CHAPTER 5
RESULTS AND ANALYSIS

This chapter presents the results of the TCAD system applied to the hearing impaired students in Thailand that is comprised of the Results from the pilot study: TCAD, TCAD+ Results, TCAD++ results and Results Analysis details

5.1 Results of the pilot study: TCAD

A set of experiments was undertaken to assess the usefulness of TCAD and TCAD+ in acquiring new English words and improving pupils' vocabulary retention. In the first phase of TCAD, two groups of 18 hearing impaired primary pupils from grade 5 (9-11 years old) from the Anusarnsoontorn School, Chiang Mai were selected. The first group, labeled A (Animation), was asked to use TCAD to learn new English vocabulary, whereas the second group, referred to as T (Traditional), was expected to follow the traditional method consisting of classroom instruction, translation of verbal language to sign language, flashcards and finger spelling. The pre-test consisted of a set of 20 words randomly selected from the TCAD e-dictionary and pupils were asked to match a picture with the correct word (Figure 5.1). Before repeating the test (post-test), both groups were given additional tuition in their respective methods. Nine months later they were asked to repeat the test and these results were recorded as the long term post-test.

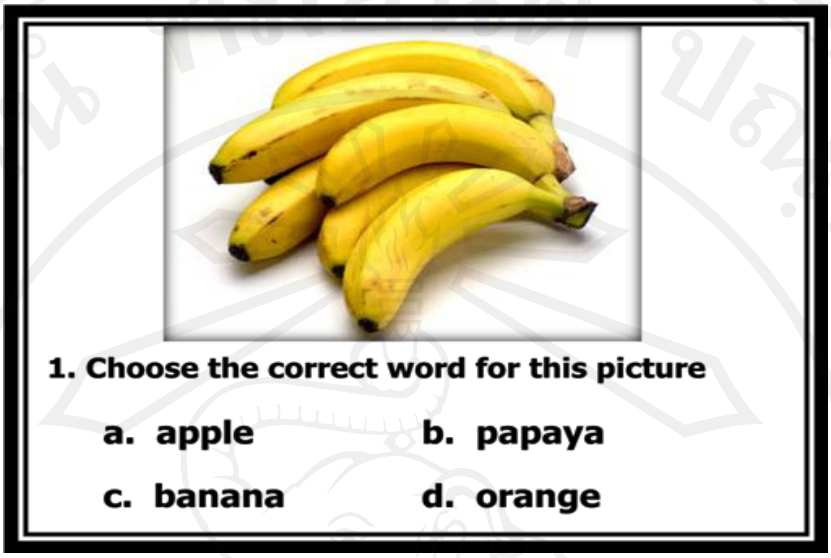

Figure 5.1 Example of a screen from the TCAD test

Experiment results show an improvement in the scores of the A group, averaging 9.6, 12.8 and 13 out of 20 in the pre-test, post-test and long term post-test respectively (Figure 5.2). A closer analysis of the individual results and range or scores also reveals that the scores for the A group outperform the T group. In the A group, test scores ranged from 7 to 13, 9 to 18, and 8 to 18 in the pre, post and long term post-test. This was compared with scores ranging from 5 to 13, 10.8 to 14, and 7 to 13 in the T group for the pre, post and long term tests (Figure 5.3). The improved scores of the long term test in the A group demonstrates a higher vocabulary retention phase than the T group.

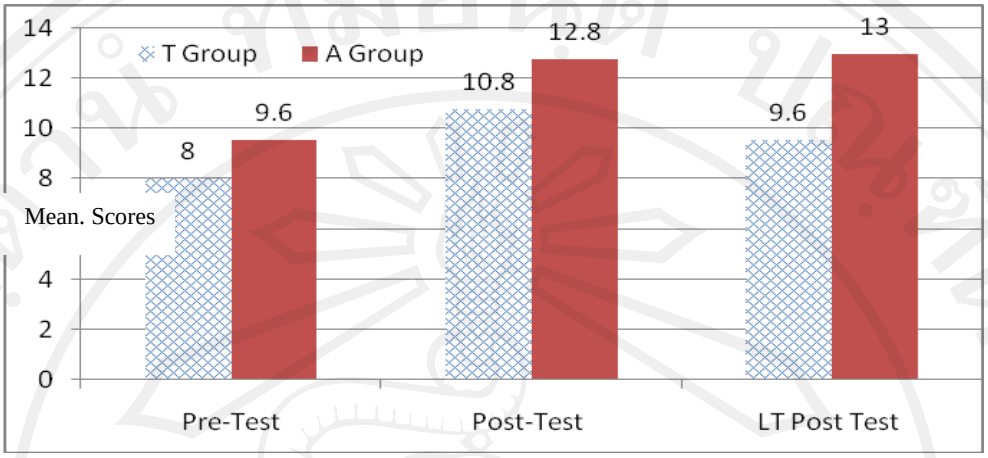

Figure 5.2 T Group vs. A Group Performance (mean test results) for pre-test, post-test and long term post-test (9 months)

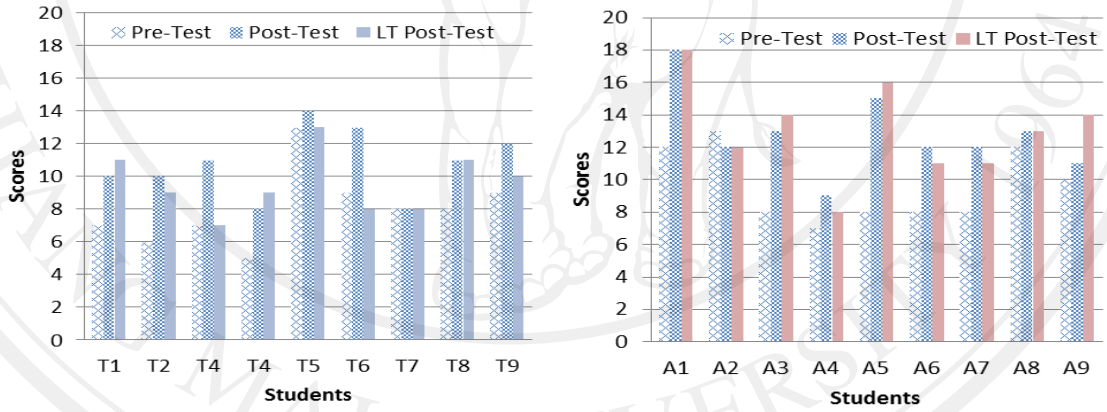

Figure 5.3. Individual student results of groups T and A

To corroborate the raw scores and assumptions that the A group has a better long term retention of vocabulary than the T group, a series of t-tests was undertaken to ascertain the statistical significance of any difference in scores. Initially, an unpaired independent t-test was calculated between the pre-test score of the A and T group. The expectation is that no statistically significant difference existed: as in the pre-test no teaching methods had yet been employed and the variation in scores should not be related to any teaching system. The next independent t-test calculated

the difference between the long-term post-test results of the two methods. The expected result was that there would be a significant difference as the results of the initial analysis (Figures 5.2,5.3) show the two teaching methods appearing to have yield different results. Table 5.1 shows the independent t-test results between the pre-test results for the A and T group. The t-value is 1.46, which is not statistically significant at the 95% confidence level. Table 5.2 shows a t-value of 2.95 which is statistically significant at the 95% confidence level. This corroborates the raw data and shows that there is a significant difference in long term post test results between the two groups and ultimately indicates that the difference between the two teaching methods has yielded significant different results. The next stage of the experimental analysis sought to ascertain more detail on this difference.

Table 5.1 Pre-Test independent t-test results between T group and A group showing that the difference in results is not statistically significant

t value for pre test between A and T groups	df	required t-value for statistical significance at 95% confidence interval
1.46	16	1.746

Table 5.2 Long-term post-test independent t-test results between T group and A group showing that the difference in results between the two groups is statistically significant

t value for long term post test between A and T groups	df	required t-value for statistical significance at 95.7% confidence interval
2.95	16	1.746

After highlighting the difference between the two teaching methods, the next step of analysis aimed to understand whether there was a significant difference in the vocabulary retention of students between the initial post-test and the long-term post-test. This analysis was undertaken using a paired dependent t-test to measure statistically significant differences within the same sample group. Calculating a paired t-test between the test scores of the initial post-test and the long-term post-test reveals a t-value of .512 for the A group (Table 5.3). This shows that between the initial post-test and the long-term post-test, at the 95% confidence interval; there was no statistically significant loss in their vocabulary retention. Calculating a paired t-test between the post-test and long-term post-test reveals a t value of -1.739 for the T group (Table 5.4). This shows that between the post-test and long-term post-test, at the 95% confidence interval, there was also no significant loss between the post-test and long-term post-test. Having said this, the difference in t-value for the T group is greater than the A group and at 80-90% confidence levels, the difference is significant, whereas in the A group there remains no statistically significant difference at the 80-90% confidence interval. Though the experiments have been limited to a small group of pupils the t-tests show that the total communication approach adopted by the first phase of the TCAD appears to be promising. The difference between the t-test results for the two learning approaches is illustrated in Figure 5.4.

Table 5.3 Paired t-test results for the A group post-test and long-term post-test results

dependent t-value for post test and long term post test in the A group (TCAD)	df	required t-value for statistical significance at 95% confidence interval
.512	8	1.86

Table 5.4 Paired t-test results for the T group post-test and long-term post-test results

dependent t-value for post test and long term post test in the T group (Tradiational)	df	required t-value for statistical significance at 95% confidence interval
-1.739	8	1.86

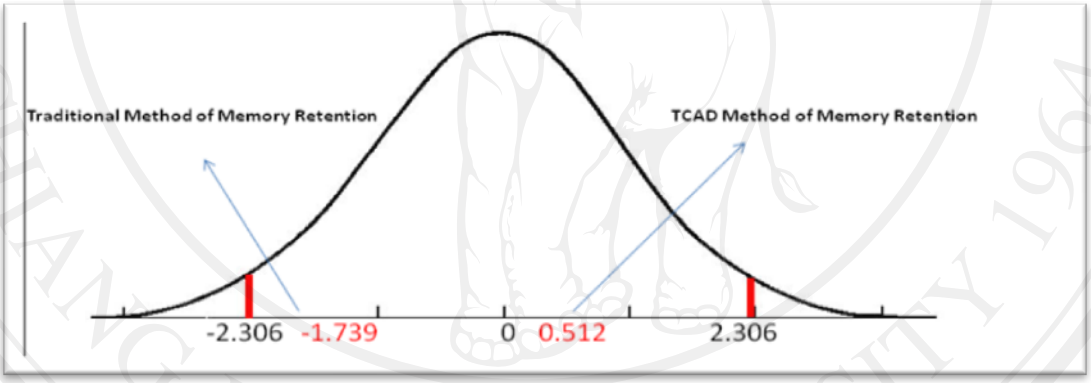

Figure 5.4 Post-Test and Long Term test Paired t-test Results
(95% confidence interval)

5.2 TCAD+ Results

Following the TCAD analysis, the TCAD+ was developed to teach vocabulary in groups and specific contexts through situated learning. Further experiments were carried to evaluate TCAD+, focusing on this situated learning approach. A class of 141 hearing impaired pupils from the Anusarnsoontorn School were asked to interact with TCAD+, by spending one hour each day over a period of two months to learn a set of 300 new words covering categories proposed by the Thai

Ministry of Education (Chapter 3,Table3.1). To evaluate their memory retention, pupils were also asked to take a pre-test and retake it after two months. The test consisted of 36 pictures depicting words randomly selected from the six categories; each picture included four distinct words and pupils were asked to choose the word that best matched the picture (Figure 5.1). The analysis of the results revealed that the post-test mean score (14.78) is higher than the pre-test (11.94) (Table 5.5). Furthermore there was a significant improvement in the post-test demonstrating the effectiveness of improving vocabulary retention using the TCAD approach as over 50% of pupils scored 15 out of 30 in the post test compared to 25% in the pre-test (Figure 5.5) and (Figure 5.6).

Table 5.5.TCAD+ Post test vs. Pre-test Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Posttest	14.7447	141	4.85564	.40892
	Pre-test	11.9433	141	4.24057	.35712

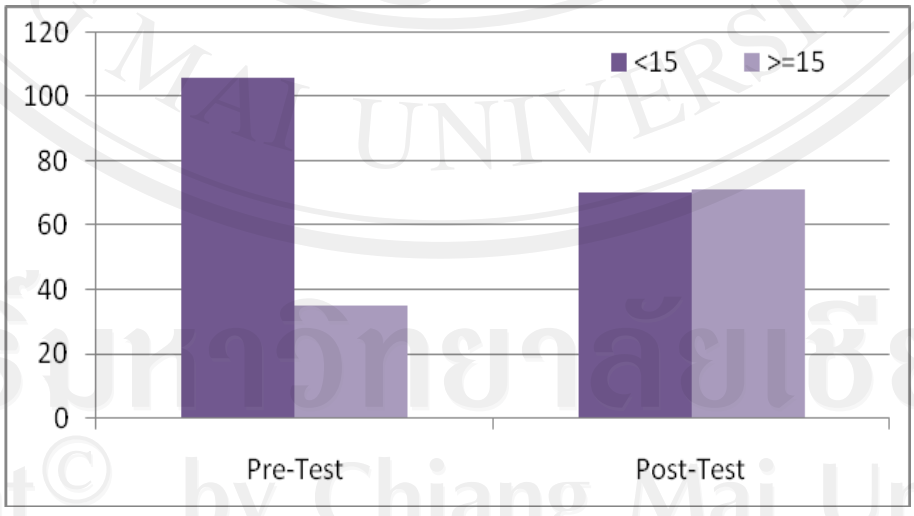

Figure 5.5 Pre-test and Post-test from TCAD+ Results

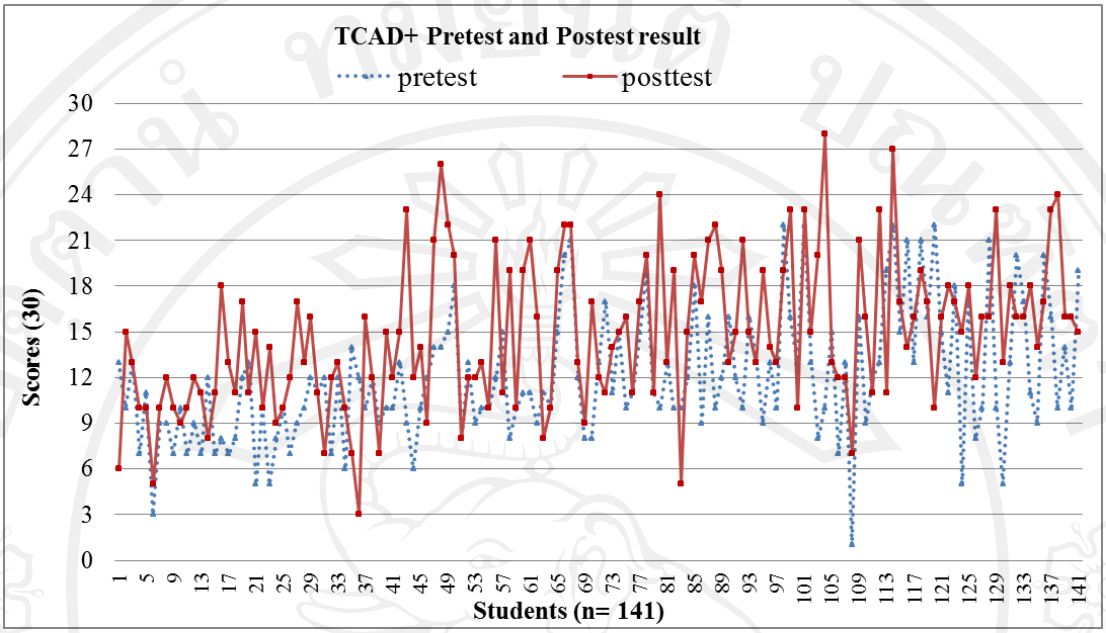

Figure 5.6 Pre-Test and Post-Test results of TCAD+ method

The inferential statistics from the paired t-test for the TCAD+ confirmed that, statistically, there is a significant difference at the 95% confidence interval between the two tests, with a t-value of 6.398 (Table 5.6, Figure 5.6). This suggests that there is strong evidence that, on average, TCAD+ does lead to improvements in memory retention.

Table 5.6 TCAD+ Post-Test and Long Term Paired t-test Results

t value for pretest and post-test	df	required t-value for statistical significance at 95% confidence interval
6.389	140	1.656

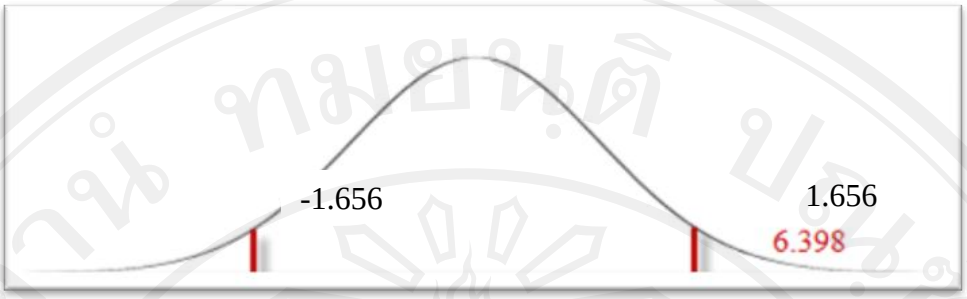

Figure 5.7 Paired t-test Results of TCAD+ Post Test and Pre-Test

Though the results of the experiments are encouraging, there are specific cases when a pupil did not improve in accordance with the cohort. In the TCAD results, the performance in the long term post-test of three pupils from the T group is poorer than the post-test, but better than the pre-test. Further examination of these cases has revealed extenuating circumstances for two pupils. The results of TCAD+ are disappointing in this situation, as a higher ratio of pupils scoring greater than 15 was expected. A further qualitative assessment of these results is required. Future work is proposed to expand TCAD+ to include stories and games based on the e-dictionary and picture database, thus extending the situated learning environment.

The drawing game vocabulary has been designed to test vocabulary comprehension by using TCAD + as the experimental group; it was compared with the control group by using the vocabulary book and vocabulary cards. The sample population is classified by the GPA level. The students in each group are randomized in a normal distribution - populations are ten, level five primary students. Using the ten vocabularies that are related to the lessons learned in class, students draw the word by using TCAD+ tool by comparing these words with the vocabulary book and vocabulary cards. They gained motivation when being able to complete the task and checking to see if all vocabularies are correct; they received some candy as a reward for their work. The results of experiment are shown in Table 5.7.

Table 5.7 Comparison of mean results between TCAD+ method and control group using time criteria and score result criteria

	TCAD+ Group (A)		Control Group (B)	
Student (n)	Time used (Minute)	Score (10)	Time used (Minute)	Score (10)
1	29	10	35	9*
2	28	10	30	10
3	28	10	33	10
4	20	10	32	10
5	20	10	25	10
n	5	5	5	5
Mean	25	10	31	9.8
SD	4.58	0	3.81	0.45

*Missing that drawn as “bee” from word “bed”

Statistical test results in time using criteria between TCAD+ group and Control group

Table 5.8 Independent t- test sample statistics from time using criteria results

$Mean_A$—$Mean_B$	t	df	required t-value for statistical significance at 95% confidence interval
-6	-2.25*	8	1.860

For independent samples, these results pertain to the "usual" t-test, which assumes that the two samples have equal variance (see Table 5.9)

Table 5.9 Significant difference detected between the variances of the two samples

F-Test for the Significance of the Difference between the Variances of the Two Samples (F- Test is the value that shown the difference detected between the variance of the two samples)

df_1	df_2	F	P
4	4	1.45	0.363794

[Applicable only to independent samples.]
P>.05 indicates no significant difference detected between the variances of the two samples.

Using time as a criteria, the independent samples show a t-test value of t = -2.25 and t value from t-table = (Confidence Intervals 0.95 (0.05); df = 8) = 1.860 that -2.25 show in the critical value by conventional criteria, this difference is considered to be statistically significant of time using in the learning between TCAD+ group and control group, The TCAD group using time for correct the exam less than the control group.

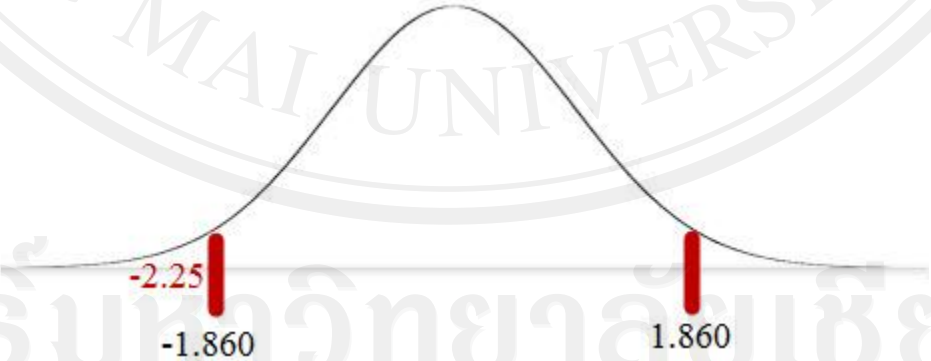

Figure 5.8 Comparison of independent mean results between TCAD+ method and control group

Statistic results inscore criteria between TCAD+ group and Control group

Table 5.10 Independent t- test sample statistics from in score criteria results

$Mean_A$—$Mean_B$	t	df	required t-value for statistical significance at 95% confidence interval
1.833	1.12	5	2.015

For independent samples, these results pertain to the "unusual" t-test, which assumes unequal Sample Variances (see table 5.11).

Table 5.11Significant difference detected between the variance of the two samples

F-Test for the Significance of the Difference between the Variances of the Two Samples

df_1	df_2	F	P
5	4	Infinity	<.0001
[Applicable only to independent samples.] P>.05 indicates no significant difference detected between the variances of the two samples.			

In the score criteria, the result from the independent samples t-test shows a value of t = 1.22 and t value from t-table = (Confidence Intervals 0.95 (0.05); df = 5) = 2.015 by conventional criteria, this difference is considered to be not statistically significant between TCAD+ group and control group. However, the control group result shows that one student has miss taking the exam. This student drew “bee” from the word “bed”; the result confirms that using the vocabulary book and vocabulary card in the control group needs more time for search and that the accuracy is less than using the TCAD+ method.

5.3 TCAD++ results

The result of TCAD ++ with the 26 students was corroborated when the students participated with TCAD++ system. The TCAD++ is the situational learning environment that is comprised of TCAD and sign language that display groups of vocabulary known as TCAD+. The system that provide the situational learning environment is comprised of the Situational English vocabulary learning via a free social network game application - the TCAD Web browser add on for Firefox browser and the Learning story with vocabulary via leaning management system (LMS). The primary level 3-4 class in the hearing impaired school used the TCAD++ for 1 hour per day over a period of two months. The results of the pretest and posttest are shown in Figure 5.9

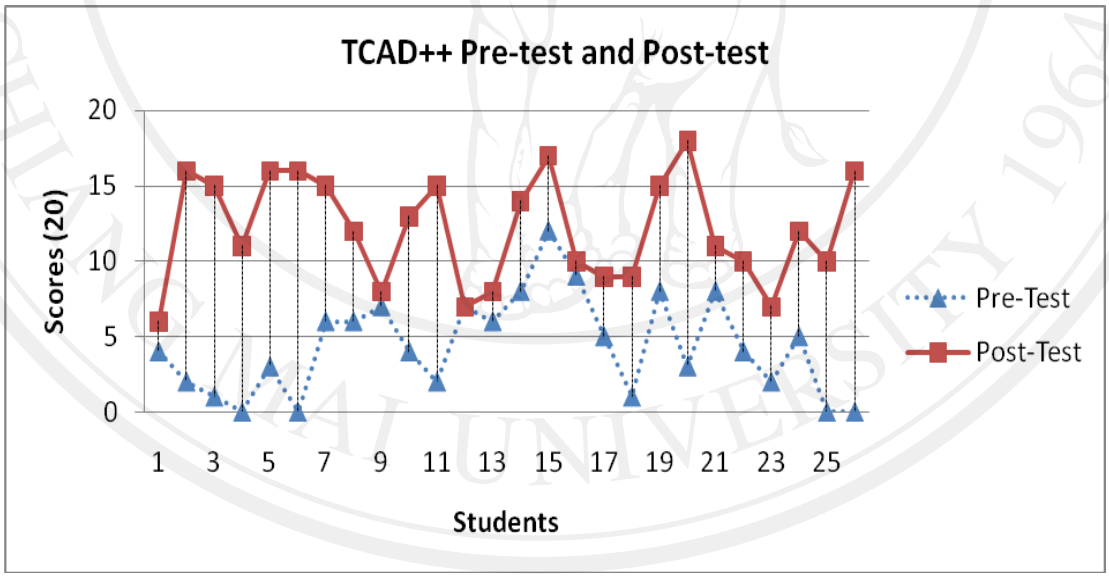

Figure 5.9 The TCAD++ Pre-test and Post-test

From the results of the pretest and posttest score, the data was subjected to a statistical test to compare the mean value by a paired t-test show in table 5.12

Table 5.12 Paired t- test samples statistics from TCAD++ Posttest vs. Pretest results

t value for pretest and post-test	df	required t-value for statistical significance at 95% confidence interval
7.994*	25	1.708

The result of the posttest and pretest from paired t- test shows a value of t 7.994 (Confidence Interval 0.95 (0.05); df = 25 = 1.708 that 7.994 is the critical value that shows a significant positive difference in score of TCAD++ between the posttest and pretest examination. The score of the posttest examination is much more than the score of the pretest examination and is clearly significant: as shown in figure 5.10

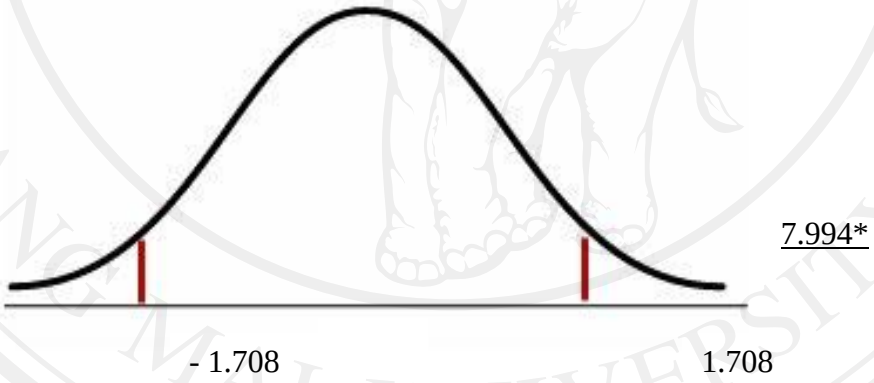

Figure 5.10 Paired t-test results of TCAD+ posttest and pretest

5.4 TCAD++ game output from students

The results from this study are not only presented in the statistical result section but also captures and show the situated game output - demonstrated in Figure 5.11 and 5.12

Figure 5.11 The example of the Farmville game result from student using the TCAD++ system (High score in the class)

Figure 5.12 The example of Farmville game result from student using the TCAD++ system (Minimum score in the class)

From Figure 5.11 and 5.12, the results of the game are related to the reading story from TCAD++ system. The assignments from the lessons learned in class are linked to the story based on the farm situation by using a free online game via Facebook social network application. The students accepted the game assignment and played by the rules from the teacher and used the TCAD++ system for helping them recognize the vocabularies. The learning and game playing occurred in this assignment. Students take part in the game with a motivation to learn by becoming unconscious of their actual behavior. The assignment undertaken by the students is to create a farm by planting strawberries, buying animals (such as a cow), and buying fruit trees. The results show more than the output because these students became more creative as they performed the assignments by themselves. Astonishingly, the students seem to enjoy the lessons learned and the game being played in a simultaneous manner.

5.5 Analysis Results

The study reveals that Thai students who have a hearing impairment were at a disadvantage in learning English language through the traditional form. These students were not taught in a holistic manner that would allow them to comprehend the application of communication and were not shown the principles and concepts of analyzing the situation. For them, there would be difficulties in understanding abstract ideas. For example, they would have difficulty interpreting the lexicon between the sentence “houses for rent” in comparison to “to rent a house”. They also find the semantic and pragmatic form such as “I love the sea” challenging when distinguishing it from “the sea love I”. On the other hand, the instruction techniques given in the classroom did not fare any better in helping students to maximize their potential in learning the English language. With most of the teaching based on learning in an abstract and passive way, it programmed students to take in learning as data that does not have significant meaning, rather than letting it become information for further analysis. This paradigm for instruction mainly focused on providing learning that focuses only in questions pertaining to ‘What is” and “That is”. This

type of learning redundancy pertains to the terms of knowing how to communicate in a conversation. The equipment used for teaching was not at the level of an effective information technology or other software media that would help these students become better learners of the English language. Students were only familiar with what they see and were not given opportunities to broaden their horizons in connecting with the abstract.

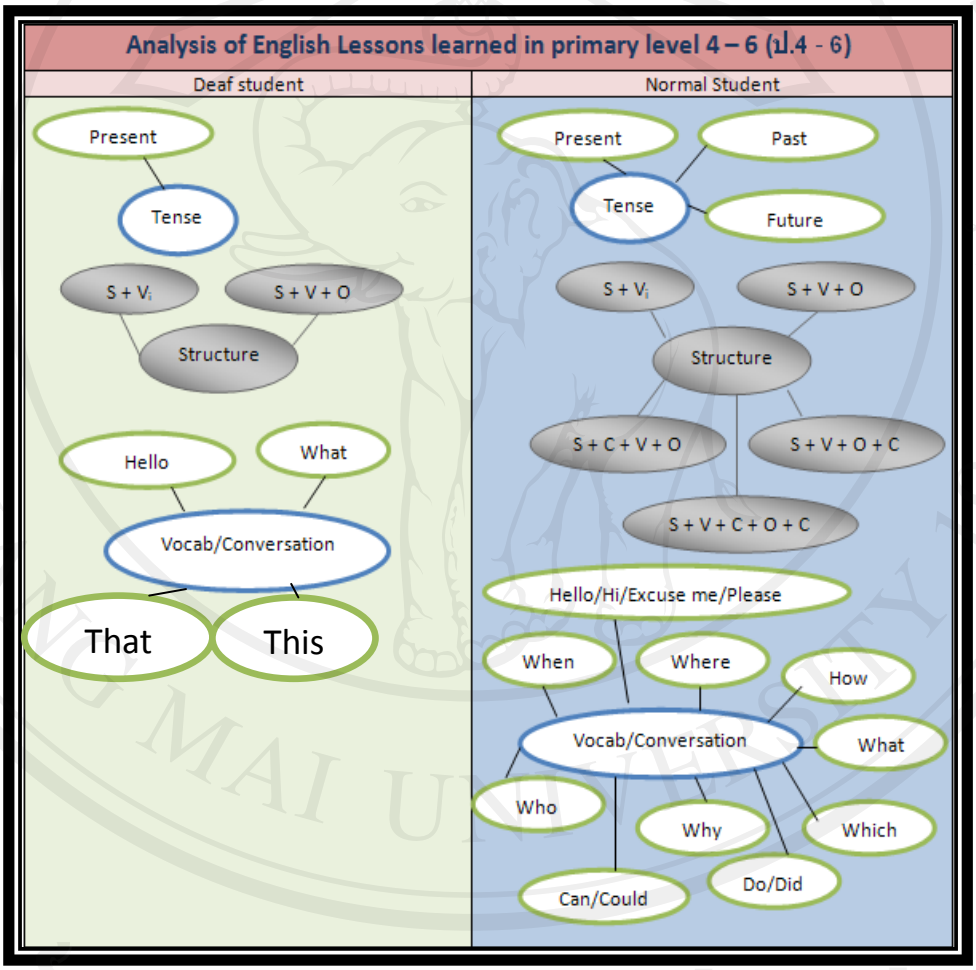

Figure 5.13 Analysis based on curriculum content of English between ChiangMai School for the deaf and mainstream student curriculum from ministry of education Thailand

Figure 5.13 illustrates how much students with a hearing impairment are missing out in learning to communicate in English. The gap between mainstream and hearing impaired curriculum can be attributed to a combination of their physical condition and in their learning environment. For example, these students are only taught the English language in the present tense, while the mainstream students are taught with the present, past, and future tenses. In the structural format, deaf students are given information to learn based on the subject and verb, as well as with the addition of an object. However, mainstream students are taught via a full structural lesson that has a combined extension of the subject, verb, object, and with a compound added into the structure. In the instructions of forming a vocabulary conversation, deaf students are only subjugated to learning how to communicate with the terms of "Hello, What, That, and This". Meanwhile, the mainstream students are significantly ahead of their counterparts, as they are fully immersed with learning how to deal not only with the aspects of greeting and having a social conversation, but also comprehending a framework of the conversation by analyzing the "How, What, When, Where, Who, Why, Which, Can/Could, and Do/Did. At the primary level of learning English, the hearing impaired students are highly disadvantaged from the outset. The key is in term of teaching abstract ideas. Abstract ideas can be effective as well as ineffective, depending on the authority that deems it appropriate for teaching. Such an abstract idea has to touch upon the sights and senses of the individual to be fully engaged in a conversation, despite dealing with a hearing disability from birth. Therefore, the implementation of the instruction can become effective by combining abstract concepts and concrete examples (Anderson, Reder, and Simon, 1996)

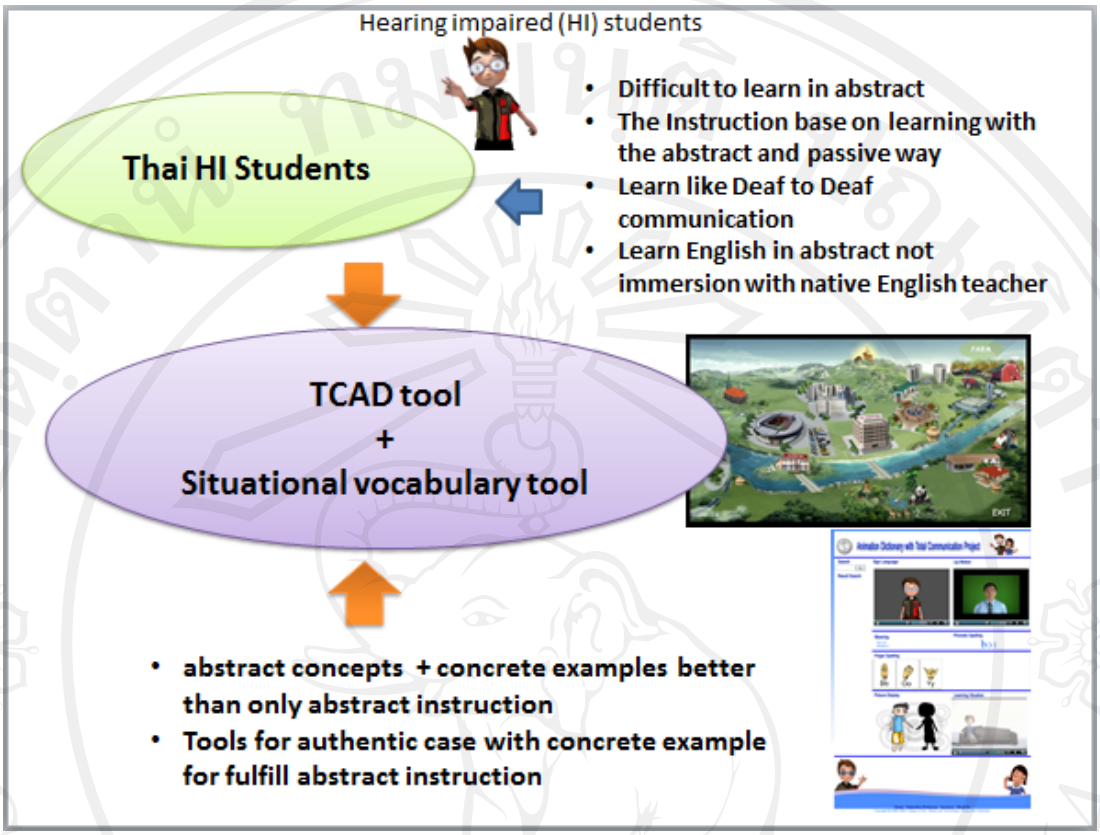

Figure 5.14 The TCAD tool system concept

In the Thai educational system, most learning occurs naturally through incorporating activities into the curriculum. In these types of activities, students are often given assignments that do not provide many ways to get the only accepted answer to a question. The context of learning is to make sure that these satisfy the aim of the lesson outcome, rather than to see if these students have actually acquired the skills required for a real life situation. The culture of learning and teaching are based on norms that act as a code for conducting one's behavior. Students are required to follow the instructions without much inquiry into the lesson. Teachers are expected to carry out their role in implementing the instructions of the lesson and making sure that these students are obedient in completing the tasks given to them. Naturally, the students become submissive and the teachers uphold the process. Any intentions to change for the sake of learning become bogged down as the techniques for improvement become outdated in helping the students to progress. The value of learning takes a back seat. Teaching in situational concepts is removed from the

natural context. The proper applications for allowing students to make an analysis are forfeited to the institutionalized form of rote learning. Teaching a language is a skill that is in the method of training. With training, the idea is to apply with what has been learned in the form of a drill, experiment, assessment, or reviewing. Training allows the student to take on the role of an apprenticeship. As an apprentice, he or she applies the skills in a situation based learning event, either to problem solve or look for an alternative solution; this method allows the students to apply what has been learned (Lave, 1988).

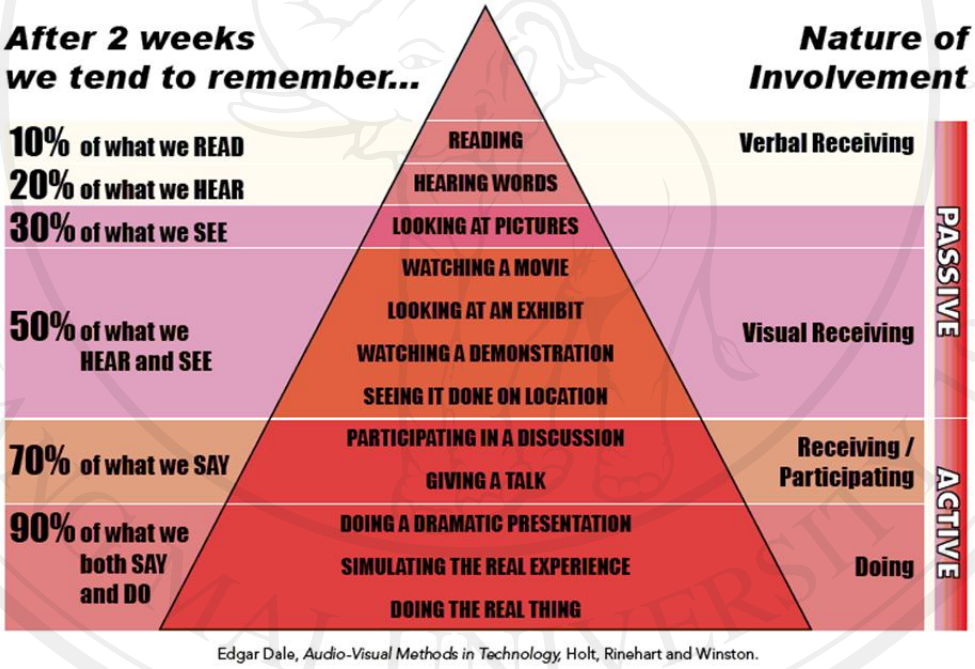

Figure 5.15 The cone of learning Dale, E. (1969)

Based on this work, the comparison of the results with the cone of learning has provided the following information. At the first stage of TCAD, the students were in the category of passive learning. In this level, the cone of learning theory depicts this information as the deaf students being able to retain 50% of what they saw after participating in the lessons. When they were observing the lessons taught, they were able to see what was happening and remember everything with the

exception of hearing. At the second stage, the TCAD+ elevated students' skill to become more active in learning. By allowing students to take a hands-on approach in the learning process, it allowed them to expand their sign language to include other English vocabulary words. For example, the TCAD+'s learning program that dealt with identifying the vocabulary words in the agricultural town (farming) context made the students become more active in absorbing the words. With dimensional pictures and a clear instructional guideline, the students felt more comfortable in learning about the new words. During the third stage, the usage of TCAD++ enabled the students' skills to be positioned in the highest echelon in the cone of learning. The technology permitted the students to become significantly more active in learning how to give the correct answers in a specific situation. By allowing students to apply their skills in a practical mode, the students were able to understand the bigger picture of what they were learning about and how to respond to the situation with the correct words to the questions given.These students formed themselves into a learning group and began exchanging ideas and information with each other through a vivid display of sign language. The TCAD++ stimulated an environment conductive to building a bridge with fellow classmates; these students helped each other with their assignments.

In retrospect from the cone of learning (Dale, E. 1969), the study asserts that the TCAD tool is diverse to meet the following needs for helping the students to acquire the necessary skills in communicating:

- The first TCAD stage is appropriate for developing students to become passive learners by allowing them to view the lesson materials given. Visual reception is an instructional tool to get students to be at the passive learning state. At this stage, these students will only retain 50% of what they see and will remember.
- The second stage, TCAD+, could be a method for transcending into being an active learner. Seeing and participating with activities allows the students to gain a better understanding of the lessons. This leads to an

increase of sign language that demonstrates the new words/vocabularies that have been leant. Lessons based on participation, with the use of TCAD+, transforms the students to learn with an active state of mind.

- In the final stage, TCAD++ is considered as the ultimate tool for allowing students to become maximized at the active level of learning. TCAD++ facilitates performance of the students to know what they have to do and how to do it. In this mode of learning, Students are more alert and rational in finding the correct words for the given assignment. The learning has fully evolved and the students are connected with what they are learning.

5.5.1 Immersion with TCAD system

Figure 5.16 TCAD system implementation

The implementation of the TCAD system provided an environment that enhanced the skills of English language learning and information. At the same time, the students were able to grasp the skills of using the software applications and adapted a keen sense of knowing how to use it for their own learning benefit.

The situation at hand has allowed what was once to be considered an unfortunate state of condition to become a discipline for learning how to learn. The students utilized what they already had to become their asset in allowing them to progress along learning the English language. Instead of being in a dismal state of not having the ability to hear, these students utilized their visual skills to act as their replacement for hearing to grab the insight of the lessons learned. The visual skills also provided aspiration to not only learn more but also with each other as a group. Here we see that the TCAD system has fostered a social affiliation among peers that are willing to learn with each other.

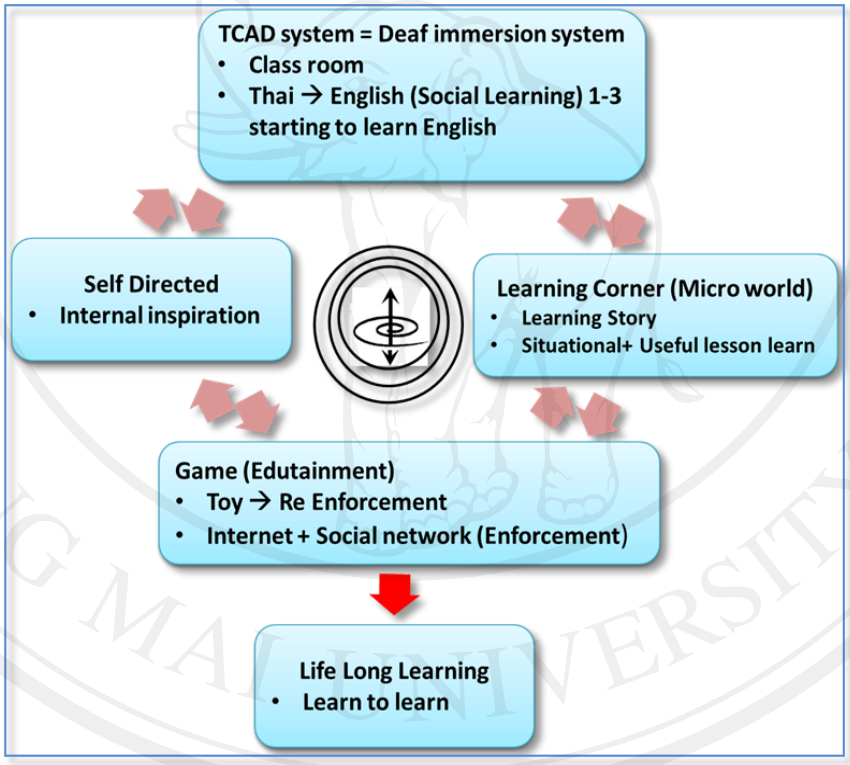

Figure 5.17 TCAD system mapping results

From the TCAD system implementation and its results, this research has found that the TCAD is an immersion tool for hearing impaired students to learn English. The system initiated the students to learn English in primary level one to three instead of learning the subject after primary level four. The new environment tool with animation games and situational content created the needs for both students

and teacher requirements. Not only does it allow the teachers to facilitate the lessons with convenience in the classroom but it also enlarges the students' learning method. They learn as if they were playing with a toy. Upon using the TCAD system, it creates a learning environment that enables them to learn at their own pace. Moreover, the system leads them to build an internal inspirational and removes the mental barriers that blocks learning the English language. The free game related to the learning content on social network becomes a form of edutainment where they gain some skills through amusement. The TCAD system is the learning corner or the micro world that is comprised of a useful lesson learned with a learning story and situational learning contents. They are relevant toward the students' life style as well as an antecedent that supports the learning attitude and perception. All contents of the TCAD system are classified as an edutainment and supplementary tool that not only supports playing and learning in the new environment, but also leads them to become engaged with the internet and other useful knowledge for lifelong learning.

5.5.2 Surprising Results

The work enabled students to foster positive thinking and a motivated attitude towards learning the English language. The teachers provided positive feedback from students demonstrating a high interest in coming and staying in class to learn as if it was a fun-filled activity.

In addition (game output) the students took upon an initiative to access the computer to look for online programs that were relevant to the TCAD. Astonishingly, some of these students became very interested in getting into the social network community, such as Facebook. What turned out from the beginning where the teachers were the ones guiding the students to play games and learn from the activities, the students reverse the situation and taught the teachers how to play the online games.