Rodrigo, M. M. T. et al. (Eds.) (2021). Proceedings of the 29th International Conference on Computers in Education. Asia-Pacific Society for Computers in Education

The Challenge of Assistive Technology (AT) for the Needs of Visually Impaired (VIP) Learners in English Vocabulary Learning

Phirunkhana PHICHIENSATHIEN*& Bhornsawan INPIN
School of Liberal Arts, Mae Fah Luang University, Thailand
*phirunkhana.phi@mfu.ac.th

Abstract: As a result of an ongoing demand for technology and education resources in the 21st-century classroom, assistive technology has crucially influenced English Language Teaching. Many studies have emerged in the field of Information and Communication Technology on visually impaired (VIP) learners using computer-based software programs. With regard to this impact, vocabulary has been given particular emphasis in learning English as a foreign language or second language. Previously, most visually impaired learners were not aware of the learning opportunities to overcome their disability. Recently, learners have been able to study both in special education and inclusive education for partially sighted learners, but the instructional materials and assistive tools have some drawbacks. Textbooks with Braille codes and CDs with a daisy-digital accessible information system have not been easily available to these learners. Furthermore, the contents of standard textbooks did not provide such learners with any assistance. As there have not been any studies on these learners in Thailand, the purpose of this study is to identify the challenges and needs of visually impaired learners of English. This study is a part of a more extensive research program conducted to create assistive technology and tools for young visually impaired Thai learners of English. This paper will focus on multi-sensory material of English vocabulary in special education which will emphasize the development of assistive technology or tools with touch and sound senses in English vocabulary for young VIP learners to encourage sustained learning.

Keywords: Assistive technology, English vocabulary learning, visually impaired learners

1. Introduction

Whilst there has been an ongoing demand for technology and education resources in the 21st-century classroom, instructional technology and Assistive Technology (AT) have crucially influenced English Language Teaching and Learning (ELTL). Furthermore, the challenge of integrating with AT has also taken into account the self-autonomous learning of visually impaired (VIP) people across the globe. Many studies have emerged on the effects of Information and Communication Technology (ICT) on VIP learners in the use of computer and software programs, such as WhatsApp and Google Play Store applications (Beal & Rosenblum, 2018; Stinson, 2018).

With regard to the impact of ICT, the learning of the English language has been particularly affected by access to the internet. As a result, learning English through the use of computers and AT. However, a major problem of this accessibility has been the need to use English as a medium for access and communication (Suwannakin, 2003). Learning vocabulary has always been of considerable importance in learning foreign and second languages (Nation, 2001). The size of vocabulary acquisition has to be taken into account in mastering the English language (Susanto, 2017). If young learners know the meaning of vocabulary, they can also gain access to a wider understanding of English language texts. For example, a knowledge of lexical words based on Nation's word knowledge (Nation, 1990) will greatly aid their comprehension. Therefore, this study focuses on vocabulary as a crucial factor in the successful learning of young VIP learners.

The Thai government encourages learners at all levels to sustain their learning, lives, and families through social integration through the use of computers and technology based on National Education Act 12. In addition, it has recommended establishing special education facilities for VIP learners (Ministry of Education, 2000, 2009). Nevertheless, it is recognized that most VIP learners are

not aware of the available learning opportunities which would enable them to improve the quality of their lives.

VIP learners are encouraged to study both in special education and inclusive education with sighted learners. However, the instructional materials and tools that are available to them have some drawbacks. For example, books with Braille codes and CDs with a daisy-digital accessible information system are not provided for VIP learners (Kittiwattanakul, 1987). VIP learners might not be able to engage in their learning without assistance from other people, e.g., teachers and peers although they can learn English from reading their lessons using Braille and listening to audio media. Thus, the critical challenge is to provide instructional materials and AT for VIP learners in terms of enabling them to use their tactile senses in autonomous learning.

Some research studies have investigated the role of technology in special education (e.g., Stinson, 2018; Susanto & Nanda, 2018; Wong & Cohen, 2015) and inclusive classrooms (e.g., Harrath, Guerrah, & Hamadouche, 2019; Smith, Lowrey, Rowland, & Frey, 2020). These include studies on how teachers encourage VIP learners with teaching strategies (e.g., Basaran, 2012) and examine the use of implementation with mobile-assisted language learning (MALL) (e.g., Retorta & Cristovão, 2017), whereas other studies focus on how VIP learners can improve their learning with specific strategies (e.g., Aryanti, 2014). Many studies integrated AT in ELTL with a diversity of materials e.g., didactic materials (Rotorta & Cristovoa, 2017), tactile tools (Makarova, Molchanova, Morozova, & Stepichev, 2016), audio-scripts (Harrath, Guerrah, & Hamadouche, 2019), voice transcripts, braille, screen readers (Souza & Freitas, 2019), and instructional materials to help writing skills through the use of technology (Smith, Lowrey, Rowland, & Frey, 2020). As can be seen in the literature, many studies have carried out professional teacher training for VIP learners (Suwannakin, 2003; Kocyijit & Artar, 2015), whereas some studies have focused on VIP learners' acquisition of English vocabulary (e.g., Harrath, Guerrah, & Hamadouche, 2019; Zorluel Özer & Cabaloğlu, 2018).

Research to date has tended to focus on the intervention of AT with computer devices and applications in English language and mathematics for listening to audio scripts and using screen readers rather than the implementation of AT by reading Braille, touching a 3D object, and listening to storytelling. Moreover, previous studies in Thailand have tended to focus on the problems of material requirements for VIP learners (Thongnoi, 2006). Tunti-a-longkarn (2014) designed e-Braille learning for VIP learners. In addition, much of the research up to now has been descriptive with regard to the educational problems of VIP learners as demonstrated by an online comic (Sirisoontorn, 2017), and Chinese language using convex forms, a curved or rounded shape of Chinese characters (Tangpakorn, 2019).

In addition to strategies to improve the quality of life and promote lifelong learning for disabled people and the elderly in accord with the Thai Government's Twelfth Plan and a national research program to develop the accessibility of information and technology including materials for the elderly and disabled (see 3.2.5), there is increasing concern over the restricted accessibility to AT. Extensive research has been conducted in a limited number of studies on material development with Braille codes and audio media focusing on visual arts (Mahamart, 2017). However, there has been very little research on the challenges and needs of learning English vocabulary for VIP learners which would require effective AT with Braille codes, audio media, and 3D touch media.

This study will focus on the development of innovative AT for the learning of English vocabulary by young VIP learners by reviewing recent research and seek to obtain data, which will help to address research gaps. As no studies have explicitly investigated mainstream ELT for VIP learners in Thailand, this paper aims to provide for the needs of VIP learners in the learning of English vocabulary in the Thai context. Firstly, the paper briefly describes the characteristics of VIP learners. Then, it will focus on the learning of English vocabulary in special education and the challenges of learning for VIP learners will be discussed in terms of language acquisition, specifically vocabulary acquisition, and teaching and learning in the classroom. Furthermore, the paper reviews research on the teaching and learning of English with AT in practice.

2. Literature Review

2.1 Characteristics of VIP Learners

With regard to the characteristics of VIP learners, the Ministry of Education in Thailand (2009) categorized VIP people into two groups: the blind and those with impaired vision. The impaired vision here refers to those who have lost their sight in terms of different degrees of acuity. Firstly, some blind people have been able to learn by using Braille audiobooks. Based on a visual acuity test for normal eyesight, they have 6/60 or 20/200 of their vision on a scale with blindness at the lowest level. This test demonstrates the degree to which their vision is restricted. For example, they can see an object at a distance of 20 feet or 6 metres. Occasionally, it is possible for the VIP to experience more than 20 degrees of the visual field (the narrowest area of vision is represented as 20 degrees).

Those who have poor vision can see an item and read large letters with magnification. Based on this visual acuity measurement, their eyesight can reach from 6/18 or 20/70 to 6/60 or 20/200. That is to say, they might be able to have more than 30 degrees of the visual field. Nevertheless, both learners with visually impaired and poor vision have strong senses of hearing, memory, and visualization when learning English. Although they suffer from visual impairment, they can acquire knowledge by means of their senses of touch and sound. This paper will focus on the learners who belong in the first group and will be referred to as VIP in English language learning.

According to Okitasaki's (2014) observation, VIP learners have a physical problem with their eyesight. They blink more often than sighted learners do and they also tend to stare at objects. Some scholars define VIP learners based on (physical) vision measurement, cognition, social and emotional skills (Beatrice & Janet, 2003). Moreover, VIP learners can be described in the following terms: 1) they perceive and learn the development of the concept, knowledge, and information from tactile and audio tools. 2) With insufficient visual cues, they might encounter obstacles in doing literary work and recognizing some alphabets, numbers, lexicons, and color objects (UNESCO, 2001).

2.2 Challenges of English Language Learning for VIP learners

VIP learners have to struggle hard to cope with English language learning although the educational policy encourages equal support for all learners relating to teaching materials, curriculum, teaching and learning strategies, and the assessment of students. To be successful VIP learners of English have to meet the challenges of language acquisition particularly vocabulary acquisition.

2.2.1 Challenges of Language Acquisition

VIP learners have to confront the challenges of language and vocabulary acquisition. Their problems can result in a lack of social adjustment, learning development, and life skills. Nonetheless, the first language (L1) can help improve their sensory exploration and perception of the world. For example, VIP learners can learn the meanings of new vocabulary in sentences by means of sound and touch (Muñoz, 2019). This means that learning English as a second language (L2) for VIP learners is a completely different experience from that of normally sighted students. In general, some L2 errors which are found in sighted students' written and oral communication, are significantly influenced by their L1. Their L2 patterns of communication will depend on a process of L1 development. For example, uncomplicated concepts will be introduced before complex ideas during classroom activities. Sometimes, VIP learners' attempts at learning L2 show how incomplete and misleading their learning of abstract vocabulary can be. Thus, such impairment needs to be addressed in terms of the impact on their learning, as suggested by Conroy (2005) and Warren (1989). Subsequently, VIP learners take a longer and more circuitous route in their education than sighted students.

Based on a student's proficiency in L1, L2 acquisition can be correspondingly determined (Dunlea, 1989). Focusing on the aspect of visual impairment, some researchers argue that VIP learners might demonstrate greater resilience to the learning process and learning strategies, by means of a strong sense of hearing, to compensate for their disability in learning acquisition (Araluch 2002; Erin, 2003). In view of this point, it has been argued that VIP learners can acquire a non-deficient language by using other compensatory mechanisms in their learning process.

2.2.2 Challenges of Vocabulary Acquisition

As for vocabulary acquisition, students can learn new words from the context or detailed explanations in general. Considerable attention to vocabulary knowledge must be taken into L2 learning and communication (Schmitt, 2000). It has now been demonstrated that there are two types of vocabulary acquisition: passive and active (Gruneberg & Sykes, 1991). To illustrate this, VIP learners can acquire a grasp of passive vocabularies from what they have been taught. Then, if they apply this knowledge in their written assignments it becomes active vocabulary. Vocabulary acquisition in learning English depends on the students' attention and enthusiasm. Nonetheless, it may be assumed that insufficient English vocabulary learning because of visual impairment might result in language failure in terms of communication. This is confirmed by Conroy (2005) and Warren (1989) who state that VIP learners will experience more difficulty in learning English than sighted students. The only way for VIP learners to gain more knowledge of English vocabulary is to stimulate their interest in learning English. Therefore, it is important to educate VIP learners in the appropriate strategies for developing their English vocabulary learning.

2.2.3 Challenges in the Classroom: Teachers and VIP Learners

On the question of the challenges for VIP learners in learning English, both teachers and VIP learners have to confront the difficulties and deficiencies in the provision of appropriate educational materials. With regard to the increasing number of VIP learners, one of the challenges to the status quo is the scarcity of properly trained teachers who are familiar with AT, the appropriate teaching strategies to use with computer devices, and suitable materials (Basaran, 2012; Coşkun,2013; Efstathiou & Polichronopoulou 2015; Lewin-Jones and Hodgson, 2004; Makarova, Molchanova, Morozova, & Stepichev, 2016; and Zorluel Özer & Cabaloğlu, 2018). It seems that teachers need to take a closer look at the background of VIP learners and the material resources available because some teachers in inclusive schools might not be familiar with the problems of VIP learners (Kocyigit & Artar, 2015; Cholthanon, 2002).

The first significant aspect of these considerable challenges is the educational system for VIP learners which includes both inclusive and special schools. Inclusive schools cater for VIP learners to study with sighted students. In fact, most inclusive schools will lack the appropriate resources e.g., teaching-learning materials and facilities designed for sighted students. Supporting VIP learners in this situation requires special management for them to be able to cope with the social environment and the lack of resources. Consequently, it might be assumed that VIP learners will be able to follow a similar learning track to that of sighted students in terms of classroom involvement, curriculum structures and content, and materials. However, VIP learners will be very unlikely to manage their learning without the necessary learning materials.

The special Education Bureau provides educational support for students with disabilities which comprises schools for specific disabilities (e.g., schools for the blind), Suksasongkraw School for ethnic groups, and special education centers (which help students with many disabilities). This study focuses on VIP learners. Studying in a School for the Blind helps young VIP children to learn Braille which eventually could enable them to survive in a sighted world. Young VIP children are required to go to special (boarding) schools before moving on to middle (inclusive) schools. Many schools for the blind have been established with attention to special education by the Foundation for the Blind of Thailand, the Royal Patronage of Her Majesty the Queen, and the Christian Foundation for the Blind in Thailand. These organizations have supported the provision of formal and non-formal education, for example, the Northern Region School for the Blind under the Royal Patronage of Her Majesty the Queen in Chiang Mai, Mae Sai School for the Blind under the Royal Patronage of Her Royal Highness Princess Maha Jakri Sirindhorn in Chiangrai, and the Southern Region School for the Blind in Surat Thani. In order to focus on an area-based approach, this study will use the School for the Blind in Mae Sai as its target study.

As previously mentioned, the difficulties of VIP learners, who have no sight, can be extremely distressing (Hallahan & Kaufmann, 2000). VIP learners might not ever be able to fully overcome the obstacles to their learning development and they will learn more slowly in the English language classroom than a sighted learner. Nonetheless, there are other learning strategies available to them in the form of AT and the materials which rely on sound and touch, which have been focused on for a few decades. The evidence shows that tactile aids (e.g., Braille, optacons, tactile maps, and 3D objects) and audio aids (e.g., audio media and a bell which ring when a Braille character is pressed) are great tools

for VIP learners to identify information, knowledge, and object shapes in the world from their fingertips and by touching and listening (Dullayakanit, 1988).

In the present transformative learning age, technology plays an important role in pedagogical practices. Many studies in other countries have paid attention to teaching and learning English, including the development of AT for VIP learners e.g., Talking Tactile Technology, special programs using computer-assisted teaching, and audio scripts from YouTube. Although AT can work with multi-sensory tools, the most compelling evidence from the literature in the Thai context has been developed in a separate sense. These AT tools are Braille textbook, applications in reading for the Blind, an assistive computer program with an audio screen reader, Braille learning machines, e-Braille learning sets, Alternative Text [ALT text], Graphic Audio, and The Comics Empower. Nonetheless, there is still a dearth of multi-sensory AT for English vocabulary learning in the Thai context. Turning now to a survey and the experimental evidence on teaching and learning English for VIP learners both overseas and in the Thai context, this account will prepare the design and development of AT for VIP learners through the use of multi-sensory resources such as Braille codes, auditory devices, and 3D objects.

2.3 Teaching and Learning English Language for VIP Learners Overseas

There has been an increasing amount of literature on the teaching and learning of English for VIP learners in recent years. Many studies in other countries have been conducted to find effective methods of teaching English to VIP learners. Interviews and classroom observations such as those conducted by Basaran (2012) have shown the role of the teacher in terms of classroom management, the teaching approaches used to overcome the problems, activities, and materials used in inclusive elementary schools and special education schools for the blind. All the teachers participated in an informal training session for the teaching of VIP learners. They implemented a grammar-translation method to allow the students to read their books with Braille and translate them into their L1. The teachers explained the grammar and sentence structure in Turkish and then encouraged the learners to write the sentences in English.

In their groundbreaking analysis of the teaching and learning strategies needed for VIP university students in an inclusive school, Lewin-Jones and Hodgson (2004) were able to show that teachers of VIP learners needed assistants for their teaching. These assistants were able to help the VIP learners to learn the content of the lesson by means of audio devices or computers. Also, using a multi-method approach (e.g., oral-written approach [reading aloud while visualizing the content on the whiteboard or projector], peer teaching, guided pair work, and group dynamics in oral responses and using background music served to integrate the students' culture into their language learning. However, it is important to bear in mind that the sighted learners would be distracted by supportive sounds while silent reading or writing a summary. This discrepancy should be considered in providing resources and activities in terms of differentiation and appropriateness in this context.

Coşkun (2013) undertook an innovative instructional method for VIP learners in Turkey. Talking Tactile Technology (T3) is a sensory tool to learn the English language. Students are provided with a program which uses touch and sound, so that tactile diagrams and audio sounds are merged to encourage the learners to become fast learners through their learning experiences and to develop their self-esteem. As a result of these training sessions, the application of the T3 program has ignited interest and shed light on the mainstream of ELT and special education globally. Notably, the results of this study do not only benefit teachers who were able to attend the program and apply this practice, but learners with disabilities and those with regular sight who were also able to pursue their interests in the time available. It is possible to claim that this talking tactile overlay program has been developed and implemented in a wide variety of disciplines e.g., music and cuisine.

In addition, a survey conducted by Efstathiou and Polichronopoulou (2015) has attempted to develop high-quality English teaching materials for VIP learners in Greece and also developed teachers' awareness. The results have substantiated the correlation between teaching experiences and implementation in a special VIP group. In regard to the materials used for VIP learners, most teachers have affirmed successful teaching experiences with audio materials and CD players while others employed large print materials, Braille materials, and school textbooks. Only teachers with trained Braille certification were able to use the English books for the blind, bookstands and slant boards, and tactile books. Based on more than a year's experience with the VIP learners, these teachers were able to

use fewer English books for these learners. As noted, it is important that teaching the English language to VIP learners is specific in terms of materials, programs, implementation, and Braille.

According to Makarova, Molchanova, Morozova, and Stepichev (2016), these scholars investigated effective approaches and activities to allow the VIP learners to study the English language in terms of the German VIP learners' needs. Based on multisensory and explicit instruction, the teachers encouraged learners to practice their English language with tactile tools (e.g., objects, plastic letters, tactile books, and tactile graphics) including traditional and universal tools such as Braille. Nevertheless, it was suggested that effective ways of teaching English in VIP classes might be restricted because of time constraints in the teaching and learning process. A possible explanation for these results may be the lack of adequate time allowed for practicing in the planning stage. That is to say, teachers need preparation and support to work with sensory materials, particularly 3D objects in the same way the learners do in the learning process. Particularly in an inclusive school, the materials provided (e.g., Braille books and tactile tools) did not sustain and motivate the VIP learners' English language development in terms of cognitive and emotional learning.

Regardless of the emphasis on Information and Communications Technology (ICT) in the teaching of Brazilian VIP learners with mobile-assisted language learning (MALL), it is likely that the insufficiency of applications and mobile devices was a problem in this project (Retorta & Cristovão, 2017). Accordingly, the didactic materials (e.g., applications on WhatsApp, songs on podcasts, and communication platforms via Facebook group) must be logically considered for VIP learners. More importantly, the differentiation of the students' ethnographical and educational backgrounds did not appear to be a factor which influenced the longitudinal study due to the growing demand for English language learning. However, it seems that this study would not be able to demonstrate self-autonomous learning by Vygotsky's Zone of Proximal Development (ZPD) without assistance for the VIP learners.

A recent study by Stinson (2018) designed an English course for VIP learners based on their disability needs and a student-centered plan for three different approaches in an inclusive classroom 1) a stand-alone or pullout instruction (focusing on English language acquisition for only VIP learners). 2) an integrated approach or push-in instruction emphasizing content-area and linguistic features in terms of a genre-based approach to encourage learners to gain more knowledge and experience and to engage in activities. In addition, 3) teachers will apply a flexible approach for VIP learners' English competency at the beginning and at other transferable levels. Based on the local state department in education, that is, five levels of English proficiency are defined as a beginning, emerging, transitioning, expanding, and commanding. On occasion, teachers employ re-teaching critical and content-based approaches to encourage the VIP learners to practice their writing in small groups and individual groups. With regard to the course design, it has commonly been assumed that the diversities of VIP learners' skills and achievements in the inclusive classroom would influence classroom management with regard to activities and time duration for learners at different stages. Subsequently, Stinson's instruction plan has been subjected to considerable criticism in terms of instructional approaches, activities, and teacher roles.

Moreover, there is some evidence to suggest that teaching English to VIP learners is unique (e.g., Susanto & Nanda, 2018) with ATs. This study has carried out a semi-structured interview and classroom observation of teachers and VIP learners based on a social constructivist framework. It has been shown that teachers lack a specific strategy to cater adequately to the VIP learners' needs. This is because some of the teachers might not have participated in the training session for those learners. Nevertheless, with a range of learning resources and accessible technology, it is possible to provide suitable facilities for those learners. Sometimes, motivating learners with the use of Braille might not be potentially effective in helping students to obtain new English vocabulary by word memorization. Some teachers implemented peer learning to encourage learners to learn new words. However, it is almost certain that learning English with a sense of hearing (e.g., music and song) will increase their English vocabulary competence. Generally speaking, there has been a tendency to develop AT for VIP learners using Braille and audio in English vocabulary learning.

A detailed examination of audio scripts of Algerian VIP students' vocabulary improvement by Harrath, Guerrah, and Hamadouche (2019) showed that those students could develop their vocabulary acquisition by using intensive listening. An interview was conducted with four teachers involved with teaching VIP learners before the experiment. It revealed that the teachers focused solely on the students' strong listening abilities before the experiment, yet they paid no attention to their teaching process and they had inadequate AT and materials. Seven second-year middle school VIP learners

participated in this implementation. They were asked to read the Braille texts twice as a pre-test and post-test. The teacher asked the students to listen to audio scripts adapted from YouTube and to answer the questions. By the end of the experiment, it was found that the students were able to learn English vocabulary more rapidly than learning Braille. Accordingly, learning English vocabulary with AT using audio scripts (e.g., YouTube) is an effective method as it helps VIP learners learn English vocabulary more easily.

There is additional evidence that teaching English vocabulary to VIP learners challenges the teachers in special VIP classrooms. Semi-structured interviews were conducted with two teachers attending formal training for teaching VIP learners from one elementary school for the blind and one middle school for the blind in Turkey. As noted by Zorluel Özer and Cabaloğlu (2018), teachers carried out the different teaching approaches on VIP young students when compared to the teaching approaches used for the sighted students. With regard to the teaching techniques, auditory teaching helped the students learn vocabulary by listening to a tape. Thus, using L1 interwoven with English was of considerable help to the students in learning English vocabulary. Even though repetition had been used for learning each new word, the teacher also used a game-based strategy for learning new vocabulary e.g., to find a new word starting with the letter 'L'. More effectively, using AT (with a special computer-assisted teaching program to motivate the students to collaborate in their learning with their friends. However, there were some limitations in orthography, teaching materials, time, dependency, negative attitudes toward learning English, and a curriculum overloaded with vocabulary and grammar, which was transferred from contents used for sighted students. Hence, it is important to consider these challenges in an EFL context with respect to the following suggestions: to provide audio materials with Braille, using appropriate AT, and increasing the time for learning.

2.4 Teaching and Learning Materials for VIP learners in a Thai Context

In Thailand, there have been many studies which have conducted surveys and stated the problems of facilities, educational materials, and technology for VIP learners for 2 decades. In addition, there has been some research focused on the development of materials for VIP learners. Although many surveys and experimental studies focused on material development, but in the literature to date, there has not been a single study which surveyed the situation and needs of teaching and learning English vocabulary.

It can be seen from a survey of the situation and the need for course materials in Bangkok and its vicinities. In 2005, the Educational Technology Center in the Office of Non-Formal and Informal Education conducted a study of middle school VIP learners in inclusive education. It reported that the VIP learners were able to participate in the lessons either in class or in self-study sessions reading Braille. More importantly, not only were Braille texts employed, but also there were a considerable amount of audio materials available. These materials contributed to their language acquisition. Focusing on materials development in special education helps VIP learners to participate more easily with sighted students and it seems to encourage the VIP learners to become equals with the other sighted students.

Similarly, Thongnoi (2006) explored the state, the problems, and the requirements of educational management for VIP learners in nearby Bangkok. This study was conducted by using an in-depth interview and a focus group interview with 8 school directors, 12 teachers, and 21 VIP learners from six inclusive schools, one special school, and an informal school. The interview questions were about the problems and management of the environment, curriculum, teachers, and budgets. The report illustrated that the existing course materials might not be appropriate for VIP learners, with the result that the VIP learners had struggled with the lessons provided, which did not include any extracurricular activities for stimulating the students' skills.

Tunti-a-longkarn (2014) established a set of e-Braille learning materials for VIP learners. These materials were designed for using C programs and pressing buttons for Thai and English letters, numerical systems, mathematical signs, tonal marks, and vowels. Tunti-a-longkarn established the program by using an MP3 player recorder and a microcontroller program. Two experts from the Foundation for the Blind in Thailand and The Center for Educational Technology validated this material before the experiment was conducted. The findings showed that 9 VIP learners and 8 teachers from four schools for the blind were satisfied with this set of learning materials after they had evaluated a test in Braille.

A study of media accessibility to online comics for VIP persons indicated that almost all of them were rarely able to access the internet because they lacked vision (Sirisoonthorn, 2017). Sirisoonthorn found that some digital media and technology had been expressly developed to support VIP accessibility to four systems (Alternative Text [ALT text], Graphic Audio, The Comics Empower), and a book set of Philipp Mayer's Life: a Tactile Comic for the Blind. VIPs can use ALT text to access the content from screen readers. Thus, they can visualize the movie by listening to the story from the Graphic Audio. Comics Empower is a website for the blind. One can perform as a voice actor by reading a part aloud and participate in a whole story. A book set of Philipp Mayer's Life: a Tactile Comic for the Blind is the first story-telling book with Braille and descriptions of geometric shapes. It should be pointed out that the contents of these media need to be significantly modified with audio clips, Braille, and geometric shapes to help VIPs understand the passages.

Braille learning machines have been developed with touch and voice by Intha, Pheamousa, and Rowthaow (2019) in order to enhance the VIP learners' Braille encoding skills. These machines contain six raised dots in two columns with optional English letters, Thai letters, consonants and vowels, and Arabic numbers. VIP learners can press their choices and put their hands and finger on the dots. When one letter appears with the raised dots, the microcontroller processes Braille with the appropriate sound. This operating system can be repeated and reversed as the user requires. After a pilot test validated the effectiveness of the machine by experts, the efficiency of the machine was demonstrated and it can be used to enhance the Braille encoding skills of VIPs. Similarly, according to a recent report by Tangpakorn (2019), instructional materials based on a sense of touch e.g., convex forms of Chinese characters have been successfully used with VIP learners from the School for the Blind in Lampang.

In summary, it has been shown from this literature review that many studies in other countries have been conducted using both quantitative and qualitative approaches with semi-structured interviews and observation to identify the problems of teaching English to VIP students, which include teaching approaches which implement educational materials for VIP learners to encourage effective ways of teaching VIP learners. Some studies have used AT with computer software programs or applications with screen readers for VIP learners to enhance their communication in the English language. However, there are still some limitations with regard to computer devices, learning resources, classroom management, and teachers' unfamiliarity with AT or specific programs. These are the challenges which confront VIP learners and teachers at present in the teaching and learning of English vocabulary in the Thai context.

3. Summary

This paper presented the characteristics of VIP learners and AT accessibility in Thailand to help solve some of the challenges of learning the English language in the classroom. The development of appropriate AT and the use of multiple sensory materials has been explored. It is important to recognize that educators or teachers should identify the needs for materials development for VIP learners to be able to acquire English vocabulary. Although there have been many studies in other countries on the needs of VIP students in ELT, no research evidence was found which concerns the development of AT for VIP learners of English vocabulary in special education. Based on this review, educators and teachers should be aware of the key concepts in terms of the characteristics of VIP learners, their perceptions of language and vocabulary acquisition, and material design. It has been demonstrated that the use of Braille, audio storytelling, and 3D objects should be properly established in the Thai context if effective ways of encouraging young VIP learners to understand English vocabulary are to be developed.

Acknowledgments

This study has been financially supported by the Research Administration Division of Mae Fah Luang University Research and Innovation Institute. We would like to thank all the people who supported this study.

References

Araluch, H. A. (2002). *Teaching English as a foreign language to blind and visually impaired young learners: The affective factor* (Doctoral dissertation). Retrieved from https://www.proquest.com/docview /305 428503?pq-origsite=gscholar&fromopenview=true

Aryanti, W. (2014). Difficulties in learning English faced by visually impaired students at Center of Language Development (P2B) in State Islamic University (UIN) Suan Kalijaga. *INKLUSI Journal of Disability Studies, 1*(2), 189-206. Retrieved from http://ejournal.uin-suka.ac.id/pusat/inklusi/article/view/1071

Basaran, S. (2012). Teaching English to visually impaired students in Turkey: A case study. *Energy Education Science and Technology Part B: Social and Educational Studies, 2*(10), 217-226. Retrieved from https://www.researchgate.net/profile/Sueleyman-Basaran/publication/281780906..._Teaching_English to_visually_impaired_students_in_Turkey_A_case_study...

Beal, C. R., & Rosenblum, L. P. (2018). Evaluation of the effectiveness of a tablet computer application (App) in helping students with visual impairments solve mathematics problems. *Journal of Visual Impairment & Blindness, 112*(1), 5-19.

Beatrice, A.O., & Janet, S.A. (2003). *Introduction to special education: An African perspective*. Adwinsa publications Ghana.

Cholthanon, B. (2002). *Fundamental acquisition of inclusive education*. [Class handout]. Bangkok: School of Intern Teacher Development, Office of Rajabhat University Council.

Conroy, P. (2005). English language learners with visual impairments: Strategies to enhance learning. *Rehabilitation Education for Blindness and Visual Impairment, 37*,3, 101-108. Retrieved from https://eric.ed.gov/?id=EJ744461

Coşkun, A. (2013). English language teaching for the visually impaired learners: Training non-native English teachers. *International J. Soc. Sci. & Education, 4*(1), 289-295. Retrieved from http://www.ijsse.com/sites/default/files/issues/2013/v4i1/paper/Paper-26.pdf

Dullayakanit, S. (1988). *A study of achievement of Mathayomsuksa III students for the visually impaired by using audio and non-audio documentary* (Doctoral dissertation). Chulalongkorn University.

Dunlea, A. (1989). *Vision and emergence of meaning: Blind and sighted children's early language*. Cambridge University Press.

Efstathiou, A., & Polichronopoulou, S. (2015). Teaching English as a foreign language to visually impaired students: Teaching materials used by teachers of English. *Enabling Access for Persons with Visual Impairment*, 67-75.

Erin, J. N. (2003). Educating students with visual impairments. *Journal of Visual Impairment & Blindness,* 90, 276-278. Retrieved form http://eric.ed.gov/?id= EJ526021

Gruneberg, M., & Sykes, R. (1991). Individual differences and attitudes to the keyword method of foreign language learning. *Language Learning Journal*, 4, 60-62.

Harrath, F., Guerrah, I., & Hamadouche, M. (2019). *Investigating the effectiveness of the intensive use of audio-scripts in improving visually impaired students' vocabulary*. (Master thesis). Retrieved from http://bib.univ-oeb.dz:8080/jspui/bitstream/...

Hallahan, J. P, & Kaufmann, J. M. (2000). *Exceptional learners: Introduction to special education* (8th Ed). Boston: Allyn & Bacon.

Intha, T., Pheamousa, Y., & Rowthaow, A. (2019). Braille learning machine by alliteration and voice. *Journal of Technical Education Rajamangala University of Technology Thanyaburi, 7*(2), 41-48.

Kittiwattanakul, P. (1987). *The state of educational organization in elementary mainstreaming schools for blind students*. (Master thesis). Chulalongkorn University.

Kocyigit, N., & Artar, P. S. (2015). A challenge: Teaching English to visually-impaired learners. *Procedia-Social and Behavioral Sciences*, 199, 689-694.

Lewin-Jones, J., & Hodgson, J. (2004). Differentiation strategies relating to the inclusion of a student with a severe visual impairment in higher education (modern foreign languages). *British Journal of Visual Impairment, 22*(1), 32-36.

Mahamart, Y. (2017). From darkness to light in hand: The application of art to the psychological theories to urge and support the free expression of blind children. *Journal of Fine Art, 7*(2), 49-116.

Makarova, T. S., Molchanova, M. A., Morozova, E. A., & Stepichev, P. A. (2016). Teaching English to BVI learners, *Дискуссия*, *8*(71), 136-140. Retrieved from https://cyberleninka.ru/article/n/teaching-english -to-bvi-learners

Ministry of Education. (2000). *National education act 12*. Retrieved from http://www.moe.go.th/

Ministry of Education in Thailand. (2009). *People with visually impaired*. Retrieved from http://www.moe.go.th/

Muñoz, M. L. (2019). *Materials for deaf Blindness: Second language acquisition and children with visual and hearing impairment*. Retrieved from https://www.tsbvi.edu/materials-on-deafblindness?id=2994: second-language- acquisition-and-children-with-visual-and-hearing-impairments&catid=99

Nation, I. S. P. (1990). *Teaching and learning vocabulary*. Boston, MA: Heinle and Heinle.

Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.

Okitasaki, I. (2014). The implementation of teaching English writing to young learners with visual impairment. *The 61 TEFLIN International Conference*, *UNS Solo*, 571-574.

Retorta, M. S., & Cristovão, V. L. L. (2017). Visually-impaired Brazilian students learning English with smartphones: Overcoming limitations. *Languages, 2*(12), 1-27.

Schmitt, N. (2000). *Vocabulary in language teaching*. Cambridge: Cambridge University Press.

Smith, S. J., Lowrey, K. A., Rowland, A. L., & Frey, B. (2020). Effective technology supported writing strategies for learners with disabilities. *Inclusion, 8*(1), 58-73. Retrieved from https://meridian. allenpress .com/inclusion/article-abstract/8/1/58/428464/…

Souza, A., & Freitas, D. (2019). Technologies in Mathematics teaching: A transcript of the voices of visually impaired students, braille teachers, and screen readers. In 2019 International Symposium on Computers in Education (SIIE) (pp. 1-6). *IEEE*. doi: 10.1109/SIIE48397.2019.8970140.

Sirisoonthorn, S. (2017). An equality of media accessibility: Comics with vision impairment. *The Journal of Social Communication Innovation,* 1,9, 133-139. Retrieved from http://ejournals.swu.ac.th/ index.php/jcosci/article/view/9117

Stinson, C. (2018). Beyond compliance: An approach to serving English language learners with disabilities. *TESOL Journal, 9*(4), 1-8. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/60169533/Stinson -2018-TESOL _Journal20190731-93795-18pasj5.pdf

Susanto, A. (2017). The teaching of vocabulary: A perspective. *Jurnal Kata: Penelitian Tentang Ilmu Bahasa Dan Sastra*, *1*(2), 182-191. http://doi.org/10.22216/jk.v1i2.2136

Susanto, S., & Nanda, D. S. (2018). Teaching and learning English for visually impaired students: An ethnographic case study. *English Review: Journal of English Education, 7*(1), 83-92.

Suwannakin, A. (2003). *A study of behavior and needs to access information through the internet of persons with visual impairment in Bangkok and vicinity*. (Master thesis). Mahidol University.

Tangpakorn, B. (2019). Creating Chinese characters with convex form to supplement imagination in an introduction to Chinese communication skill for students. *Journal of Education Studies, 47*(2), 137-154.

Thongnoi, A. (2006). *Education management for the blind in Bangkok metropolis and vicinities*. (Master thesis). Dhurakij Bandit University.

Tunti-a-longkarn, P. (2014). Electronic braille learning set for beginners. *The Journal of KMUTNB., 24*(2), 214-222.

UNESCO (2001). *Understanding and responding to children's needs in inclusive classrooms: A guide for teachers*. Retrieved from: http://www.unesco.org/eduction/educprog/sne

Warren, D. (1989). Implications of visual impairments for child development. In M. Wang & M. Reynolds (Eds.), *Handbook of special education: Research and practice*. Low incidence conditions (Vol. 3, pp. 155-172). New York: Pergamon Press.

Wong, M. E., & Cohen, L. G. (2015). Access and challenges of assistive technology application: Experience of teachers of students with visual impairments in Singapore. *Disability, CBR & Inclusive Development, 26*(4), 138-154. Retrieved from https://www.firah.org/upload/notices3/2016/access-and-challenges -of-assistive-technology-application.pdf

Zorluel Özer, H., & Cabaloğlu, N. (2018). Teaching vocabulary to visually impaired EFL learners: A small scale study. *Cukurova University Faculty of Education Journal*, *47*(1), 151-163.