A Development of Smart Book to Assist Communication
for Hearing Impaired Students

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Abstract

This research aimed to develop smart book to assist communication for hearing impaired students. The objective included: 1) to study basic information on developing smart book by interviewing 10 hearing impaired students in high school from schools under the Ministry of Education, academic year 2016 and 10 experts and develop contents based on the information, and 2) to develop smart book to assist communication for hearing impaired students. Topics include 3 daily life communication situations: using BTS transportation, going to a hospital, and making an identification card. The smart book was developed for a smart phone with Android system and was tested by 10 experts.

Research findings were as follow:

1. Hearing impaired person usually has language problems such as limit in vocabulary and incorrect grammar. Visual perception is very important to do activities in everyday life. Learning language requires visual perception to replace or pair with hearing to convey meaning to other people. This is a basis that leads to further learning which affects intellectual skills by comparison, differentiation, relation, and prediction. These skills can be trained. Media design for hearing impaired people should consider various types of media and multimedia presentation. The use of text helps to understand the content only a little. Multimedia which consists of text, pictures, and sign language will help students to understand the content better than text only or text with sign language. Likely, presentation media with text and pictures will help students to understand the content better than text only or text with sign language. Therefore, it can be concluded that media design to assist communication for hearing impaired should consist of text, pictures, and sign language.

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2. Smart book to assist communication for hearing impaired students consists of 6 elements: 1) Information, 2) Multimedia and technique, 3) Interface and navigation, 4) Screen design, 5) Display and access to resources, and 6) Using instruction. Evaluation results of smart book by the expert found that the overall quality assessment of the smart book by 10 experts found that the quality was at highest level ($\overline{X}$=4.76, S.D. = .44). When considering each item, Application structure was designed to cover the content and Picture had the highest mean ($\overline{X}$=-5.00, S.D. = 0.00), followed by The accuracy of the content and The format of the application is appropriate for use ($\overline{X}$= 4.90, S.D. = 0.32).

Keyword: Smart book, application, hearing impaired students

Introduction

Special education for people with disabilities is one of the important policies for human resource development of Thailand. It enables people with disabilities to develop quality of life and to develop themselves so that they can help themselves and society (Division of Promoting the Production of Educational Media for the Disabled, Centre for Educational Technology, 2007). Also, it focuses on creating equality to access to education to eliminate discrimination to people with disabilities as well as to promote and increase opportunities for people with disabilities to receive educational services (Ministry of Education, 2014).

Hearing impaired people have less access to regular media than other types of disabilities, such as visual impaired people can still hear sounds and can understand the message that senders want to convey. However, hearing impaired people are insensitivity to sounds. They still need subtitles or an interpreter to convey meaning which leads to communication problem (Muangthet, 2013). When hearing impaired people communicate with normal people who can communicate by written language but not by sign language, it can lead to misunderstanding. Also, there is insufficient number of sing language interpreters for people with hearing impairment. When hearing impaired people make an official contact with agencies or offices, it is difficult to create common understanding of both parties. According Saekaew (2008), more than half of hearing impaired children does not have the opportunity to study at bachelor's degree level because of the lack of interpreters to translate during teaching and learning session. When hearing impaired people make an official contact with agencies or offices, they have to reserve an interpreter. It depends on what issues they are contacting, such as going to see a doctor, going to court, going to do a transaction, etc. This also includes going to have a meeting with the requested agency and attend urgent matters such as going to a police office or hospital. Sometimes the translator does

not have knowledge on the issue that hearing impaired people are facing. For example, male hearing impaired patient went to see a doctor to consult about male disease, however, there was no male interpret. Then, he had to use a female interpreter which could make him feel embarrass to talk about the problem. In some cases, hearing impaired female who was pregnant went to see a doctor for an examination. However, a translator did not have any children. This will cause some difficulty in communication. Therefore, to support people with hearing impairment to communicate with other people by themselves, it should consider the use of media facilities to provide services and other assistance to solve the problem of lacking interpreters and to replace hearing loss with visual perception (Kijtham, 2004).

In knowledge-based society, media and technology are important tools for learning. Media and technology can improve learning effectiveness and quality. They also increase an educational opportunity for hearing impaired children. Therefore, there is an urgent need to develop and provide enough media for learning (Thepmeaung, 2008). Media is a main factor which enables children with hearing impairment to receive news and information and communicate with other people. "Technology media" is a widespread media which is familiar and popular among people of all ages and educational levels. As a result, it has become a medium that can develop meaningful learning and understanding between the sender and receiver. Technology media has been modified and developed to be modern, interesting, and up-to-date. However, there has been very small amount of ideal media for children with hearing impairment.

It is important to help children with disabilities by providing media facilities, services, and other assistance to supplement and replace the hearing, based on the principle "the use of other senses to supplement or replace hearing". Information technology is used to enhance knowledge, ability, and potential of children with hearing impairment. With the development of technology, information technology has been used to help communication by means of research and development of advanced equipment. Multimedia can present simulated situations that meet the needs of children with disabilities, especially situations that occur in everyday life.It should contain both pictures and text which are the elements of multimedia that facilitate learning. Multimedia will enable hearing impaired children to perceive and understand things more concrete. It leads to correct understanding when communicating with normal people and result in quality communication for future living. Also, it increases educational opportunity to create equality for children with hearing impairment. Therefore, the concept of "Smart Book" was developed. Smart Book was developed as multimedia on a mobile phone with Android operating system. The content is stored in the form of relational databases to allow users to search or retrieve the required data, both from databases in the application and other applications that provide

information and communication support. The application can pronounce words, phrases, and sentences which enable normal people to understand correctly. It is a tool to help hearing impaired children and use it in their daily life to communicate accurately and to understand information which is displayed on the screen concretely. This will allow hearing impaired people to develop their ability equally to normal people in terms of education and living in society.

Research Objective

To develop smart book to assist communication for hearing impaired students

Research Method

This study is Research and Development (R&D) consisting of 3 steps: studying basic information, developing smart book, and studying using results. This article will include Step 1: Studying basic information and Step 2: Developing smart book.

Step 1 Studying basic information about developing smart book to assist communication for hearing impaired students. It was conducted by interviewing 10 hearing impaired students (hard of hearing level) who studied in high school from schools under the Ministry of Education, academic year 2016. During the interview, there was repeated answering to receive the correct information. Also, the interview was conducted with 10 experts in special education on electronic media production. Smart book was developed based on structured interview on daily life communication and smart book developing. The received information was analyzed.

Step 2 Developing smart book to assist communication for hearing impaired students by using interviewing results, analyzing and synthesizing document, and related research as basic information in designing smart book. The smart book consists of 3 topics on communication in daily life: using BTS transportation, going to a hospital, and making an identification card. The smart book was developed for a smart phone with Android system and was tested by 10 experts.

Research results

The research results will be presented into 2 parts.

1. Hearing impaired person usually has language problems such as limit in vocabulary and incorrect grammar. Visual perception is very important to do activities in everyday life. Learning language requires visual perception to replace or pair with hearing to convey meaning to other people. This is a basis that leads to further learning which affects intellectual skills by comparison, differentiation, relation, and prediction. These skills can be trained.

Media design for hearing impaired people should consider various types of media and multimedia presentation. The use of text helps to understand the content only a little. Multimedia which consists of text, pictures, and sign language will help students to understand the content better than text only or text with sign language. Likely, presentation media with text and pictures will help students to understand the content better than text only or text with sign language. Therefore, it can be concluded that media design to assist communication for hearing impaired should consist of text, pictures, and sign language.

1) Sing language interpreter and oral interpreter to enable hearing impaired people to read. The interpreter facilitates the communication between normal people and hearing impaired people in different situations. In the media, the interpreter should be at the same position throughout.

2) Subtitles display the text that corresponds to the content. Its working principle is similar to spontaneous translation.

3) Illustrations to support the text or content in the media. If people are unfamiliar with sign language video or the video has difficult content to understand, illustrations, whether they are still image or animation, will help to understand the content more.

2. Smart book for people with hearing impairment was developed as an application that can be used with mobile phones. The design of the smart book for hearing impaired people consists of 6 elements: **1) Information**. The content is clearly divided into sections and linked together. The presentation is organized in an appropriate order. Most users may not be familiar with the terminology and formal symbol. There should be extra methods to explain the content such as demonstrating, giving examples, etc. In addition, illustrations or concise subtitles should be presented. Be careful of punctuation so that the meaning does not change. **2) Multimedia and technique.** Subtitles should be as concise as possible. Use simple and clear font style. The color of the font should be comfortable to read and contrast with the background color. The focus of the media should be on face, gesture, content and illustration rather than on background or props which can divert user's attention. Sign language should convey meaning correctly according to text and should not be too fast or too slow. **3) Interface and navigation.** The content should be divided into sections or sub-content. The navigation system is user-friendly, easy to navigate, formatted, and consistent. For example, an object is placed in the same position on every page. Users can interact with the media and control the media by themselves. The location of the user on the screen should be shown. **4) Screen Design.** It should emphasize on simple and easy-to-use design. Illustrations should convey meaning and come with short message. The position of buttons

and signs should be consistent and in accordance with international standards. Contents should be clearly classified or organized to prevent confusion. The media can be adjusted and resized according to the screen display.**5) Display and access to resources**. The application should display quickly and is easy to access. It should be compatible with different devices, such as network, phone model, and device type. **6) Using instruction**. There should be user instruction which is clearly explained and concise and should consist of illustrations to understand easily. Users should be able to search the information as they need. There may be a keyword search or search from a specific place. It should include communication channels with people who can answer questions when users have problems such as an administrator or sign interpreter.
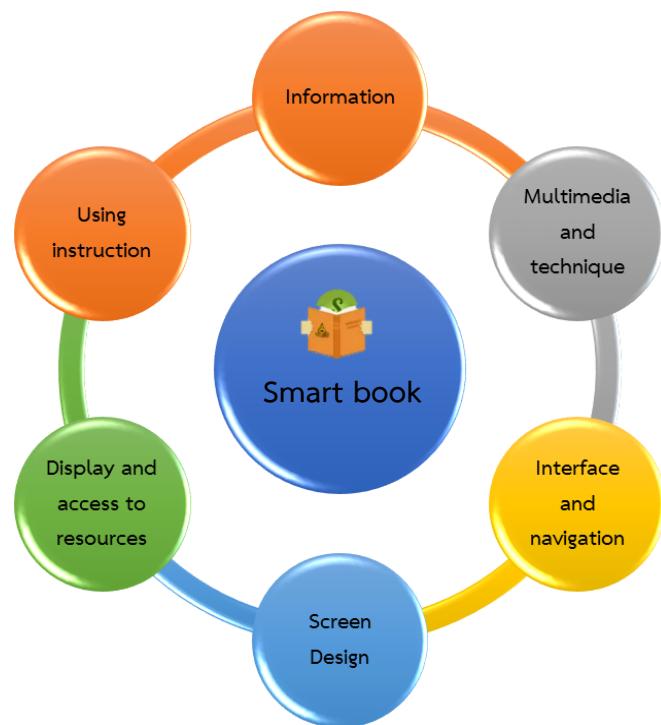
Figure 1 The elements of the smart book for hearing impaired people

The design of smart book as an application focuses on animation, social media, and sign language. Users can find the situation they want by themselves. It is designed to be easy to understand. In addition, administrators can improve the system and edit data without affecting users. The Smart Book Application features are presented in figures 1-4.
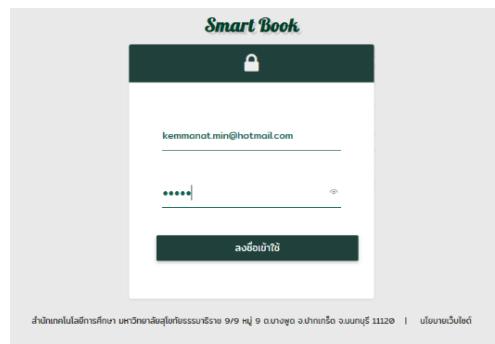
Figure 1 Smart Book Application Management System
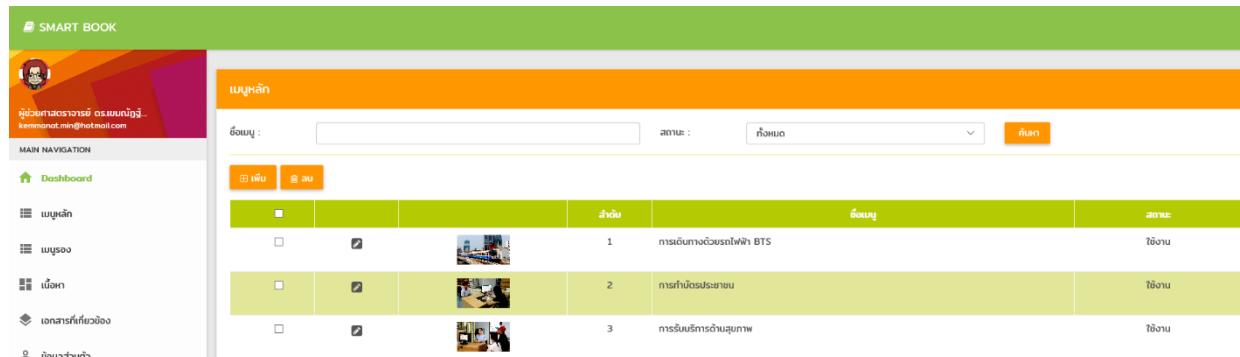

Figure 2 Main Menu
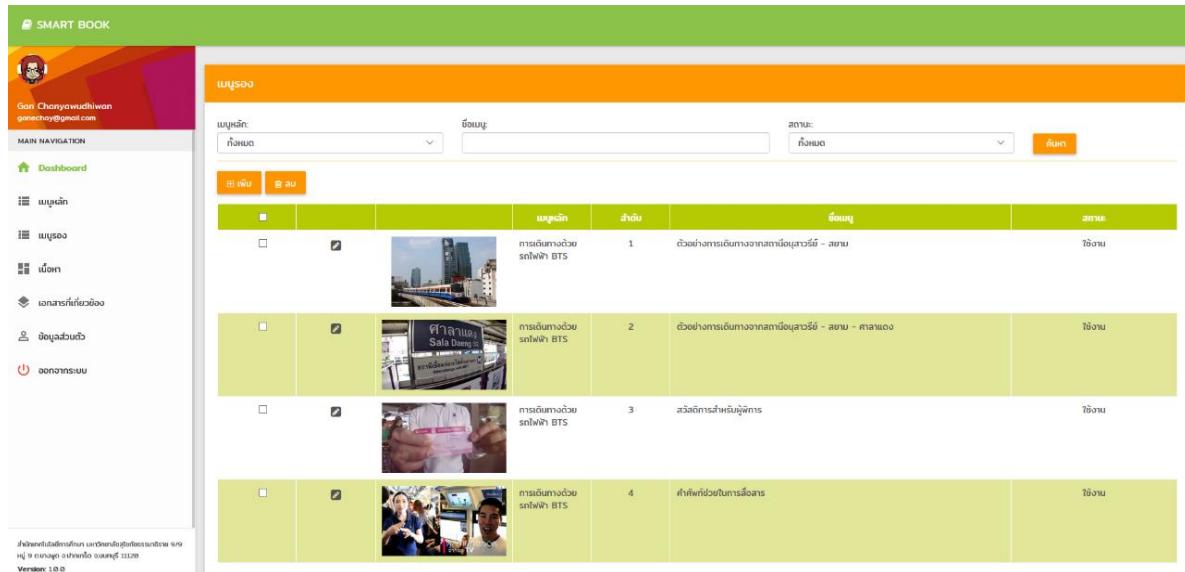
Figure 3 Sub Menu
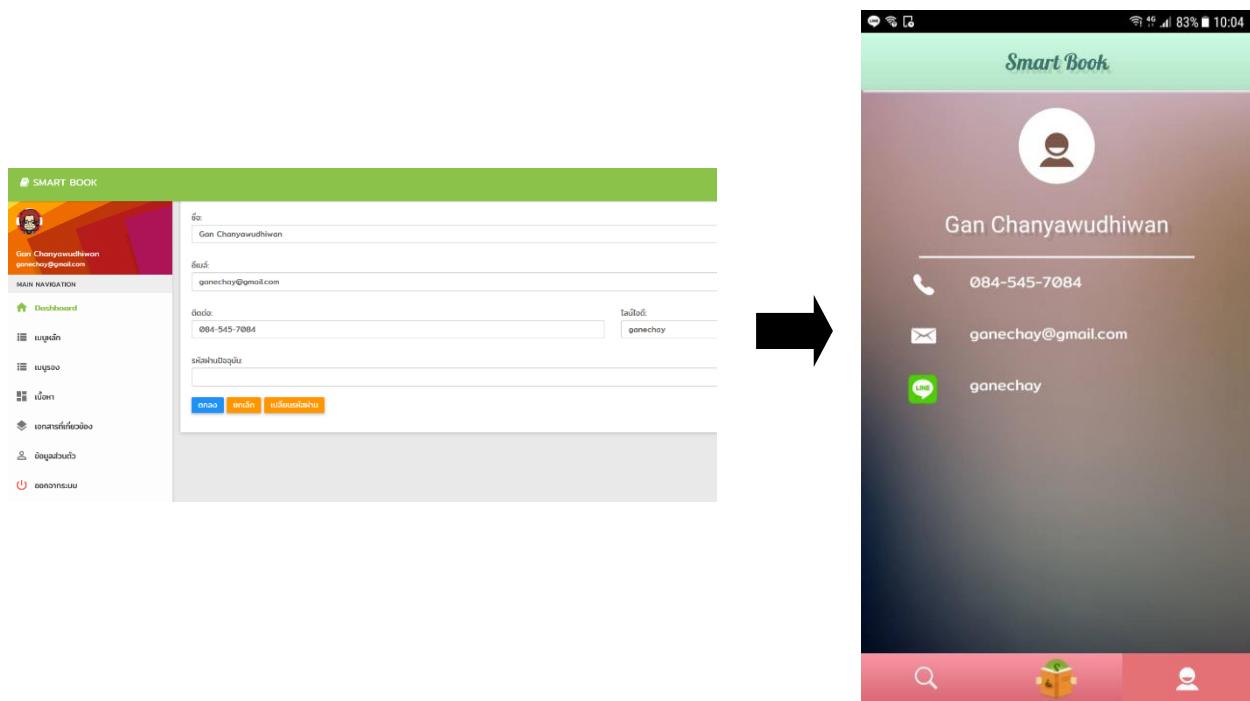
Figure 4 Display screen of Smart Book Application

The technical development of the application has developed all 6 elements into the structure of Smart Book Application as an application that works on Android devices and can be accessed via stou smartbook.

Element 1 Information The content is divided into category and short section. The presentation is organized in an appropriate order. Examples are provided to create more understanding.
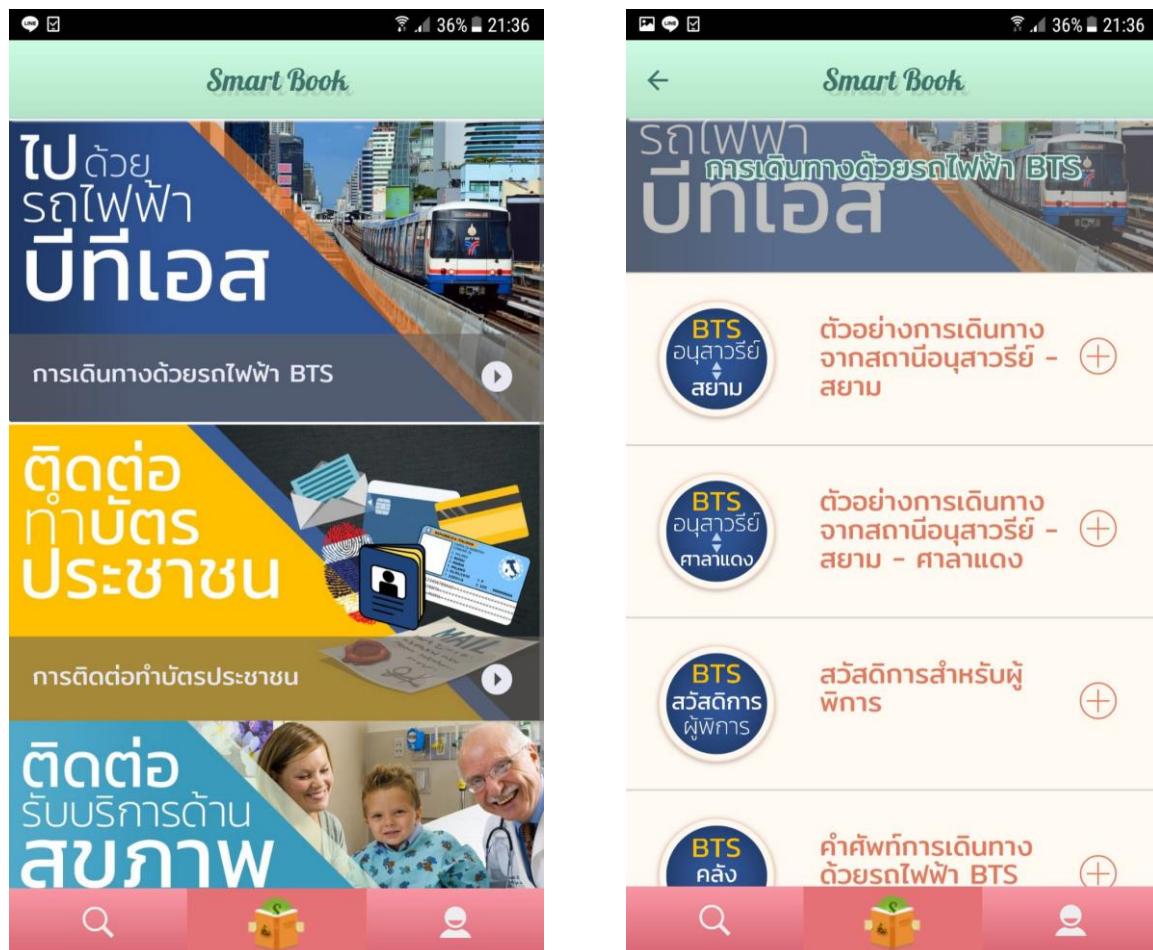

Figure 5 Organization of the content

Element 2 Multimedia and technique Subtitles should be as concise as possible. Simple and clear font style should be used. The color of the font should be comfortable to read and contrast with the background color. The focus of the media should be on face, gesture, content and illustration.
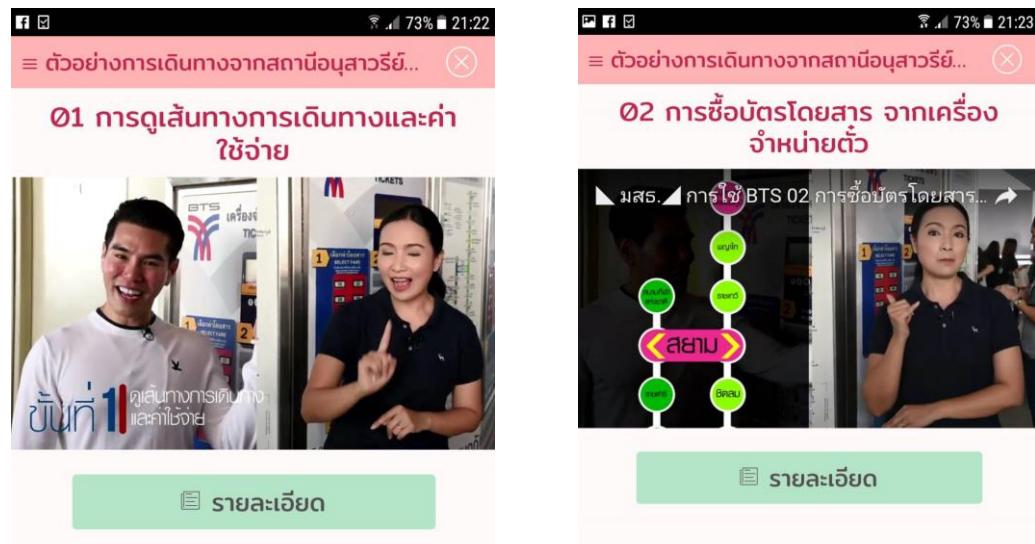

Figure 6 The content presentation with picture, text, and sign language

Element 3 Interface and navigation The content should be divided into sections or sub-content. The navigation system should be user-friendly, easy to navigate, formatted, and consistent, and connect to related content.
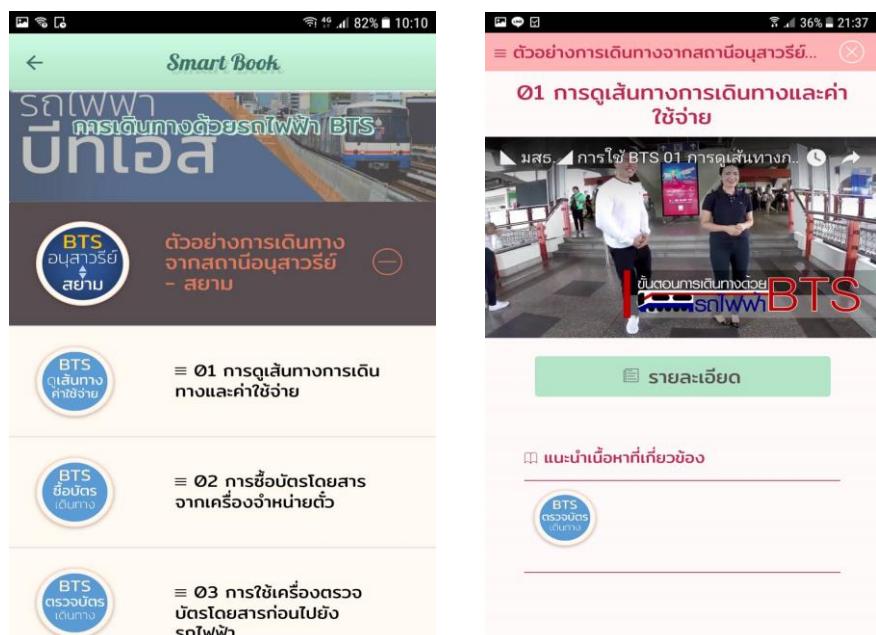

Figure 7 The content is divided into sections and connects to other content for the ease of use.

Element 4 Screen Design It should emphasize on simple and easy-to-use design. Illustrations should convey meaning and come with short message. The position of buttons and signs should be consistent and in accordance with international standards. Contents should be clearly classified or organized to prevent confusion. The media can be adjusted and resized according to the screen display**.**
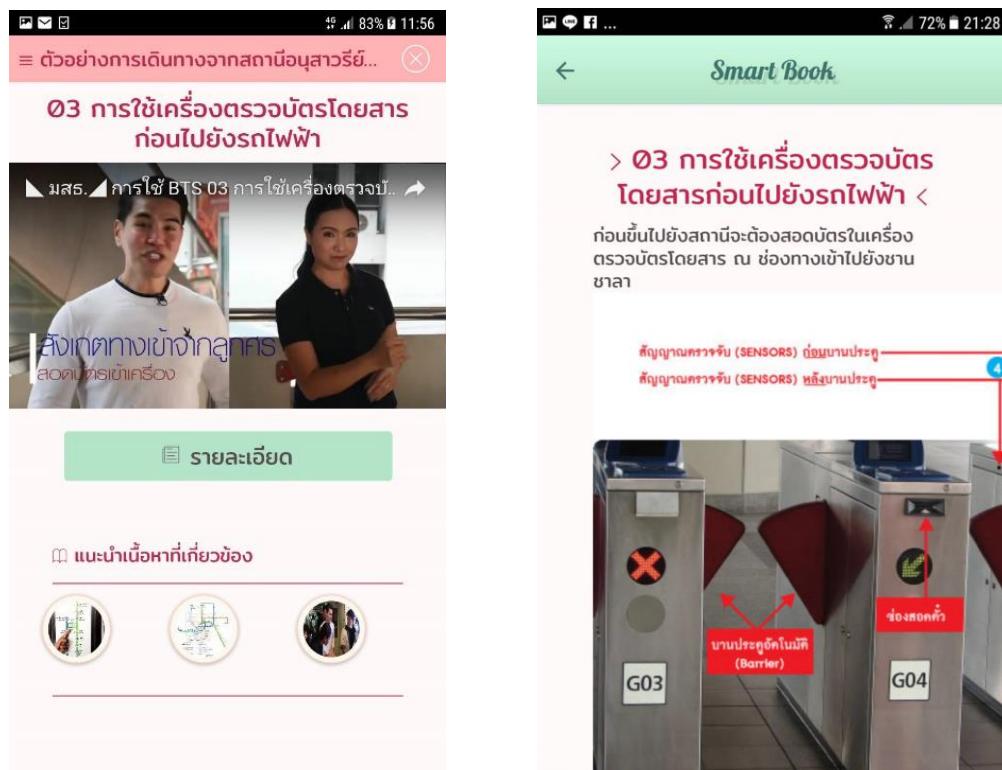
Figure 8 The use of illustrations to convey meaning of the content

Element 5 Display and access to resources The application should display quickly and is easy to access. It should be compatible with different devices, such as network, phone model, and device type.
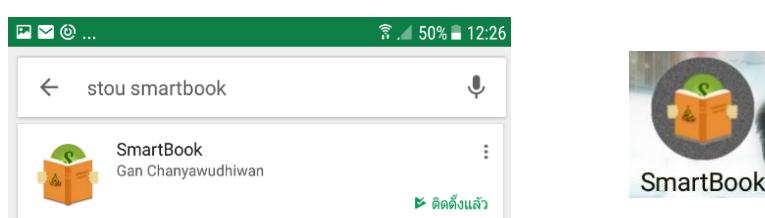
Figure 9 Installing Smart Book

Element 6 Using instruction There should be user instruction which is clearly explained and concise and should consist of illustrations to understand easily. Users should be able to search the information as they need. There may be a keyword search or search from a specific place. It should include communication channels with people who can answer questions when users have problems such as an administrator or sign interpreter.
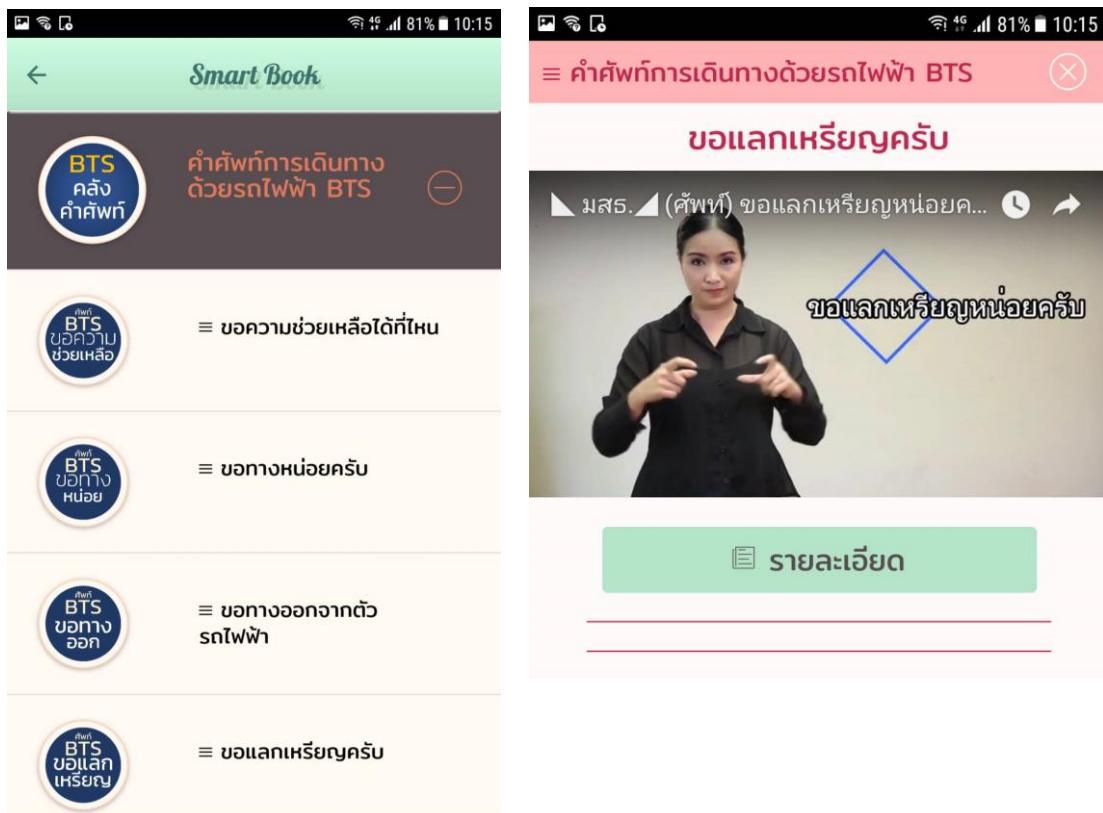

Figure 10 Vocabulary for communication
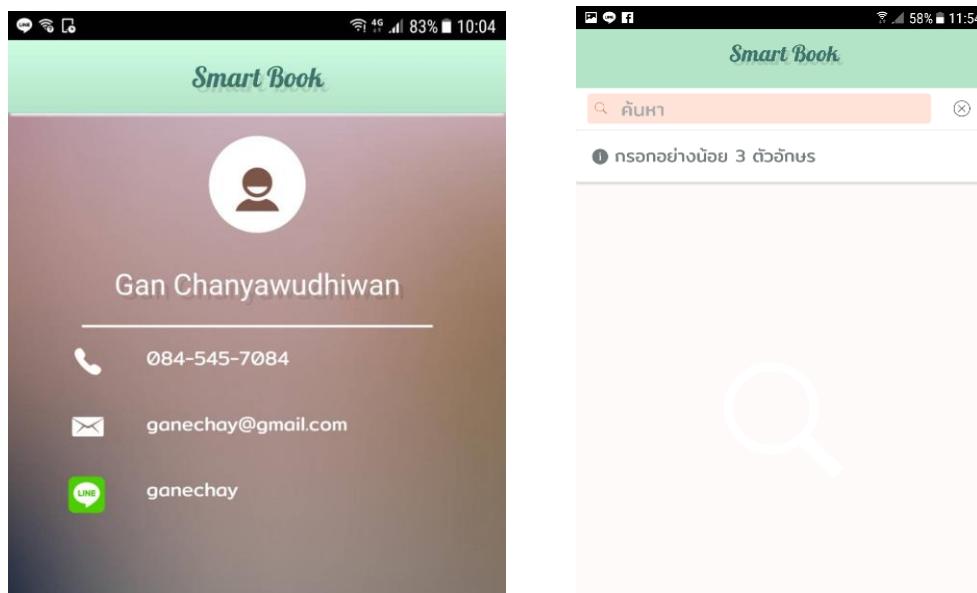
Figure 11 Communication channel with an administrator or searing from keywords

The overall quality assessment of the smart book by 10 experts found that the quality was at highest level ($\overline{X}$=4.76, S.D. = .44). When considering each item, Application structure was designed to cover the content   and Picture had the highest mean ($\overline{X}$=-5.00, S.D. = 0.00), followed by The accuracy of the content and The format of the application is appropriate for use ($\overline{X}$= 4.90, S.D. = 0.32). Details were presented in table 1

Table 1 The results of quality assessment by 10 experts (n = 10)

Items	$\overline{X}$	S.D.	Meaning
1. Application structure			
1.1 Application structure was clearly designed.	4.80	0.42	Highest
1.2 Application structure was designed to cover the content.	5.00	0.00	Highest
1.3 Structure is suitable for the target group.	4.80	0.42	Highest
2. Content			
2.1 The completeness of the content in each section.	4.80	0.42	Highest
2.2 Content organization is easy to understand.	4.70	0.48	Highest
2.3 Content presentation is easy to understand.	4.70	0.48	Highest

Items	$\overline{X}$	S.D.	Meaning
2.4 The accuracy of the content.	4.90	0.32	Highest
2.5 Clear communication by sign language.	4.80	0.42	Highest
3. Design			
3.1 Font	4.70	0.48	Highest
3.2 Picture	5.00	0.00	Highest
3.3 Color	4.80	0.42	Highest
3.4 Symbol and button	4.70	0.48	Highest
3.5 Connection	4.60	0.52	Highest
4. The use of the application			
4.1 Application is easy and convenient to use.	4.60	0.52	Highest
4.2 The format of the application is appropriate for use.	4.90	0.32	Highest
4.3 The facilitation to access the content.	4.70	0.48	Highest
4.4 The speed of the response of the use.	4.40	0.70	Highest
Total average	**4.76**	**0.44**	**Highest**

Discussion

Discussion will be organized according to elements of the smart book for hearing impaired students which was developed as an application to be used in mobile phones. The 6 elements include 1) Information, 2) Multimedia and technique, 3) Interface and navigation, 4) Screen design, 5) Display and access to resources, and 6) Using instruction.

Element 1 Information Communication behaviors of people with hearing impairment and normal people are different. People with hearing impairment tend to communicate with short, concise and easy-to-understand reading and writing. The design of the smart book, therefore, has considered communication behaviors. The content should be simple and easy to understand, so that people with hearing impairment is confident in communicating with normal people. According to Pichedpan (2004), people with hearing impairment often communicate with people with hearing impairment rather than with normal people. The main reason is the differences in structure of the written language which is different from those of the normal people or different from the correct structure of Thai language. This makes them lack of confidence in communicating with normal people. Therefore, communication via mobile phones is important and popular medium for hearing impaired people to seek information. In addition, the content is an important part of getting

users to communicate with the public. The content of each section should be clearly categorized and concise. Illustrations are used to make it easier to understand concretely. This is in line with the research by Suprapas (2008) who developed computer-assisted instruction (CAI) for hearing impaired people. The computer-assisted instruction provides the simple content with videos of a sing language interpreter. Learners can study the content based on their own capacity and can review the part they do not understand. This can promote independent learning.

Element 2 Multimedia and technique The design for hearing impaired people should choose easy-to-read font, focus on using illustrations than lectures, and use the short content to make users easier to understand. There should be sign language that corresponds well to the text by a skilled translator. Suprapas (2008) mentioned that media for people with hearing impairment should use simple and easy-to-understand illustrations. Sub content should relate to overall content which will enable students to remember the content well. Sri-On, et al. (2001) mentioned that media creation and presentation for people with hearing impairment should include a skilled Thai sign language interpreter to communicate and create confidence for communication. This is because people with hearing impairment cannot communicate by writing or speaking completely. In addition, the design of the smart book should consist of various media for hearing impaired people to choose the right media for them, including sign language, still image, and text. This is relevant with the research of Pavanantaput (2011) that created media to develop a skill in making pave setting jewelry for people with hearing impairment. The video media contains photos and videos that show the operation steps. It has Thai soundtrack and subtitles. Also, it presents pictures of finished work to create knowledge, understanding, and reviewing to enable hearing impaired people to easily apply and develop their skill to be accurate and effective. This can reduce time and budget for teaching and learning. The research of Nuchitprasitchai et al. (2005) developed computer-assisted instruction which consists of a variety of media formats: text, pictures, graphics, graphs, charts, animations, videos, and audios. The lesson should be interesting and inspirational by using animation, graphics and vibrant colors (or audios, in the case that people with hearing impairment can still hear a sound). The use of CAI to supplement in the classroom or for students to study by themselves can enhance the learning experience for people with hearing impairment. Lesson is in CD format so students can study by themselves.

Element 3 Interface and Navigation The content should be divided into sections or sub-content. The navigation system is user-friendly, easy to navigate, formal, and consistent. It should focus on easy to use and can navigate back to the main menu. Khlaisang (2011)

mentioned that user-friendly navigation was very important for the user friendly and easy design. There should be consistent pattern and sequence of items, for example, the same position on every page. Graphics should be meaningful and convey meaning along with clear explanation. Mingsiritham (2014) mentioned that the navigation system was similar to an object that helps learners to navigate into the lesson easily. Patterns and symbols should be easy to understand and have a consistent placement on every page. For example, if a homepage has a button or text link, there should be the button or text link in the same style on every page. This also applied with the use of the color scheme. Nondhavasi (2014) mentioned that users should be informed about their using situation. Also, there should be immediate feedback for users.

Element 4 Screen design The design should be simple and easy to use. It should use meaningful graphics, including animations and still images along with short message. The content should be divided into sections. Khlaisang (2011) mentioned that quality and reliable media should focus on the design. A well balanced screen layout of the menu items, selection list, content, and illustrations will make users become more interested in the content. Most often, the screen is divided into sections, including title section, announcement section, content section, illustration section, and other additional sections. Kamdee (2013) mentioned that the layout of each element, the space of each element, and the space of the contents should be appropriate. If the element or content are too dense, users will feel uncomfortable. In contrast, if the space is appropriate, user will feel more comfortable with the objectives of the application. However, the same layout may lead to different feeling. It depends on colors and other elements using to decorate the area which will make the application look interesting and become more dimensional. As a result, users feel the depth, width, and narrowness of the application page. The use of arcs can reduce the sharpness of the rectangle, making the appearance not to strong and creating lively feeling. Nondhavasi (2014) mentioned that the screen should be flexible enough to accommodate the screen size of each student's devices. The screen should be able to adjust the display format to a percentage of the screen or let the user choose the display format manually. Background colors and background images should not use bright colors. This may cause eye fatigue when using for a long time.

Element 5 Display and access to resources The smart book is developed for a smart phone with Android system because they are the primary communication technology that people with hearing impairments use to communicate. In addition, the development has taken into account the ease of use and simplicity. The content is suitable for users. Nuchitprasitchai et al. (2005) mentioned that the change in technology resulted in the use of

information technology to improve the quality of life of the disabled by the research and development of modern equipment, tools, and programs. Also, it was found that more information technology has been used in teaching, especially, mobile phones which are the primary technology that helps people with hearing impairments to communicate. Porkathong (2004) mentioned that mobile phones were the main communication technology for people with hearing impairment, although they were not directly developed for people with hearing impairment. The reason is because the development of extra features has allowed people with hearing impairment to use mobile phones. Also, when they use mobile phones, other people will see them as normal people. They will feel equal and not different from normal people when communicate and use the same technology. Technology helps reduce distance, time, and space dimension, resulting in easy, fast, and independent communication. It allows people to communicate more often and develop personal relationship. The smart book can be used with smart phones because it is fast and easy to access and can link to internal and external content. Mingsiritham and Koraneekij (2017) mentioned that the supported tool and technology in the application should emphasize the use of tool and technology that respond to learners and can access information quickly. It should be flexible to use on various technological devices which are a part of the everyday life of learners.

Element 6 Using instruction There should be a search from keywords to match the needs of users. Illustrations should be included as well as communication channel with an administrator. The research of Pavanantaput (2011) created media to develop a skill in making pave setting jewelry for people with hearing impairment. Learners can choose to view videos with sing language, subtitles, and still images. This will makes learners to understand operation steps. If hearing impaired people can directly ask questions, it will make them receive more information.

Conclusion

Information technology is used to enhance knowledge, ability, and potential of children with hearing impairment. With the development of technology, information technology has been used to help communication by means of research and development of advanced equipment. Multimedia can present simulated situations that meet the needs of children with disabilities, especially situations that occur in everyday life. The concept of "Smart Book" was developed as multimedia on a mobile phone with Android operating system. The content is stored in the form of relational databases to allow users to search or retrieve the required data, both from databases in the application and other applications that provide

information and communication support. The application can pronounce words, phrases, and sentences which enable normal people to understand correctly. It is a tool to help hearing impaired children and use it in their daily life to communicate accurately and to understand information which is displayed on the screen concretely. This will allow hearing impaired people to develop their ability equally to normal people in terms of education and living in society.

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