CHAPTER 3
THEORETICAL FRAME WORK

This chapter mainly focuses on the proposed methodology for designing a TCAD for the hearing impaired students that is comprised of a Theoretical Frame work, Research Design, English Curriculum Analysis, Vocabulary number set form Basic Curriculum, English, Thai and Mathematics Curriculum Analysis, TCAD system overview and introduction in Implementation and Evaluation and Results and Analysis.

3.1 Initial Conceptual Framework of Research

An overview of the conceptual framework is illustrated in Figure 3.1, with specific detail outlined in the sections below.

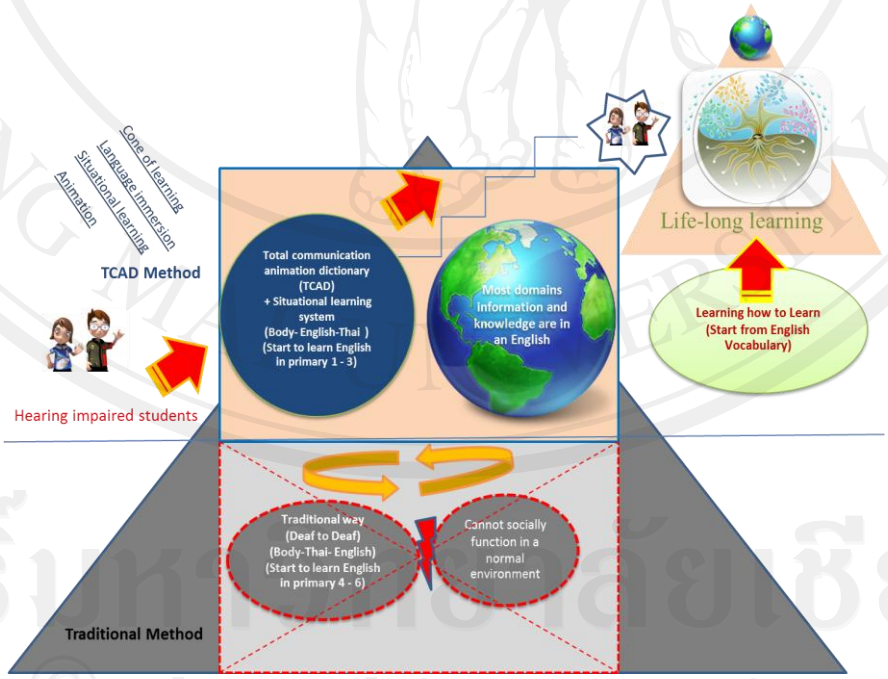


Figure 3.1 The initial conceptual framework of this research

The problems that affected the languages learning of the hearing impaired students it is well documented that literacy is the strongest predictor of success of hearing- impaired children's education, and it relies heavily on vocabulary knowledge. However vocabulary development for the hearing- impaired children is quantitatively reduced as compared to that of typical hearing peers (Moores1978) as they have smaller lexicons, and acquire new words at slower rates (Cole and Flexer, 2007; Paul, 2009). Barker (2003) also explains that vocabulary and language deficiencies have deep effects not only in language based activity but also in the interpersonal and private realms. Not only have that mentioned on above the problems that affected the learning process of the hearing impaired students of in Thailand (Wicha, 2009) were the following

- lack of suitable periods for learning English as a second language; they start to learn English at primary 4 – 6 rather than primary 1 - 3 (refer to chapter 1).
- The designed learning method for interactive communication did not extend to the mainstream environment (deaf to deaf communicating).
- Insufficient learning media to improve the ability for communicating in the English language.
- Lack of opportunity to deal with the international context where most of the information and knowledge are formatted in the English language.

These factors created an impact on these students who are learning how to learn, thus making them meager towards functioning in their social environment and being motivated to lifelong learning.

This research proposes a new framework to develop these students learning environment. The framework is used as the main strategy to help the hearing impaired students improve their English language learning ability. Not only does the concept aims to improve the English vocabulary recognition and memory performance capabilities but it also allows the student to improve their learning behavior that is within the learning media with real situational context. The "Total

Communication Animation Dictionary System", otherwise referred to as TCAD, was used as a prototype to leverage the hearing impaired students' English vocabulary learning system. The TCAD model was used at the primary level of one to three to conduct and control the English vocabulary programs: such as the animation dictionary system (TCAD), the vocabulary related knowledge system (TCAD+), and a vocabulary classified situation game that also includes a story for reading (TCAD3). The methodology in creating the TCAD1 was managed with the "Cone of Learning" theory (E. Dale 1969). It was combined with the Total Communication principle which composed of animation concepts, language immersion (Allen, 2004) and a situational concept (Lave, J and Wenger, E 1991). These theories were applied as the core principles for helping the hearing impaired students improve/increase their English ability; mainly in situational learning from this system. Students gain insight from cases that are relevant to English vocabulary in real life. This method enables them to be motivated to learn by an authentic case (playing a game that is related with the lesson learn) that affects their learning attitude and ability. At the same time, various activities from other principles and theories were conducted to train students for the purpose of continuous improvement in English vocabulary learning - vocabulary retention results and learning behavioral (see details in chapter 2). The final target of this research is to improve the hearing impaired students in extending their vocabulary ability in reading through stories and acquiring a learning management system (see the detail in chapter IV in TCAD3 part). This will also affect their English learning ability and mental attitude. Moreover, these systems will play an important role in supporting the hearing impaired students on learning how to learn and moving forward with lifelong learning.

3.2 Research Design

From the initial conceptual framework (see Figure 3.1) the details of this study will be described with the research design model (see Figure 3.2). The objective of this work is to create and implement a learning system framework to solve problems occurring with the hearing impaired students in learning English. This

research took the implementation process by using three phases for developing and three cycles of implementation. Hence, the software development life cycle and action research was used as the main methodology for designing and implementing the research. The method has four basic steps which are part of the action research concept. The first step was initialing studies and defining problems. The second step was creating a learning system with a software development life cycle. For the third step, a system was implemented. As for the fourth and final step, there was a reflection on the data collection as well as doing an analysis for evaluation in the next development cycle. This research applied the software development life cycle concept and is described in the following demonstrated below (see figure 3.2).

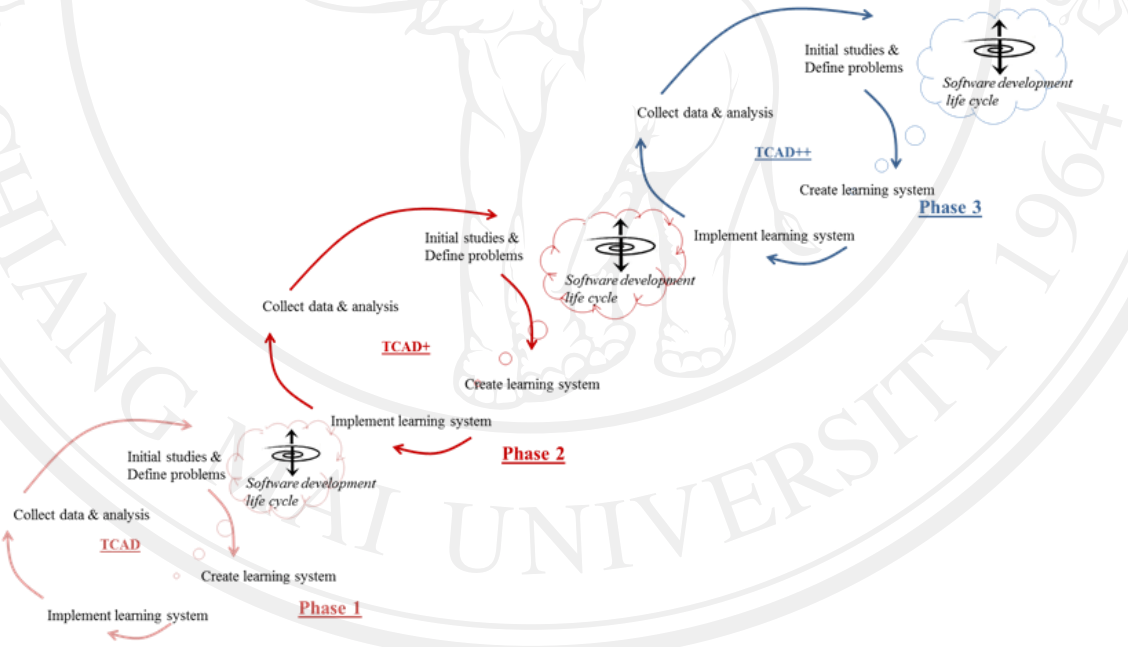


Figure 3.2 The research design framework of this research

3.3 Research Process

From the research design framework (Figure 3.2), this research process will follow the Figure 3.3

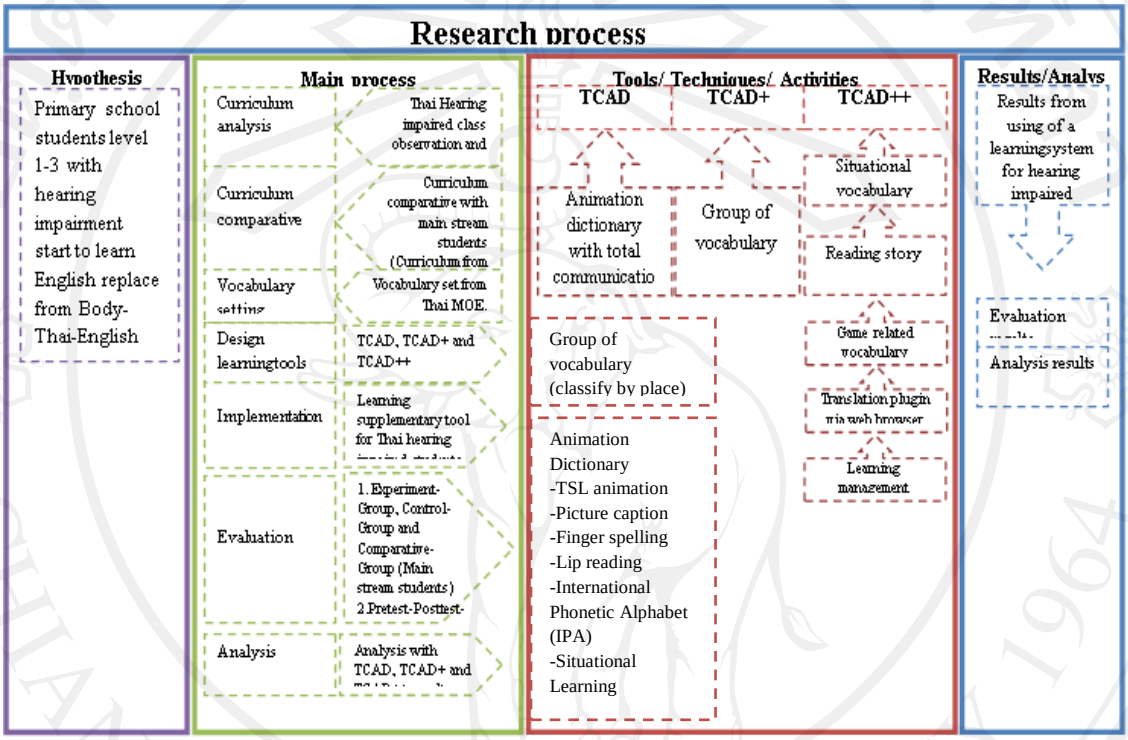


Figure 3.3 The research process of this research

Based on figure 3.3, the research process framework provides the detail of this study with a research hypothesis, the main process, tools technique or activity, and results or output. The hypothesis of the research asserts that “Primary level 1-3 school students with hearing impairment start to learn English that is replaced from Body-Thai-English into Body-English-Thai as the suitable period for the start of learning a second language (see Figure 2.2 Period of language learning). The main process focuses on the hearing impaired students’ curriculum analysis and is comparative with the main stream students for proofing the vocabulary number set, choosing the vital vocabulary, designing the learning tools, implementation, evaluation, and analysis. The tool technique and activities focus on how to create TCAD tools that

comprises of TCAD,TCAD+ and TCAD++; this will be described in Chapter 4. The Results and outputs focus on the results of the learning system for hearing impaired students, which will be described in Chapter 5.

3.3.1 Curriculum analysis

Based on the basic curriculum of primary school students from the Ministry of Education (MOE), this research is followed by that curriculum to analyze the group of instruction for the hearing impaired students to comprise the group of learning areas. The Basic Education for the main curriculum has been arranged to the following eight learning areas (Ministry of Education, 2001):

1. Thai Language
2. Mathematics
3. Science
4. Social Studies, Religion and Culture
5. Health and Physical Education
6. Arts
7. Occupations and Technology
8. Foreign Languages.

For each learning area, the standards serve as the goals to be achieved in developing learners' quality. It covers all stage of basic curriculum and learning areas. The first stage includes primary level one to level three. The second stage includes primary level four to level six. The third stage includes secondary level one to level three. The fourth stage includes secondary level four to level six. For the list of learning areas of the MOE main basic curriculum, the list can be described in the detail of each areas: shown in Figure 3.4

Learning areas comprise bodies of knowledge, skills or learning processes and desirable characteristics attainment, which is required of all basic education learners. The contents are divided into eight learning areas (Ministry of Education, 2001):

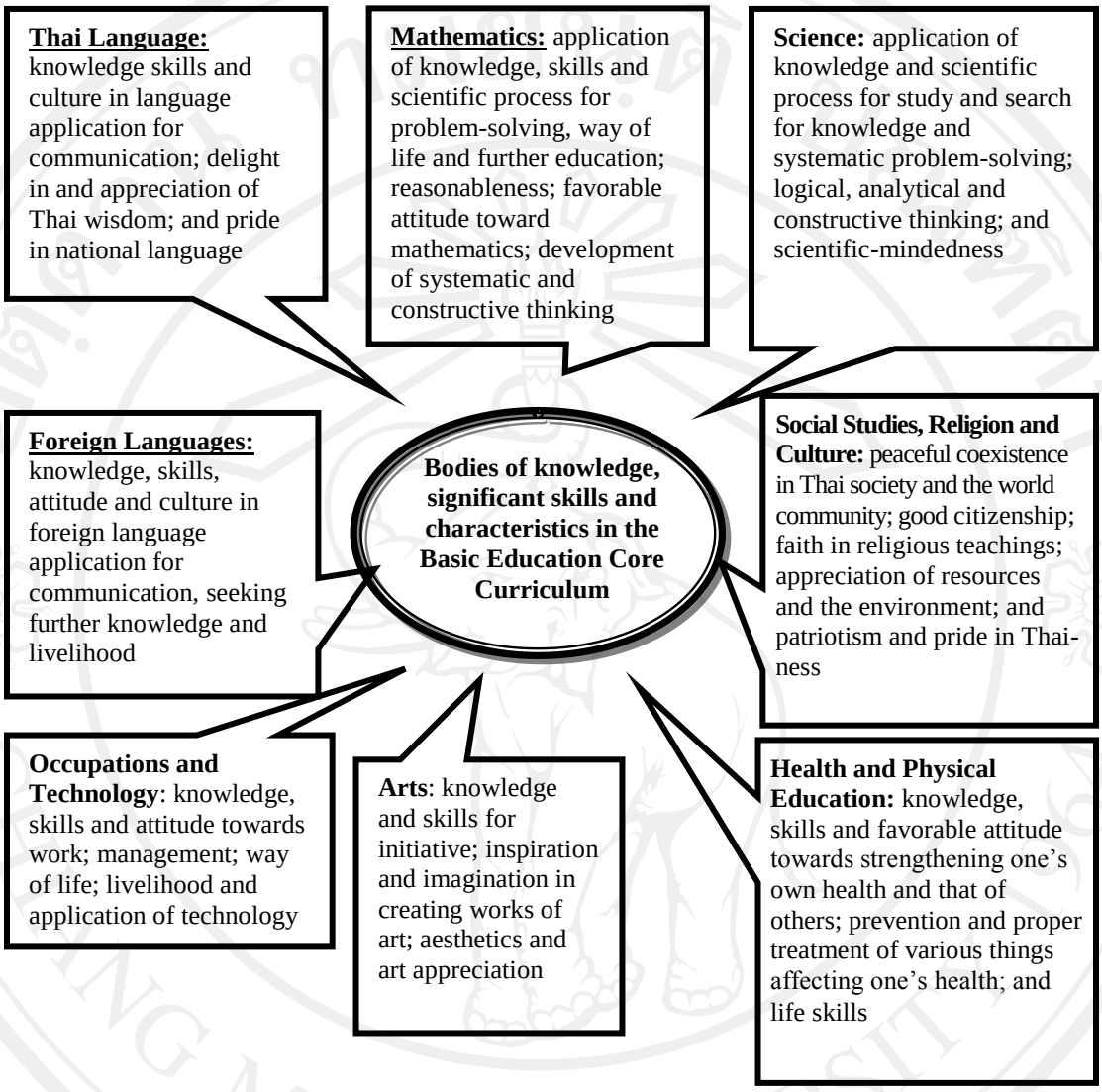


Figure 3.4 The learning areas main detail from MOE

The research focuses on English language learning of the hearing impaired students. From the basic curriculum of MOE, this research starts to drilldown and analyze the three main related learning areas that are comprised of foreign languages (English language) and compare them with the Thai language and Mathematics. The objective is to explore the approach of primary level students learn in proofing as well as finding out the gap between these students and how they cope with the main stream basic curriculum.

3.3.1.1 English Curriculum Analysis

The Basic Education Core Curriculum proposes a standard for each learning areas. They are the guidelines for the detail of each learning areas. The main body of knowledge topic that students should learn are the following (Ministry of Education, 2001):

Topic 1: Language for Communication

: Understanding and having the capacity for interpreting what has been heard and read from various types of media, and ability to express opinions with proper reasoning

: Possessing language communication skills for effective exchange of data and information; efficient expression of feelings and opinions

: Ability to present data and information, concepts and views on various matters by speaking and writing

Topic 2: Language and Culture

: Appreciating relationship between language and culture of native speakers, and having the capacity for use of a language that is appropriate to occasions and places

: Appreciating similarities and differences between language and culture of native speakers and Thai speakers, and having the capacity for correct and appropriate use of language

Topic 3: Language and Relationship with Other Learning Areas

Standard F3.1: Using foreign languages to link knowledge with other learning areas and as a foundation for further development in seeking knowledge and widen one's world view

Topic 4: Language and Relationship with Community and the World

: Ability to use foreign languages in various situations in school, community and society

: Using foreign languages as the basic tools for further education, livelihood and exchange of learning with the world community

3.3.1.2 Vocabulary number set form Basic Curriculum

From the main topic of Foreign Languages areas, this research focuses on English language as the Foreign Languages areas. The main topics are widely mentioned about the learning areas. This research focusing on the English vocabulary learning, the curriculum analysis focuses on the vocabulary learning from the MOE, which focuses on the vocabulary number set of English, Thai and Mathematics. The group of English vocabularies which are set in the reference from the curriculum analysis and comparative are shown in the figure below:

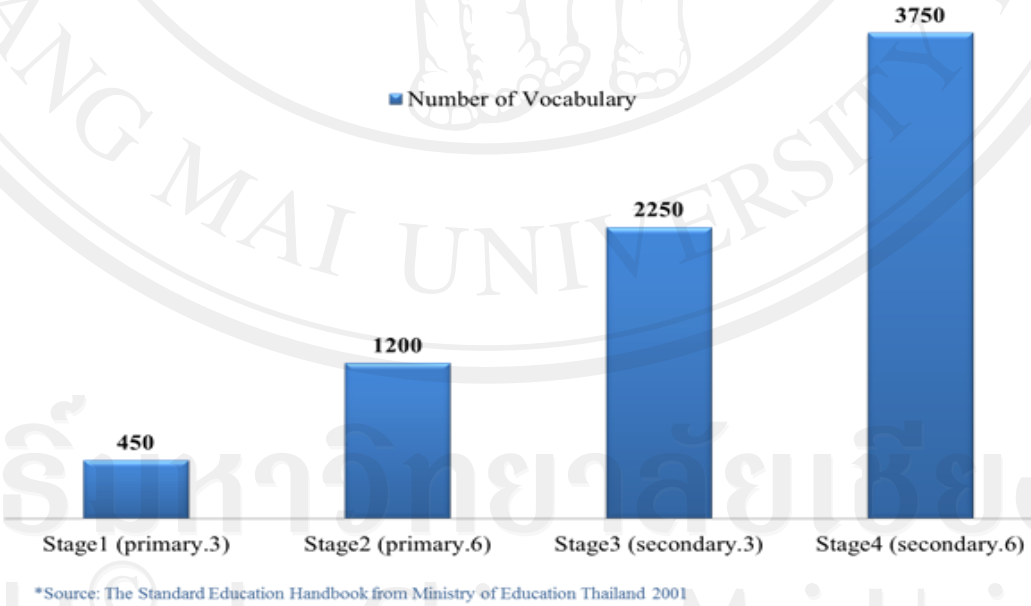


Figure 3.5 The standard number of English vocabulary analysis from the MOE, 2001 in each stage

Figure 3.5 shows the Basic English Vocabulary List for Primary School students' level 1 to Secondary School level 6. In stage one (Primary one to three) the total number set of vocabulary that students will have to learn is 450. In stage two, the additional vocabularies in this level is 1,200. In stage three, there are a total of 2,250 vocabularies. In stage four, there is approximately 3,750 vocabularies for the students to learn.

Stage 1

Vocabularies in this stage refer to personal identification, an environment that is close to their families, food and beverages, and relationships between individuals. The number of vocabularies is within 300-450 words (words that are concrete). In this stage, students are tasked in learning how to use these words into a sentence that is a simple form.

Stage 2

Vocabularies in this stage refer to personal identification, an environment that is close to their families, food and beverages, relationships between individuals, hobbies and recreation, health and welfare, trading, and weather. The number of vocabulary is within 1050- 1200 words (words that are concrete and abstract). In this stage, students have to learn how to use these words into a sentence that is in a simple and compound form.

Stage 3

Vocabularies in this stage refer to personal identification, an environment that is close to their families, food and beverages, relationships between individuals, education and career, travel services, places, language, and science and technology. The number of vocabulary is within 2100 - 2250 words (words are more additional and abstract). In this stage, the students learn how to use these words into a sentence that is in the form ranging from simple, compound, and complex.

Stage 4

Vocabularies in this stage refer to personal identification, an environment that is close to their families, food and beverages, relationships between individuals, education and career, travel services, places, language, and science and technology. The number of vocabulary is within 3600-3750 words (Terms with the different uses.). In this stage, the students are required to learn how to use these words into a sentence that is in the form ranging from simple, compound, and complex.

From the vocabulary number set, the main vocabulary groups are provided in the following figure presented:

1. Personal Identification
2. House and Home
3. Life at Home
4. Education and Future Career
5. Free Time and Entertianment
6. Travel
7. Relation with Other People
8. Health and Welfare
9. Shopping
10. Food and Drink
11. Services
12. Places
13. Foreign Langauges
14. Weather

Figure 3.6 List of main vocabulary group (J.A. Van EK, 1977)

In figure 3.6, the 14 groups of vocabulary are learned for communication skill which is reference from the Council of Europe (J.A. Van EK, 1977). The vocabulary groups comprising of personal identification, house and home, life at home, education and future career, free time and entertainment, travel, relation with other people, health and welfare, shopping, food and drink, service, places, foreign language, and weather, are incorporated into the teaching and learning system in Thai schools. These were following group of vocabularies selected in this study for the primary students - food and drink, places, shopping, house and home, life at home, and personal identification.

The Thai Ministry of Education (MoE, 2007) identified a list of requirements for special educational schools to support computer-assisted instruction (Table 3.1). The main emphasis is placed on the need for schools to provide access to the Internet and develop educational materials for teachers and hearing impaired learners to improve the learning and teaching of English as a second language.

Table 3.1. Requirements of educational media content based on teacher input at a school for the hearing impaired, Thailand. (Source: MoE, 2007)

Requirements of educational media content	
Computer-assisted instruction (CAI) content	**Internet (Web) content**
1. Vocabulary and meaning 2. Vocabulary spelling lesson 3. Writing lesson 4. Conversation lesson 5. Reading lesson 6. Noun 7. Verb 8. Place and location lesson	1. Tale and short story 2. Daily life short story 3. Short English news 4. A-Z 5. Fruits 6. Animal 7. Direction

The example of English language learning area

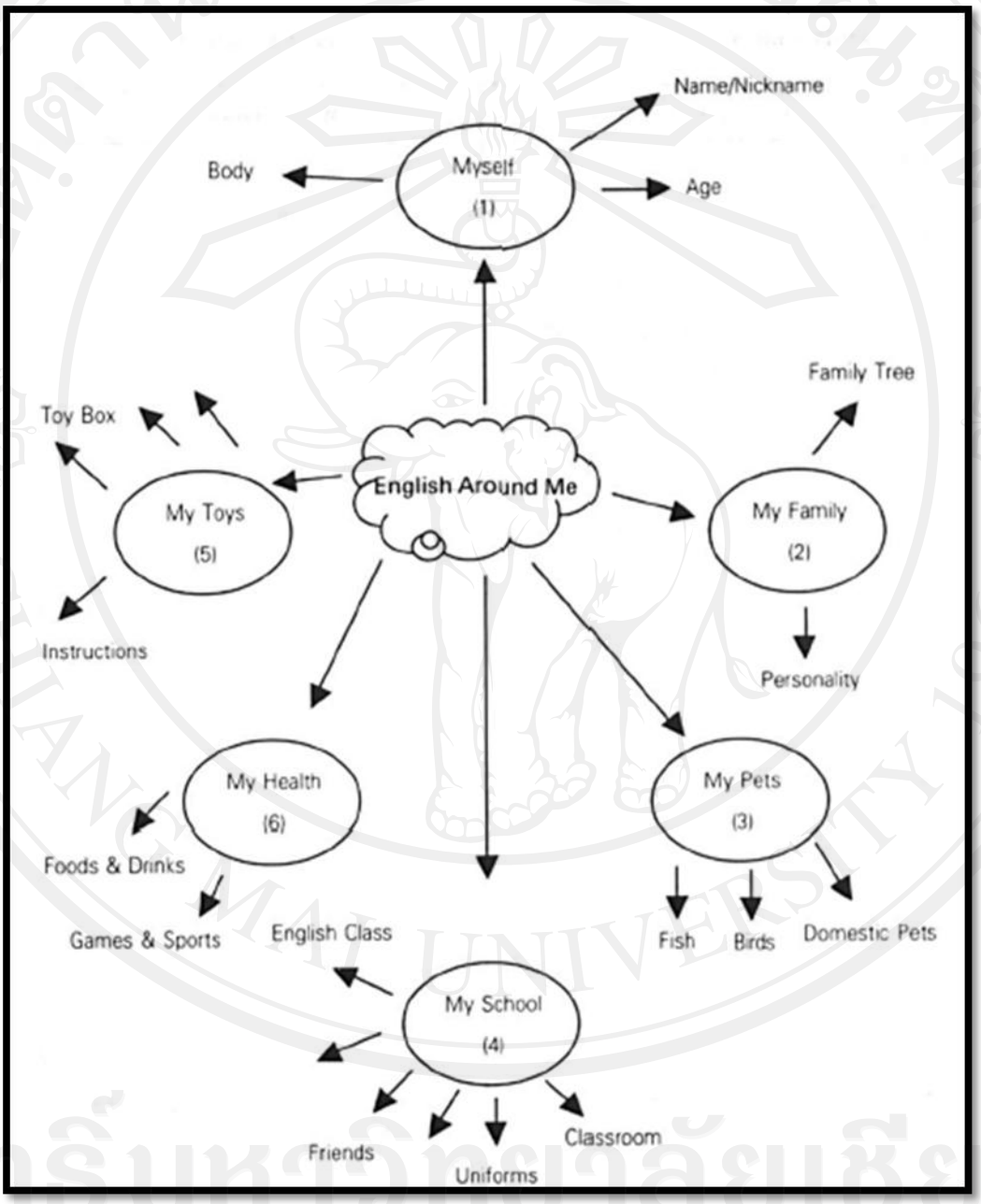


Figure 3.7 The example of English language learning area in Primary level 1 from MOE

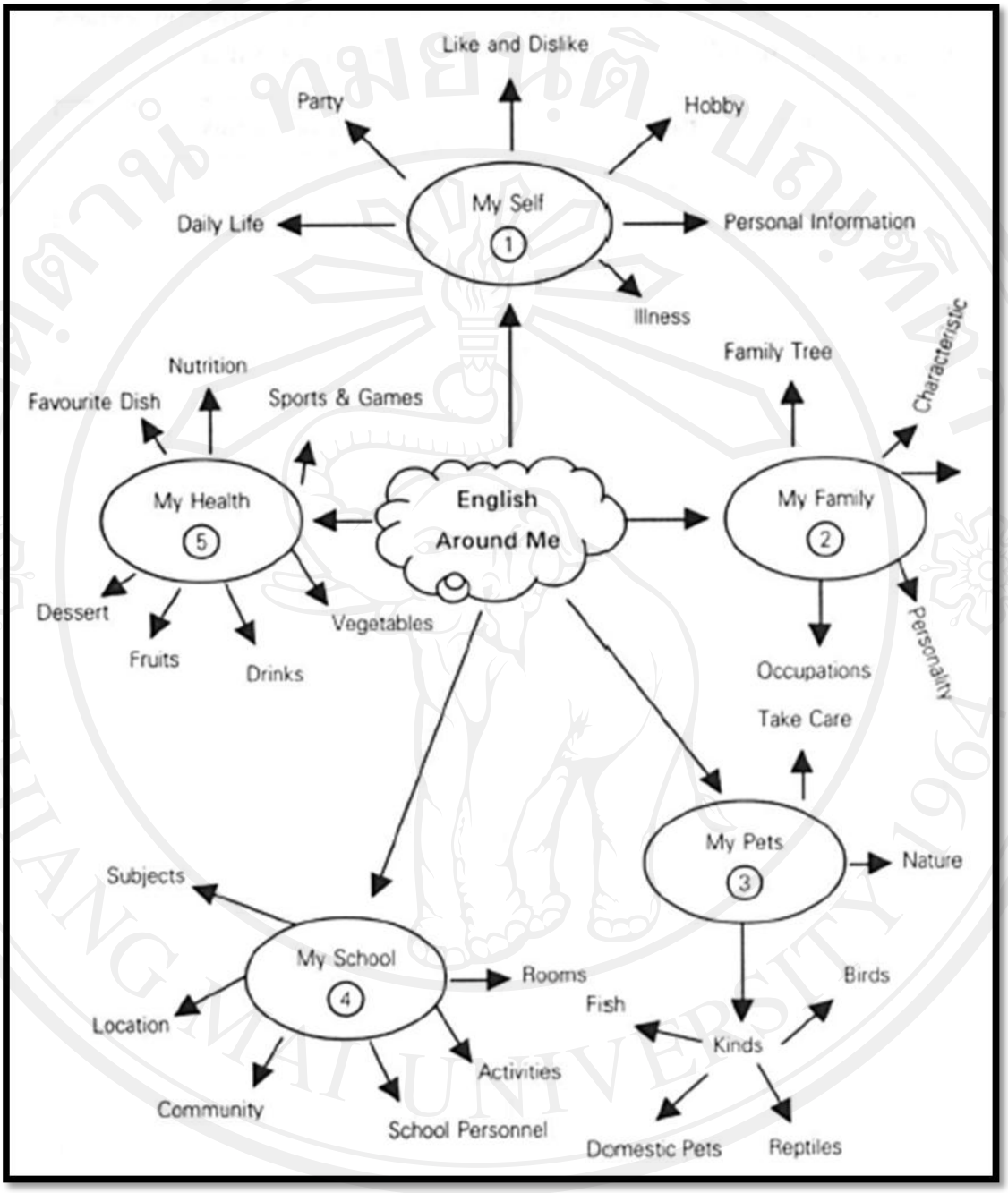


Figure 3.8 The example of English language learning area in Primary level 6 from MOE

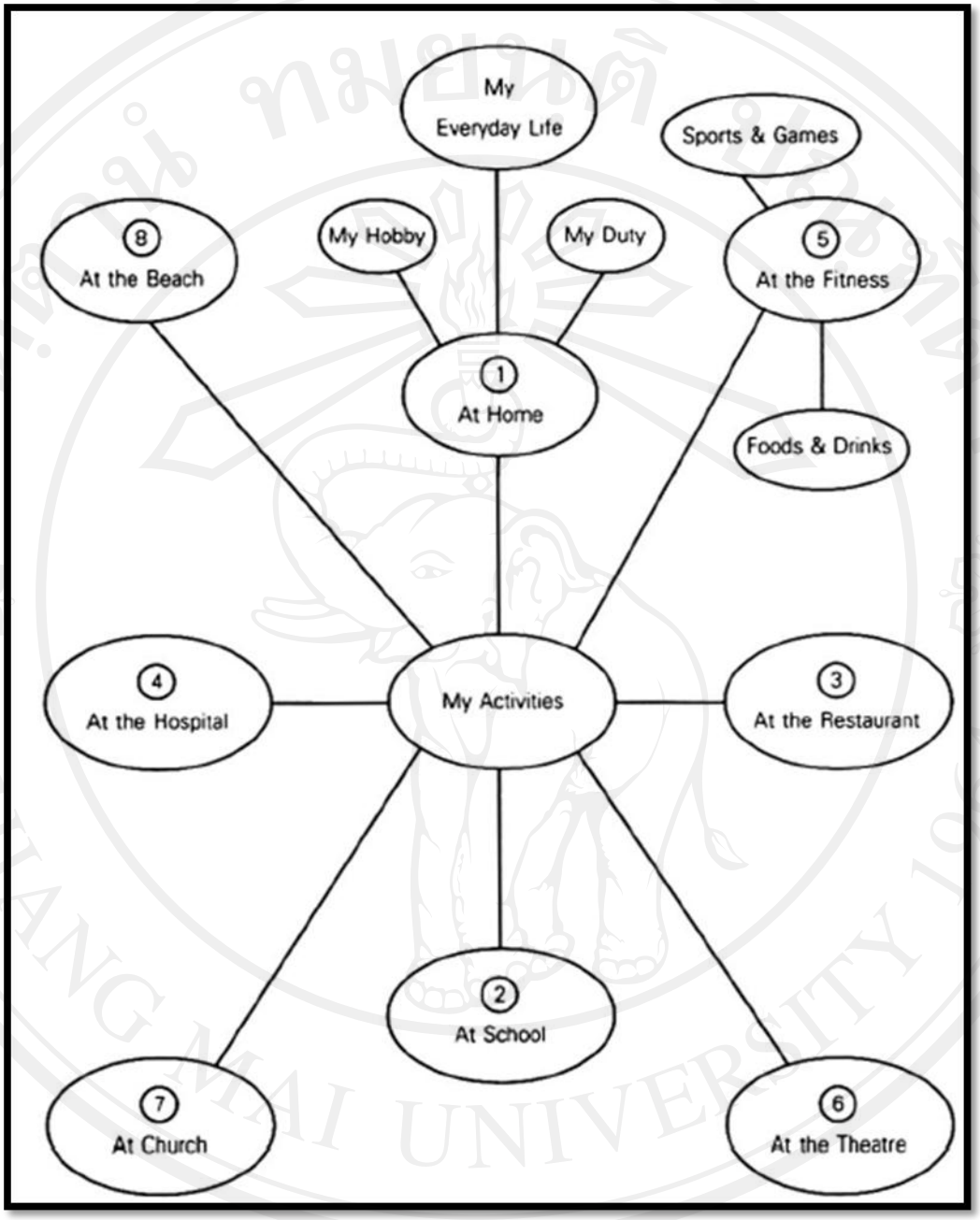


Figure 3.9 The example of English language learning area in Secondary level 1 from MOE

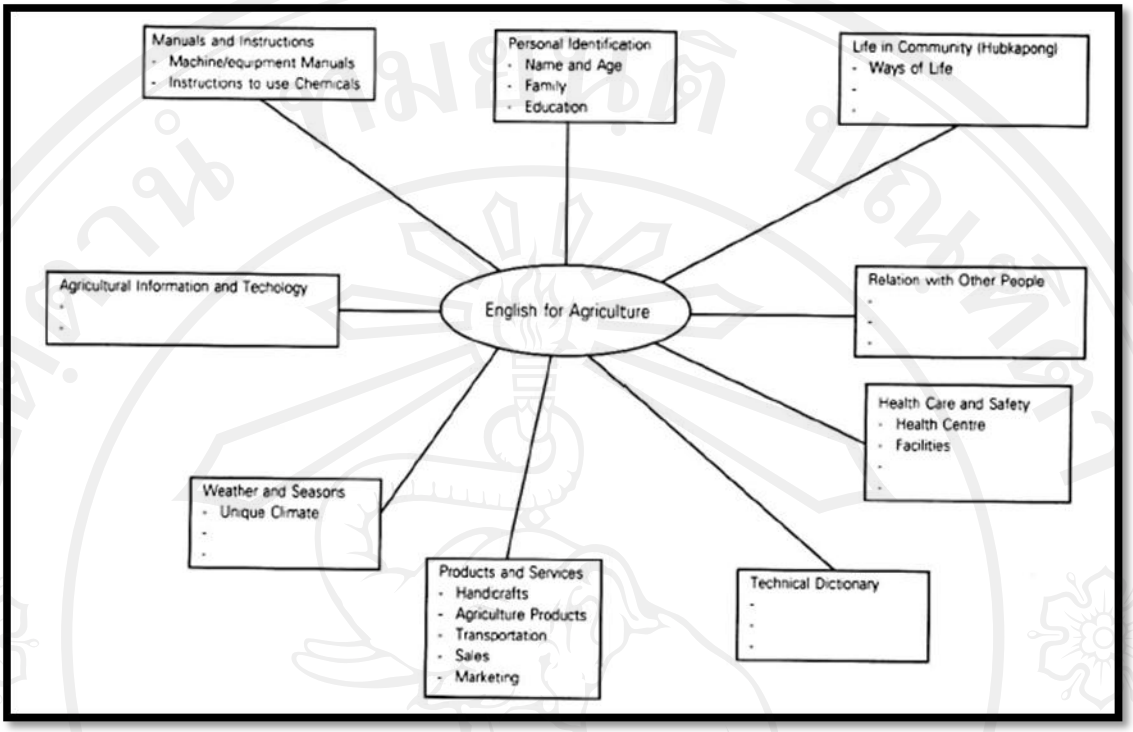


Figure 3.10 The example of English language learning area in Secondary level 5 from MOE

From Figure 3.7 to Figure 3.10 are the examples of the English learning ontology start from Primary level 1 to Secondary level 5. That mentions the learning curriculum with "What is" question in each learning modules. For examples in the Primary level 1 questions that "what is the pets?" and list for the related vocabularies and learning story. However those ontologies cannot support related situational questions for examples: Why, How, When, Which and Where.

3.3.1.3 Hearing Impaired English Curriculum Analysis (Compared with mainstream students)

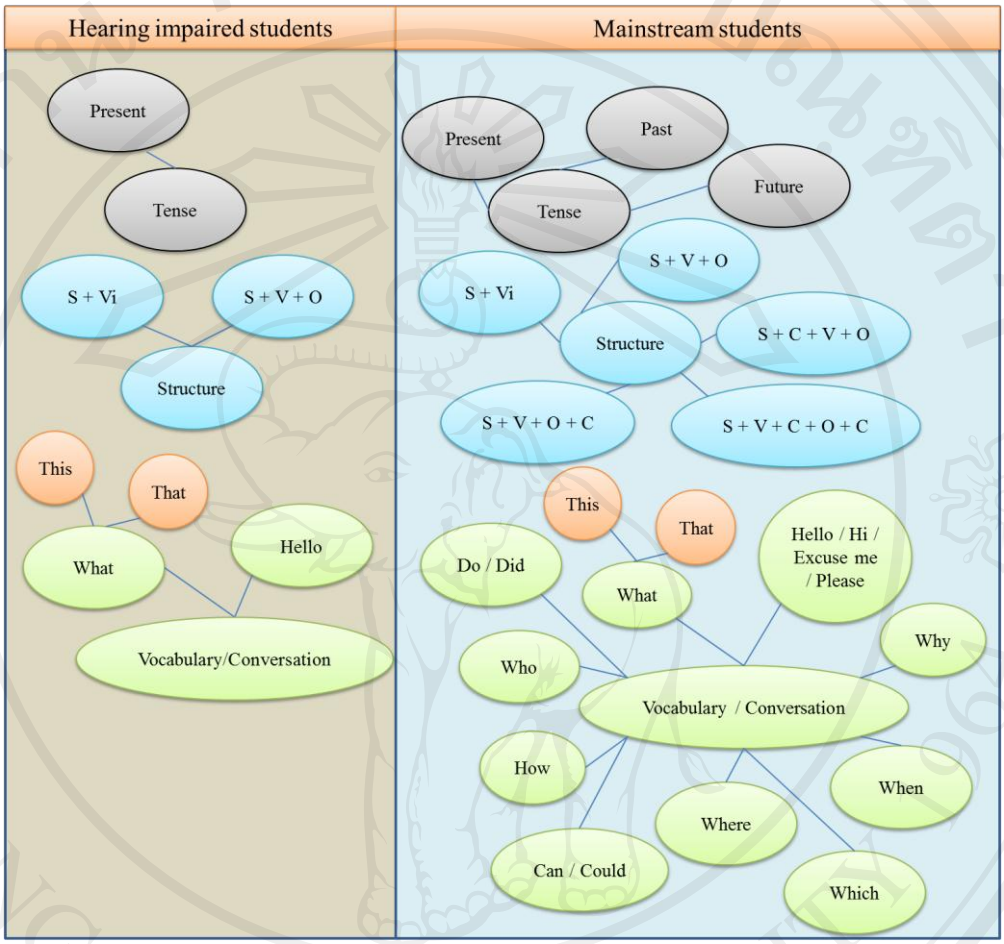


Figure 3.11 The English curriculum analysis and observing result

Based on the initial findings from the class and curriculum analysis and observation, the researcher found that primary students have limitations in learning English; which is exemplified by a limited vocabulary, sentence structure and grammar. Limited teaching and learning media affect class teaching that focuses only on Thai sign language, Thai writing and a relatively small amount of English. Students start to learn English at level 5 (12-13 years old). The research idea of using Total Communication (TC) in English vocabulary teaching came after a literature review showed a gap in a current research (Chapter 2), as well as team brainstorming at the school, and doing a

curriculum and instructional analysis. The discoveries were adapted to the total communication methods. Essentially, they were to replace paper based materials with total communication methods and an Internet media for initializing the idea. In response to the Thai Ministry of Education report, the Anusarnsoontorn School for the Deaf is collaborating with the Deaf School Rotary Club and Chiang Mai University to develop a computer-based learning management system to support teachers and improve the acquisition and retention of the English language vocabulary. The school, which is located in the city of Chiang Mai, and is supervised by the Bureau of Special Education under the control of the Thai Ministry of Education, consists of 45 teachers and 330 hearing impaired students.

Curriculum analysis was undertaken at Anusarnsoontorn School for the Deaf to compare the curriculum content with that of Thai mainstream education. These curriculum observations, combined with an analysis of 6-11 year old pupils' English language competence, have revealed a number of issues, as summarized below:

- Limited knowledge of English vocabulary
- Low memory retention of English vocabulary
- Limited ability in structuring basic sentences
- Focus is limited to the instruction of Thai sign language only
- Limited educational media resources available to teachers (pictorial based flash cards as the only tool)
- Limited availability of teachers to teach English to hearing impaired students

In response to these curriculum observations and the Thai Ministry of Education requirements, a Total Communication Animation Dictionary (TCAD) was developed as a potential solution.

3.3.1.4 English Class Observing Summary

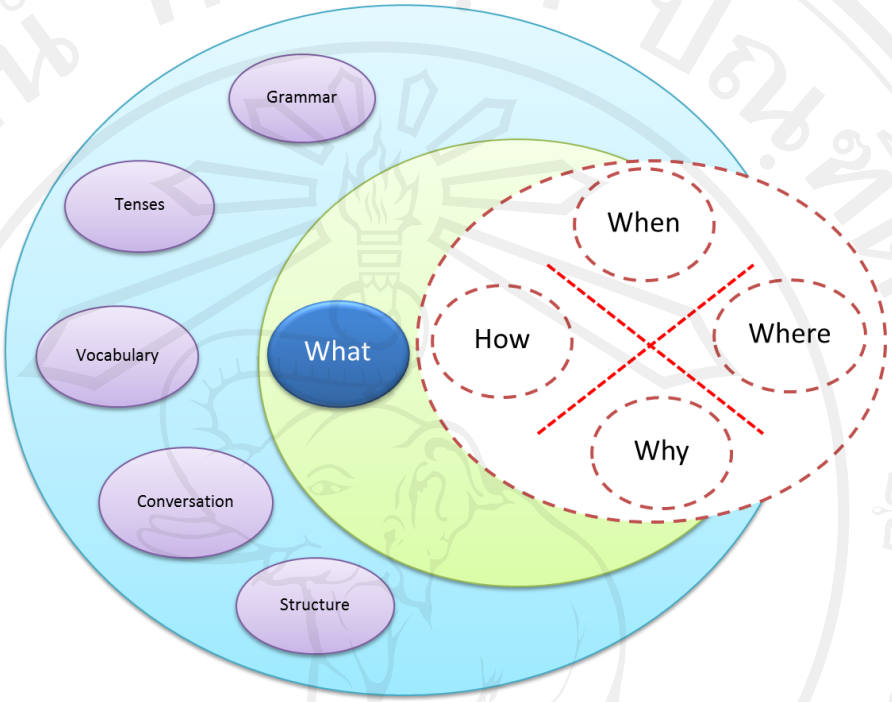


Figure 3.12 English class observing summary

From the example of the MOE curriculum analysis, figure 3.11 shows a summary of the English curriculum that is operated in Thailand. The main knowledge context of general domain and English learning compose of questions dealing with "what, how, why, when, and where" before they're drill-downed to each learning details. From the main general topic of the curriculum, they learn grammar, tenses, vocabulary, conversation and sentence structure. However, in the general curriculum the main point is focusing on the "what" question (see Figure 3.7, 3.8 and 3.10) and only displays the "where" question in figure 3.9

From the learning context, these students are limited in gaining knowledge structured in the perspective questions of "When, Where, How and Why" which are considered crucial to the main part of the learning domain.

3.3.1.5 English, Thai and Mathematics Curriculum Analysis

To study sought out to find the set of vocabularies for the learning tool not only in the English curriculum but also in Thai curriculum and Mathematics curriculum from MOE. The research deems that these learning areas are the standard basic for all Thai students to learn. The analysis is focused on the vocabulary list of primary level one to three. The vocabularies set form of the Thai curriculum is show below:

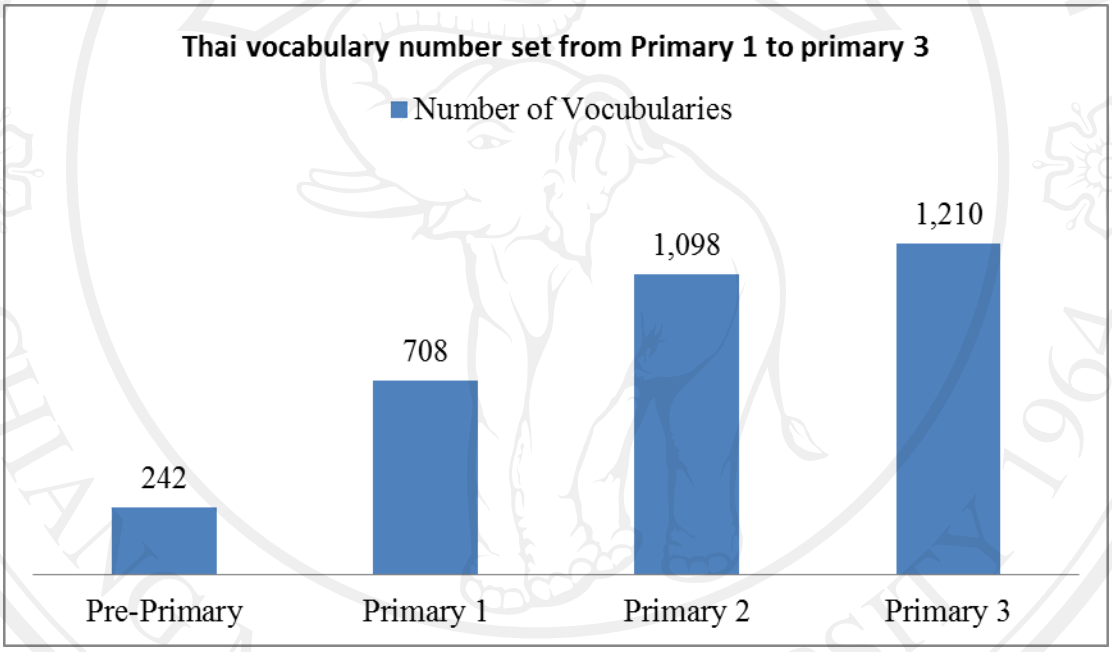


Figure 3.13 Thai vocabulary number set in Primary school student level 1 – 3 analysis from Thai curriculum MOE

Figure 3.13 presents the total number of vocabulary being used in Primary 1-3. There are approximately 3,258 words that are composed of vocabularies: pre-primary consists of 242 words, primary one consists of 1708 words, primary two has 1,098 words, and primary three possesses1,210 words.In terms of primary level one to three, they learn in numbers and operations. For primary 1, students learn about numbers ranging from 0-100. At primary 2, the students learn about numbers from 1-1000. When they

reach primary 3, the learning of numbers range from 1-100000. In addition, students learn how to use the +, -, X ,÷,<>, = ,≠ formulas with these numbers. For measurement, they learn about length (meters, centimeters, millimeters), weight (gram, kilogram and capacity), volume (liter, milliliter), time (clock in second, minute and hours day, week, month, year) and amount. The geometry learned is in the format of two-dimensional and three dimensional; these dimensions are angle, triangle, rectangle, circle, oval, radiation, circular cylindrical and other shapes. The students are also taught the basics of algebra. For understanding probability, they learn with pictures, charts and bar charts. From the mathematic curriculum analysis, this study found that the mathematical vocabulary set is approximately 100 – 120 words for setting up the learning tools.

3.3.1.6 Vocabulary immersion set for Primary 1 – 3

Figure 3.14 Vocabulary immersion set for Primary 1 – 3

3.3.2 Design learning tools

For this section will describe the overview and framework of learning tool call as “TCAD” for more details of TCAD system will be explained in Chapter 4.

3.3.2.1 TCAD system overview

TCAD is a conceptual teaching tool designed to enable hearing impaired pupils in primary schools to acquire English vocabulary and improve their retention skills. It attempts to incorporate the seven ways of communicating, which include sign language, finger spelling, lip reading, picture captioning, reading, writing and vocabulary. It is designed to allow pupils to work together, or individually, and to explore, discover and acquire new English lexical knowledge. Technically, TCAD comprises three main sections: a database management system and a server (managed by an administrator), and a front end supporting the user interface (Figure 3.15,3.16). It is implemented using a mixture of IT tools such as motion capture to support the animation of realistic and effective sign language, an SQL database to build the dictionary, and PHP and Java Script to build the user interface. Phase one of TCAD focuses on developing an e-dictionary consisting of 300 English words. Each word is introduced to the learner through an animated character, with pupils being given a choice of character gender. An example screen shot is shown in Figure 3.17. As the learner clicks on a given word the animated character reveals the corresponding Thai sign language and displays its matching picture, followed by its denotation in English and Thai, as well as its international phonetic alphabet (IPA), the relevant finger spelling and lip reading, and a situated learning contextual illustration. TCAD provides the learner with word searching and browsing facilities. In this TCAD version, teachers with administrator privileges can enter new words and/or delete existing words.In phase two TCAD+ extends TCAD by placing words in the e-dictionary into their specific contexts. For example, when the learner clicks on a given lexical item, (e.g. house), a picture illustrating the context is

displayed, as exemplified in Figure 3.18.If the learner clicks further on the ‘house’ picture, another situated learning screen is displayed, listing a set of related lexical terms giving the learner the opportunity to discover additional lexical terms and their specific contexts (Figure 3.19). Finally, if the learner wishes to further explore any of these additional lexical items, (e.g. ‘living room’), the animated character again appears to reveal the corresponding Thai sign language in addition to a picture representing the ‘living room’, and its denotation in English and Thai languages (Figure 3.20). In summary, TCAD+ attempts to create a learning environment where the vocabulary learned will also be depicted in a real life setting through multimedia content. It is based on the situated learning approach which suggests that learning is best achieved when situated in a specific context and embedded within an activity, particularly a social and physical environment (Lave and Wenger, 1991). In phase three from previous work this phase improve the learning system with situation learning by using learning management system and learning story (Figure 3.21) to provide and extend the vocabulary knowledge in to the reading skill that link with related story via free game in the social network (Figure 3.22, 3.23) and bundle with vocabulary web browser plugin translator (Figure 3.24) all of those system call as TCAD++.

3.3.2.2 Framework of TCAD system

From the review of related work and the limitation of English learning media for Thai hearing impaired students, the research develops the previous TCAD bundle with situational learning theory to create a new learning framework for Thai hearing impaired students to learn English vocabulary and read stories via a game within a real life context that is claimed, “TCAD++”. The primary objective of the TCAD++ tool is to provide an easy to use GUI to create a real English vocabulary learning situation using reading content in a real context using a game via a existing free social network game bundled with TCAD and TCAD+ (e.g. FarmVille; the farming game, CityVille; the

city building game from Facebook etc.). The propose of TCAD++ and its architecture explained are below;

3.3.2.3 Propose TCAD system architecture

In this section, the system architecture of TCAD for hearing impaired students will be shown in order to visualize the subsystem, functions, services, tools, and interface between each element in the system. The proposed system architecture at the design level of the framework will be ameliorated in order to present functionality of the service. The functional view of the system is illustrated in Figure 3.15

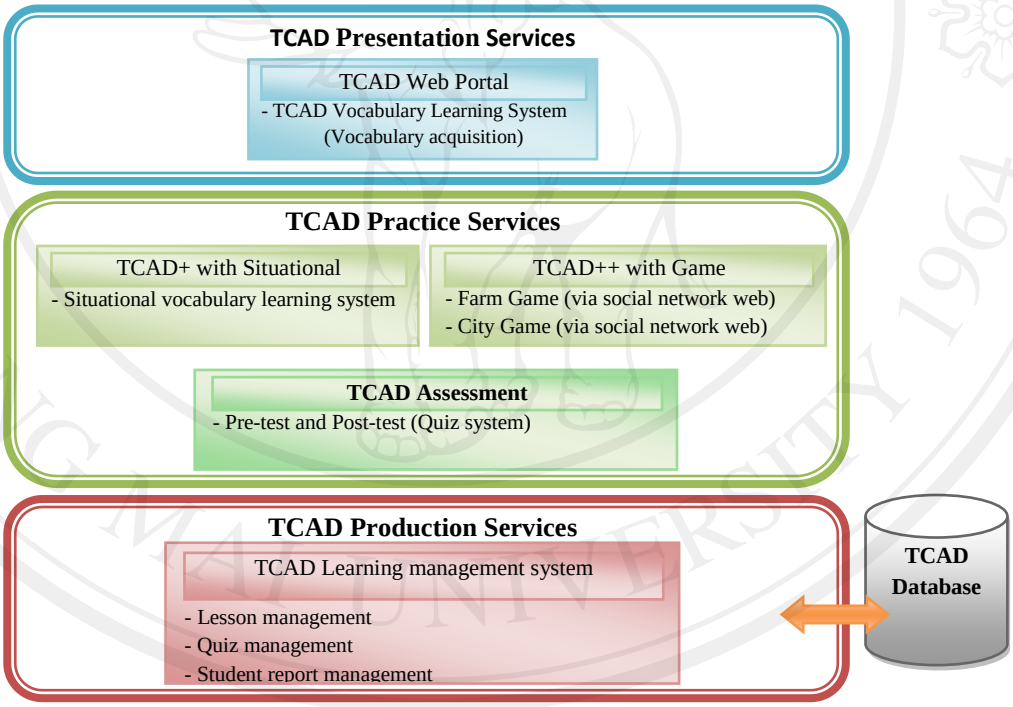


Figure 3.15 TCAD system architecture

The architecture in Figure 3.16 shows the proposed functions which support the activities in each service. The TCAD presentation service level is fundamental to present TCAD as a learning tool via a web service. It aims at supporting the vocabulary learning activities of hearing impaired students.The

second level is a TCAD practice service which focuses on improving English vocabulary learning of hearing impaired students. This service is divided into three levels:TCAD with situational vocabulary learning that comprises the authentic vocabulary lesson to emphasize vocabulary memory retention in hearing impaired students.The TCAD game within these modules aims at enhancing vocabulary memory retention and vocabulary context with examples via game.The TCAD assessment of these modules aimsfor the students to join with TCAD previous system and take part in the quiz activity to test the vocabulary learning through a pre-test and post-test examination. The last level is a TCAD production service which focuses on a learning management system (LMS) for teaching facilities, the teacher can create, update and add the lesson related to TCAD vocabulary autonomously. These levels compose the lesson management modules for creating ,editing ,deleting and controlling the lesson, the quiz management modules for creating, edit and managing the pre-test and post-test examination and the last module is the students report management modules used to report students scores and statistics.

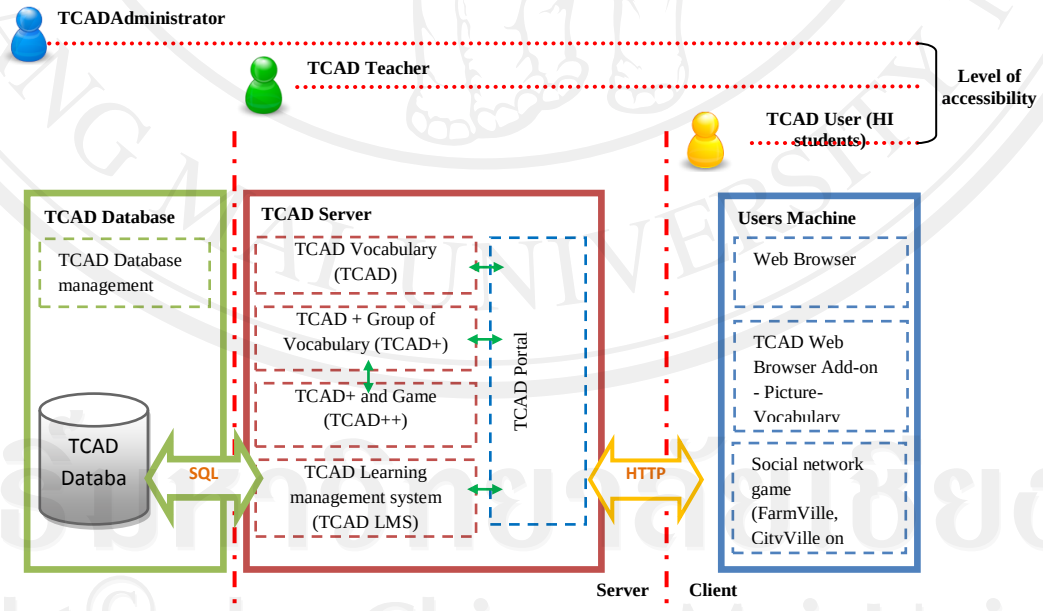


Figure 3.16 TCAD service functionality and level of accessibility

The architecture revealed the TCAD services functionality and level of accessibility. The modules for presentation services for users or students are depicted on the client side, while the TCAD server system for the teacher is depicted as the server side. The TCAD database system is shown as the administrator side. The presented architecture implies that there are two parts of the application that support the service, server and client side. The sever portal is a server-side application which allows users to access all provided services on the TCAD via a web browser on the client side section (e.g. Internet Explorer, Mozilla Firefox). The TCAD portal is a server-side application which aims at presenting services from diverse modules (e.g. TCAD vocabulary or "TCAD", TCAD plus the group vocabulary or "TCAD+", TCAD with game and learning management system or "TCAD++") in a unified way. The portal also handles HTTP connections from a web browser on the users' machines. Another application is the TCAD database management system for the administrator to manage the TCAD database directly, which was developed for this TCAD system. Adopting the notion of the TCAD server system and TCAD database management system, the system will facilitate direct access for the administrator and teacher to all available services on the system. For the teacher the system will provide them the ability to add, edit, and delete the learning content autonomously that. This makes it possible for TCAD users to access the learning content via a web browser and users can utilize the TCAD web browser add-on that supports the hearing impaired to translate TCAD content with normal text into the picture and the motion of Thai sign language.

Figure 3.17 TCAD e-dictionary screen showing the e-dictionary with male and female characters

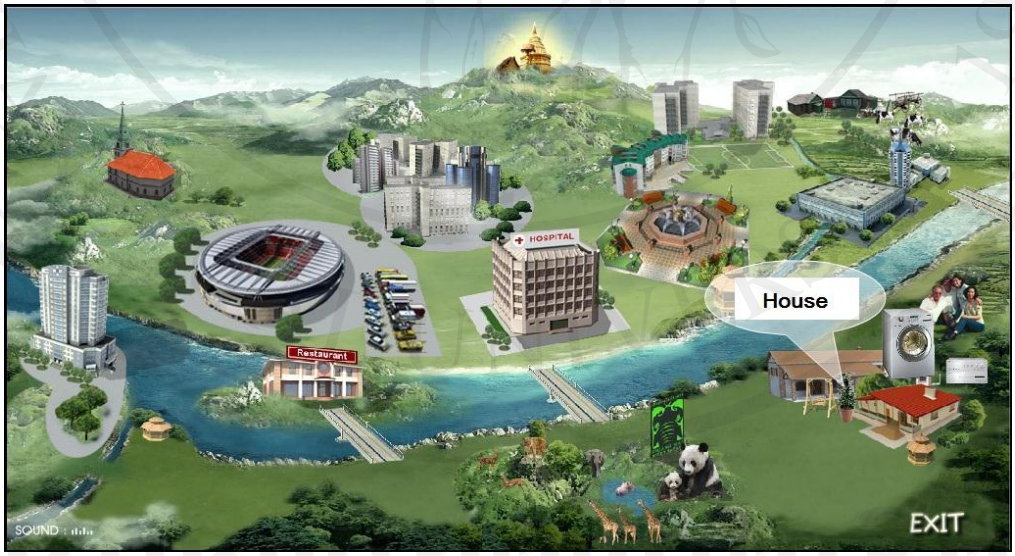
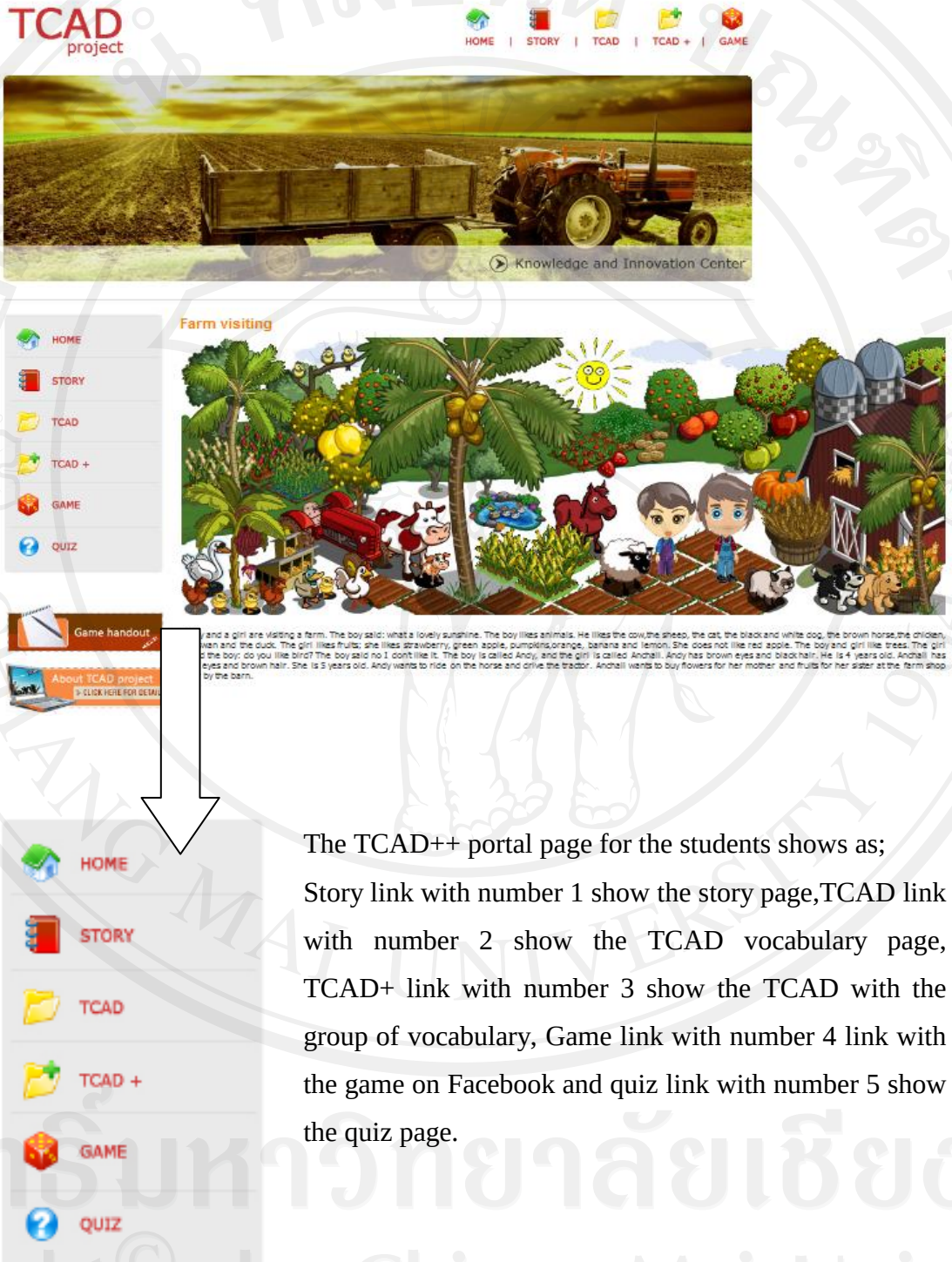


Figure 3.18 TCAD+ screenshot depicting the main screen (vocabulary classified situation or location)

Figure 3.19 TCAD+ screenshot illustrating the context related to learning vocabulary associated with the word ‘house’

Figure 3.20 An example TCAD+ screenshot showing the contextual vocabulary associated with ‘living room’



The TCAD++ portal page for the students shows as; Story link with number 1 show the story page,TCAD link with number 2 show the TCAD vocabulary page, TCAD+ link with number 3 show the TCAD with the group of vocabulary, Game link with number 4 link with the game on Facebook and quiz link with number 5 show the quiz page.

Figure 3.21 TCAD++ Learning management system (LMS) and reading story

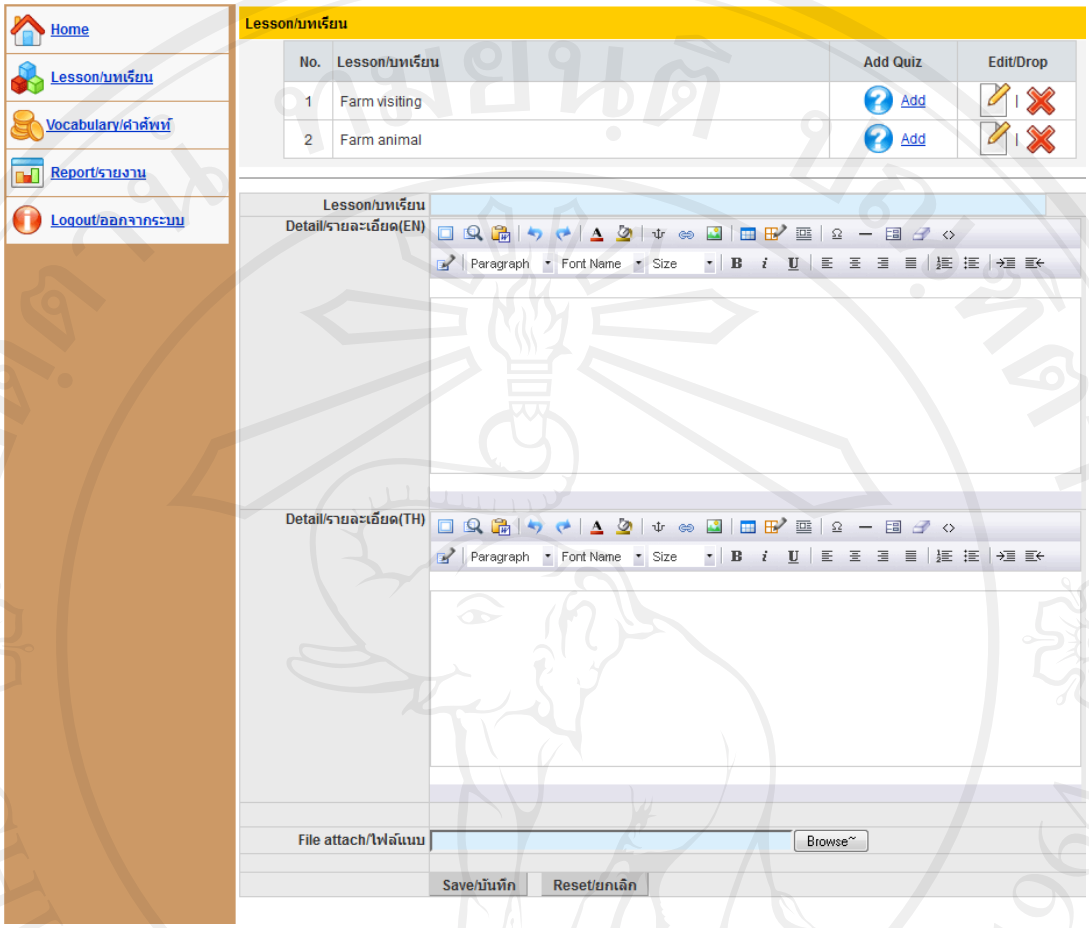


Figure 3.22 Learning management system (LMS), lesson management part

Figure 3.23 The TCAD vocabulary web browser plugin translators for Firefox add-on show the picture and sign language animation for the hearing impaired

3.3.3 Implementation and Evaluation

The TCAD learning system was implemented to the hearing impaired students as a supplementary tool in the English language teaching class for every day: within 30 minutes to 1 hour per day. As for the TCAD tool, the students learn the meaning of each vocabulary with the animation dictionary tool. The total communication philosophy is comprised of an animation sign language, picture caption, text for descript the meaning of vocabulary in English and Thai, International Phonetic Alphabet (IPA) to learn the phonetic symbol, finger spelling, lip reading video, and situational based learning link with TCAD+. The TCAD+ compensates for the shortcoming of the TCAD by using the group of words that are classified into places. The daily life vocabulary from the total communication was developed into a word group system. It is represented as situational vocabulary by "where it is" and bundled with animation and Flash engine to present the learning tools as TCAD+. TCAD+ is used for everyday English class with TCAD in the notebook device and computer laboratory. Based on the application of the TCAD and TCAD+ in the case study, the review from students and teacher created the requirement for developing TCAD++. From the review, the students needed a learning tool that enables them to enjoy studying and being matched with a lifestyle where one is able to use the device for fun and games or simple leisure. The teacher needed to extend the instruction from vocabulary learning into a reading story. The ideas for improving TCAD and TCAD+ were based on ideas derived from educational games that were provided free on social networks. The concept was bundled with the learning management system and other TCAD and TCAD+ resources which converged to the model of TCAD++.

- Target group

  The primary school students with hearing impaired from level one to level three were used as the case study group. From the first TCAD implementation phase, the target groups were separated into two groups - the first one is the control group using the traditional method that was composed

of learning the vocabulary from the teacher without the supplementary tool, as for the second group, they used the animation dictionary as a supplementary tool for teaching and learning. The author of this study made a comparison on the number set of vocabulary content learned between these groups to obtain the results and create an analysis.

3.3.4 Results and Analysis

Figure 3.3 represents the research process in the results and analysis topic. The details are fully given in Chapter 5. It follows the research process which provides the results and analysis for discussion about the topic;

- Results from using a learning system for hearing impaired students that is comprised of a pretest, posttest and long term posttest score from using TCAD, TCAD+ and TCAD++.
- Evaluation results

  After the pretest/posttest in TCAD system, this research delineates the statistical results from the pretest, posttest and long term posttest.
- Analysis results

  When data collection was completed, an evaluation is provided from the use of the TCAD system. The statistical results and observation data were analyzed to find out the learning impact and any outcome from the TCAD system.