be linked to data expressed in words or sentences through processing more than 90%. From the criteria at Rattananorset [16], it can be said that DAISY-WIBORD audio books can work very well.

1.2) the testing results of the audio books on the DAISY-WIBORD system by a blind student group found that learning process has average score is 80.70 and post-test is 82.65 respectively. Therefore, the learning outcome with DAISY-WIBORD audio books has the average score is 80.70 / 82.65 which stay in accordance with the hypothesis of the efficiency criteria that not less than 80/80. This may be the result of systematically implemented audiobooks. There is a plan and implementation steps by obvious objectives and the expert examination. Thaweerat [17] who said that the consistency index up to 0.5 is considered reliable because all experts are experienced in teaching psychology as well as behavioral science has been correctly theoretical checked and totally covering all content. The method for finding content straightness by the experts is commonly used to find the straightness of standard
psychological tests [18]. Moreover, they brought the improving method by trial with sample group in keeping with the research and the development process. accordingly, the DAISY-WIBORD audio books has an effective in accordance with specified standards which is consistent with the research of Boonsom [19] that developed Daisy system Subject: ASEAN Studies for visually impaired students School for the Blind in Bangkok found that the study has a high level of overall quality as an effective as the criteria of 70/70.

2. The comparative study of learning outcomes in social studies of visually impaired students by using the DAISY-WIBORD audio book program and normal methods, Grade 4 from Bangkok Blind School with the number of students 15 people. The finding found that students in the control group has mean score after the class is 16.67 and the experimental group has the mean scores is 16.53. The mean score comparing between the experimental group and the control group were not statistically significant at the level of 0.05. In addition to the control group was studied normally learning from Braille and original audiobooks whereas the experimental group received the learning method from the DAISY-WIBORD audio book followed by the Empowerment Of Persons With Disabilities Act, B.E. 2550 (2007) and the Education Provision for Persons with Disabilities Act B.E. 2551, Section 2 (3). There are an institution for promoting the disabled students to receive learning facilities media and assistive technology to get more efficiently. Therefore, the design of experimental research of both groups were given equal learning facilities that reach learning achievement of both groups were not different. The psychological condition of the blind people is more senses to noise than other types of sensory because it feels safe and recognize directions as well as the distance of small round box with a lid can be obtained from the sound. So, the loss of sensory perception had causing blind students to pay attention and specialize in the use of auditory senses. They will be aware of barrier with good ears that can be clearly utilized [20].

The result consistent with the study of promotion for the production of educational media for the disabled (2005) found that audio books enhance as a learning medium that encourage blind students to learn faster. Moreover, the visually impaired students need social media for learning on social studies subject in part of Religion and culture. Since it is a subject that has a lot of content and most content can understand by describing explanations that consistent with Boonsom [20] that developed the Daisy book Subject: ASEAN Studies for visually impaired students Bangkok Blind School, finding stated that the learning achievement of students who studied with Daisy audio books had higher score than pre-tested. This is accordance with the results of Veerapan [21] which has developed sufficient 2D cartoon multimedia learning materials on the internet. It was found that the learning achievement of learners after class has an averaged 82.33% of the score, higher than the standard criteria set. Furthermore, this is consistent with Srikuna [22] who has studied the learning media to teach Chiang Mai words electronically found that all students take the posttest was passed the specified criteria 77.96%, and the students have fun and enjoy the media.

3. The results of students' satisfaction on the DAISY-WIBORD audio books Grade 4 students were satisfied with the DAISY-WIBORD system on social studies at high level ($\bar{X} = 4.35$) which found that students have the highest level of satisfaction in learning with DAISY-WIBORD audio books system is convenient ($\bar{X} = 4.73$). There are a variety of suitable sounds to choose for lessons ($\bar{X} = 4.60$) and DAISY-WIBORD audio book lessons helps to understand the content better ($\bar{X} = 4.47$) respectively, in accordance with Nakhana [20] visually impaired students are satisfied with audio books in number one. Audiobooks are very responsive information and uplifting entertainment lead to be the popular audiobooks as fast, accurate, and modern entertainment. Therefore, making it modern and fast consistent with the results of Chathiranmongkol [23] revealed that the satisfaction of the visually impaired students has an average is 4.28 which is at the high level of satisfaction.
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