# Learning Outcome of e-Learning with Cuteness in Science Teaching about Plants and Animals for Grade 4 Hearing Impaired Students with Different Learning Style

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**Abstract**

The study aimed to achieve four main objectives. Firstly, to design and develop e-Learning with cuteness in science teaching about plants and animals, the target for this program was identified as fourth-grade students with hearing impairments who exhibit diverse learning styles. Second, to study learning styles via e-Learning with hearing-impaired students who have different learning styles. Third, to examine the learning achievement before and after this e-Learning with cuteness, and finally, to study students' learning development who had different learning and studied via e-Learning with cuteness. This study is experimental research using one group pre-test and post-test design. The research instruments used for this experiment were: 1) e-Learning with cuteness in science teaching for grade 4 under the topic "plants and animals," pre-test and post-test exams, and Kolb's learning style questionnaire. The samples for this study were 15 grade 4 students with hearing impairments at Surin School for the Deaf under the office of special education administration. Statistics employed for data analysis were mean ( $\bar{x}$ ), standard deviation (S.D.), t-test, and f-test. The findings revealed that: The efficiency of e-Learning with cuteness in science teaching for grade 4 hearing-impaired students with different learning styles was highly efficient, meeting the requirement of Meguigans' criteria. The students' learning achievement after learning via this e-Learning was significantly higher at the 0.05 level, while there is no significantly different in the learning achievement of students with different learning at the 0.05 level. However, learning via this e-Learning students' achievement yielded a mean score of the learning achievement lower than the criterion (50 percent).

**Keywords:** e-Learning, Different Learning Style, Cuteness.

## 1. Introduction

The Thai government recognizes the importance of education. It has determined that Thai people receive basic education for at least 12 years, regardless of whether they are underprivileged or disabled [1]. However, nowadays, computer technology makes accessing data and information instantaneous. But it is not known whether, amid all these modernizations, there are still several people who cannot access and utilize such information technology to the fullest [2] due to several limitations. This is the opportunity to fill this gap in this section. People with disabilities are among those who miss and lack social opportunities and access to information [3], [4] due to limitations in daily activities and participation in society. It is caused by impairment in various fields such as vision, hearing, movement, communication, mental, intellectual, emotional, behavioral and learning disabilities, including disabilities overlap and autism. The hearing impaired is a group of people with disabilities who have difficulty recognizing or understanding spoken through hearing. There are language development barriers, which means they cannot communicate

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what they want. It is also unable to send messages to normal people so that they can understand the meaning [3], [5], [6]. Since these people with disabilities use sign language to communicate, it is difficult for normal people to understand. If talking about the level of intellectual ability of this type of disabled person, it was found that the intelligence level was not different from normal people. They have less linguistic comprehension and no verbal comprehension, as a result, there is a disadvantage in perception processes and cognitive thinking that have rather more delayed development than normal people. Such delays are often seen in computational, language, and cognitive subjects [5]. With delayed awareness, it becomes difficult to teach this group of students to learn and understand the content equally. Moreover, the current teaching methods and measurements are more suitable for normal children. As a result of such problems, many students with hearing impairment had relatively low academic achievement [5]. However, if the teaching materials are designed by considering the potential, learning styles, and context of the students that is suitable for slower development than a normal person. These may lead them to further develop their competencies and sustainable learning.

In the society of learning, media and computer technology play an important role in education. In addition, innovation and computer technology have been used to increase the efficiency and quality of teaching and learning. As a result, learning is not confined to the classroom alone [7], [8]. e-Learning is a type of innovation in learning that provides instruction based on computer technology as a base for sending content to students and to help students benefit from learning without restrictions on time and place. It also supports teaching and learning that helps students are quick and easy to understand the content and conceptual in a short time. Furthermore, these materials stimulate interest, curiosity, and ongoing curiosity. It also solves the problem of differences in students' learning [9] - [12]. It is difficult to develop good e-Learning and to be in accordance with the principles of development. It can be seen that most of the development of e-Learning is similar to e-Books, which has fixed content and is not quite as flexible as it should be. The results for media are unsightly or not interesting. However, if the presentation features of e-Learning such as text, images, and animations, as well as the various components, are elements in the content. It may help to create a student's attraction or to interest in learning, especially the cuteness of characters, images, animations, as well as colors and text in the lesson content.

Cuteness is beautiful, sweet, playful, chubby, and plump like a newborn or baby, and looking at it makes them tingly. These attributes will help attract and motivate them [13] - [15]. This is consistent with the research Hiranrat, Khopolklang and Ruksasuk [16] that has found that students had higher learning achievements when studying through computer games using cuteness. In addition, most of the students like large heads and small bodies in the cuteness of characters. There is also a research report that the loveliest product is curved shapes [17] and added brightness and intensity with it [18]. As well as previous research by Cheok and Newton [15] said that most children and adults agree that curved shapes are cuter than straight shapes. Nowadays, these distinctive features of cuteness are applied in product design to create value and identity, it also attracts consumers to access that [17], [19].

Therefore, it can be concluded that feature design is using cuteness. They are developed and implemented in different ways for each task. If it is used in the design of e-Learning, it will be a form that will help attract the attention of students as well. However, whether they are hearing impaired or normal students have different learning potential and styles [10]. Therefore, the learning method of each person has a different method by using habits for seeking knowledge [20]. In order to be easy to learn and to achieve maximum efficiency in teaching and learning on e-Learning, the learning style of each student is considered. This is consistent with Dille and Mezack [21] research, which studied the learning achievement of learners with different learning styles and discovered that learners with different learning styles had different interests

and learning achievements. However, although students with hearing impairments have the same learning potential and learning style as normal students, they have different learning behaviors in terms of physical, emotional, social, and intellectual aspects [22]. These will be an indicator of how the student will learn best. It also reflects the adaptation to the environment [23], [24] where each person will also have different characteristics, resulting in different perceptions of the individual [9]. Kolb's learning styles is one of the types of learning styles that are teachers used to design teaching and learning activities to suit students. Model of four of Kolb's learning styles, which are based on the experiential learning cycle as follows: diverger is a learning that focuses on perception or feeling and observation or watching, while converger focuses on doing and thinking, next assimilator is learning style with an emphasis on observation or watching and thinking, and the last accommodator emphases doing and perception. However, Kolb's model of learning is experiential learning that focuses on students create knowledge from past experiences [22], [25] - [27]. Therefore, if teaching and learning will the highest learning outcomes, then teachers need to be mindful of individual differences and learning styles of each student. Especially students with hearing impairments, they are a variety of differences in learning, parenting, and individual character style.

Science is one of the eight subject area in the core curriculum of basic education that the Ministry of Education of Thailand has provided teaching and learning at all levels because science is related to everyone in daily life, occupation, technology, tools, and equipment. These are almost all the results of science. In addition, science helps humans to be creative, critical, and logical thinking to be able to plan, make decisions, and analyze problems appropriately [28], [29]. Therefore, science is a fundamental subject that everyone needs to learn as a basic so that everyone can apply knowledge to livelihoods or can further study subjects. Especially about plants and animals, there are a creature that is close to humans and are extremely beneficial to humans [28]. However, teaching science to a student with hearing impairments with the purpose of assisting students to gain both knowledge and process and be able to apply knowledge rationally. Teachers must convey content to students so that they can receive knowledge and content like normal children. However, the different or additional from normal children is the teaching method, teaching style [5] including teaching materials being able to adapt to the context and help these students achieve effective learning and achieve learning objectives [30].

Therefore, in order to provide the most effective teaching and learning on e-Learning for hearing-impaired students, they have the opportunity to develop intelligence equal to that of normal children. With the strengths of e-Learning and the cuteness of characters, if they are applied to these students, it will enhance and fulfill the need to learn various contents of students for greater potential. Then, the researchers have foreseen the importance of study and research about e-Learning with cuteness in science teaching about plants and animals for grade 4 hearing impaired students with Kolb's 4 different learning styles. In order to manage teaching and learning on e-Learning media to achieve maximum efficiency with hearing-impaired student. There are four research objectives as follows: first, to develop e-Learning with the cuteness principle in science teaching about plants and animals for grade 4 hearing impaired students with different learning styles. Next, to study the learning style and to study the post-test achievements, and finally, study the learning development of grade 4 hearing-impaired students with different learning styles who studied e-Learning with cuteness principle in science teaching about plants and animals. While, four the research hypotheses were: first, e-Learning with cuteness principle in science teaching about plants and animals for grade 4 hearing impaired students with different learning styles is effective as the Meguigans' criteria (more than 1.00). Second, hearing-impaired student with different learning styles who studied e-Learning via cuteness had post-learning achievement higher than pre-learning achievement at statistical significance at the 0.05 level. The third finding of the study indicates that there was a statistically significant difference in learning

achievement among hearing-impaired students with distinct learning styles, as determined by a significance level of 0.05. Finally, these students with different learning styles had 50 percent higher learning development.

## 2. Theoretical Background and Related Researches

### 2.1 Electronic Learning

Electronic learning, or e-learning, is the use of computer technology to transfer content from a teacher to students, which is presented in the form of multimedia. So that students can learn anytime, anywhere, and according to their differences. In addition, the students can control the lessons themselves, which enables them to make decisions and set directions for their studies according to their own needs. While the teacher can choose the format of the content presentation which, helps to facilitate and reduce costs [9] - [12]. Further Laohajaratsang [9] said that content, a learning management system, modes of communication, and testing are important in design and development. However, if there is no clear design and development of e-Learning, the lessons may not be effective. Therefore, to lead to the success of quality teaching, it is necessary to rely on the instructional design, which is planned and followed up on in terms of content, measurement, and evaluation, along with the development and improvement of lessons.

### 2.2 Cuteness

Gary [13] said that cuteness is not limited to cartoons. but has both living and non-living parts, and it is often referred to as some sort of cuteness that resembles a baby. Then cuteness means beautiful, sweet, big eye, big and thick head and forehead, sexually attractive, playful, chubby, plump, like a newborn or baby [13] - [15]. If the cuteness principle were used to design and develop teaching materials, it would help attract learners who are interested and love to learn even more.

### 2.3 Learning Style

Learning style refers to the style or characteristics of individual students prefer to use in learning and is a behavior that can be modified. One approach considers the teaching and learning process as well as reflecting the development of the student's personality and adaptation to the environment [22], [23]. The learning styles of each student are different. Each style has a goal for students to learn and each student has a unique learning style. The learning stage based on Kolb's Experiential Learning Cycle (ELC) is a process of learning and adaptation of a person, consisting of four stages [10], [25], [31] as follows:

1. Step 1: Concrete Experience (CE): The first stage is a step that focuses on feelings and involves experience.

2. Step 2: Reflective Observation (RO): This is the next stage that emphasizes the distribution of ideas and the understanding of the meaning of the experience gained by observing or watching.

3. Abstract conceptualization (AC): It is a stage that focuses on reasoning and thinking.

4. Active Experimentation (AE): The final stage of Kolb's learning styles cycle is learning by experimenting and doing. The students apply knowledge or principles to lead to new experiments.

Moreover, Kolb proposed a model of four learning styles that are based on the experiential learning cycle, and there was a combination of two preferred styles as follows: [22], [25] - [27]

1. Diverger results from the combination of feelings and watching, or CE and RO. This type of student has the ability to perceive and create with their imagination. They work well in situations that require a wide range of ideas, love art, and are often emotional. This group of people usually has a background in the humanities, social sciences, and liberal arts including a counselor.

2. Converger is from AC and AE which is thinking and doing. The students with this type are good problem solvers. They have the ability to apply abstract concepts in practice. This group of people usually has engineered.

3. Assimilator is a learning style between thinking and watching, or AC and RO. This group of students has a cognitive approach and an interest in abstract concepts and theories.

There are usually backgrounds for science and mathematics.

4. Accommodator is a combination of CE and AE or doing and perception. Individuals with an accommodator are people who like to practice (hands-on) and like to work with people, they will work well in situations that require adaptation. They often can discover the answers with think of themselves. This group of people usually has a management background.

**2.4 Literature Review**

Ruksasuk [31] studied teaching information science through web-based instruction and the relationship between learning styles and interaction styles that affect student achievement at Suranaree University of Technology. The David Kolb's Learning Styles Questionnaire was evaluated by the sample group. It was found that different learning styles and interaction styles in the lessons did not affect learning achievement. Even students with different learning styles and different interactions can learn as well.

Thongruang [27] investigated and determined the relationship between the learning styles of Phranakhon Rajabhat University's first-year students using Kolb's model. It was found that the learning styles of most students were assimilation, converger, diverger, and accommodating respectively. In addition, it was found that the type of learning style of the students and gender were not correlated, but the type of learning style was related to the faculty.

Hiranrat, Khopolklang, and Ruksasuk [16] designed and developed the computer instructional game with the cuteness principle about my family and my animals in English teaching. It was found that the student had higher learning achievement after using the computer instructional game with cuteness. In addition, it also found the learning achievement and the satisfaction of sample group with design of the cuteness are positively related and significantly at .05.

Ohkura and other [17] studied to compare the cuteness of colors and shapes. It was found that the loveliest objects were curved in shape, and warm colors tend to be chosen as lovely colors in two-dimensional objects while blue is chosen as the loveliest color in three-dimensional virtual space. Two years later Ohkura and Aoto [18] also studied and researched the cuteness of the product. It was discovered that all colors are lovely, especially when brightness and intensity are added.

Cheok and Newton [15] analyzed cuteness with a pattern of different proportions which it was concluded that most of the samples of both children and adults agree with curved shapes as more cute than angled or straight-edged shapes. They also have the opinion that characters of animal, human and plants with large tubers, as well as the blue-green tone were cute, too.

## 3. Research Methodology

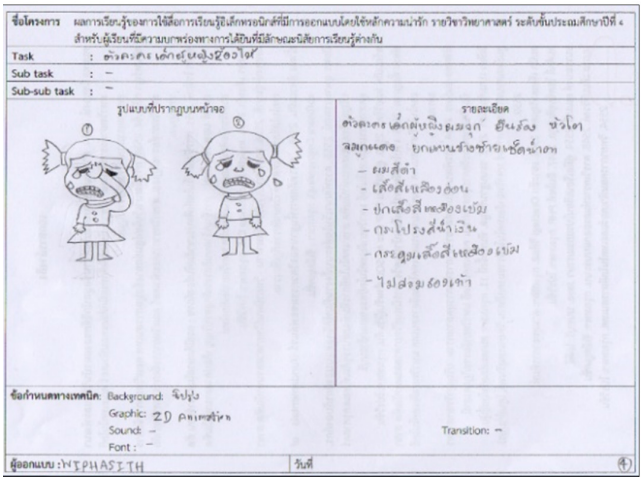
It is experimental research in which the experimental design used was a one-group pre-test post-test design [32]. The population was grade 4 hearing-impaired students of school for the deaf under the office of special education administration in Northeastern. The sample was taken through purposive sampling from 15 grade 4 students with hearing impairments at Surin School for the Deaf under the office of special education administration.

Tools were Kolb's learning style questionnaire, translated and edited by Ruksasuk [31], e-Learning with Cuteness, and the pre-test, and post-test exam, which are research tools. The researcher developed a research tool according to the ADDIE model [33] with 5 steps as follows:

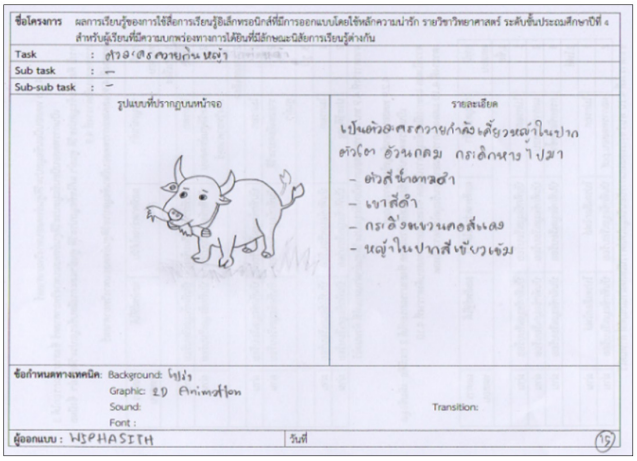
1) Analysis (A): At this stage, three parts of the data were analyzed as follows: first, need analysis, it was found that students with hearing impairment and some students have multiple disabilities. They have trouble communicating and limited language skills. Therefore, it is a huge obstacle to learning. If appropriate media is developed, it may be a way to support learning. The next part was the analysis and preparation of student characteristics by using Kolb's learning style inventory. In order to know the student's style of learning and thinking, it was found that each student has a different interest in learning and a different learning style. Finally, task analysis consists of cluster analysis, and task inventory,

to determine task knowledge, and to obtain content appropriate and consistent with the standards for a content standard of science subject.

2) Design (D): The cuteness principle is used to design characters that are sweet, pure, gentle, charming, cheerful, happy, and funny, as well as adopting cuteness like a baby, such as a large body, small limbs, curved in shape, as shown in Figure 1. On the storyboard, some elements determine the composition and layout of the sign language, text, images, and videos that would appear on each page of the lesson, as shown in the example in Figure 2. In addition, a lesson flowchart, an objective learning test, and an achievement test were designed in this stage.



*(a) Characters of Little Girl Crying*



*(b) Characters of Buffalo with Big Eye and Mouth*

***Figure 1.*** *(a) and (b) Design Characters.*

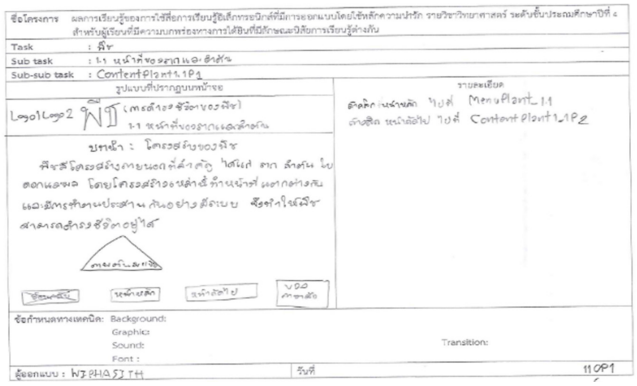


***Figure 2.*** *Design: Story Board of the Content.*

3) Development (D): The development is divided into 3 parts with the following details:

3.1) Development of characters: The characters developed are two-dimensional animation and still images in Figure 3. Then, the characters are used to develop the content and assignment.

***Figure 3.*** *Development Characters.*

3.2) The development of the assignment and its content involved several steps. Firstly, the assignment consisted of 54 items with four multiple-choice options. The consistency between the objectives and the assignment was evaluated by three content experts, resulting in a rating of 0.96, indicating a high level of agreement. Secondly, the quality of the assignment was assessed by fifth-grade students with hearing impairments who had previously studied the content. The results indicated that the quality of the assignment met the standard criteria. Subsequently, the assignment was divided into two sets: pre-test/post-test and assignment. The pre-test/post-test was developed using the quiz module of LearnSquare learning management

system, while the assignment and content were created using CourseLab 2.4. Then, each learning unit is delivered through the LearnSquare learning management system, as shown in the figure. 4 - 7. Then, e-Learning with cuteness was tried out by non-sample students to determine quality.

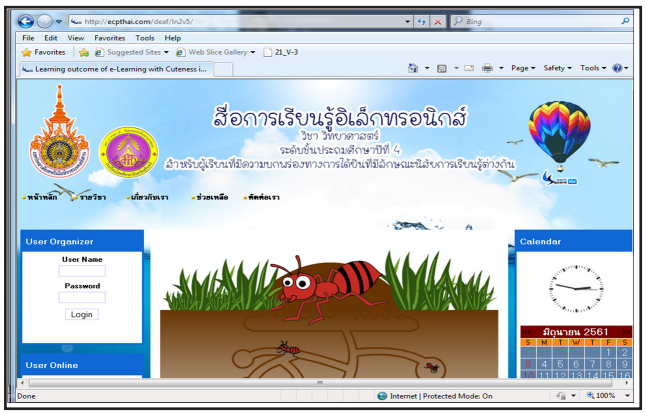



***Figure 4.*** *Home Page of e-Learning with Cuteness.*

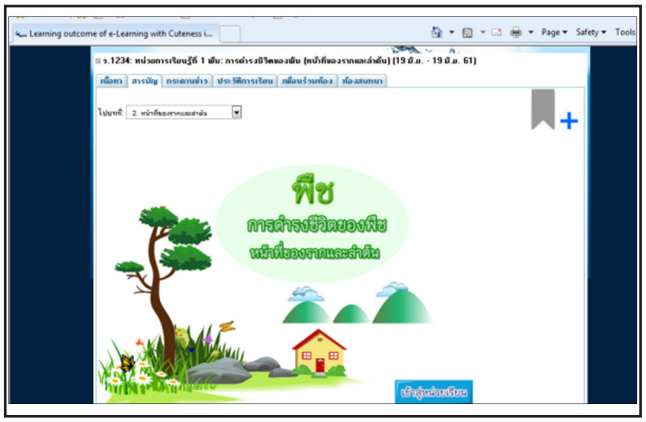



***Figure 5.*** *Title of Lesson 1.1.*

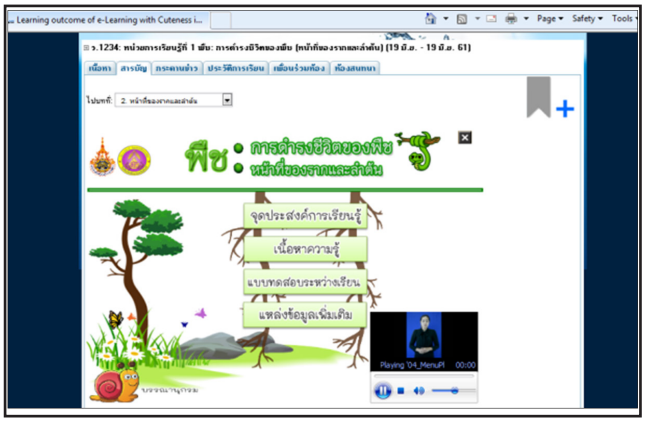



***Figure 6.*** *Menu of Lesson.*

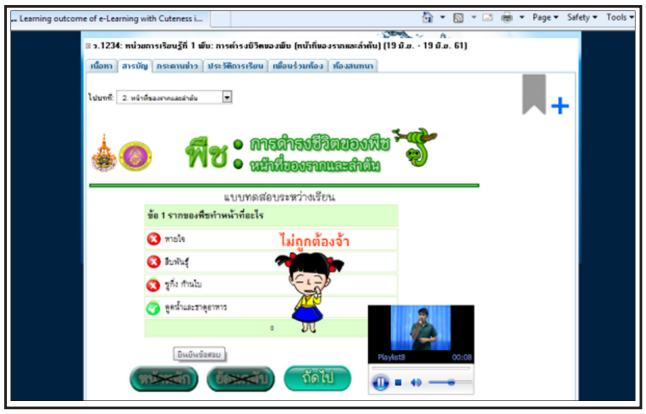



***Figure 7.*** *Assignment of Lesson 1.1.*

4) Implementation (I): The user manual was developed and the e-Learning with cuteness was installed via a computer network. The URL is http://ecpthai.com/deaf/ln2v5

5) Evaluation (E): Finally, this e-Learning with cuteness was evaluated for quality by five technical and method experts. It was found that the experts accepted this e-Learning with a good level of opinion ( $\bar{x}$ = 4.160; S.D = 0.584). Some experts suggested that downloading lesson content is quite slow, some images are slightly jittery and the text of the pre-test and post-test is a bit too small. The researcher has modified it according to the expert's suggestion. After that, the e-Learning was trialed on the sample group.

**Data Collection**

1) The researcher contacted the director of the School for the Deaf, Surin province, for requesting the courtesy of collecting data from the sample group and the use of a computer laboratory.

2) The research explained the use of the learning style questionnaire to the sample group. The questionnaire was evaluated by the sample group, while there was a sign language expert as an interpreter to communicate and exchange information with the sample group.

3) The research analyzed the learning style of the sample group.

4) The e-Learning with cuteness was tested in the first semester of the academic year 2018 which explained and demonstrated the use of this e-Learning to the sample group.

5) e-Learning with cuteness was used by the sample group. There were the following steps:

5.1) Students verify their identity to log in to the e-Learning.

5.2) Students choose a unit of learning. Then the students take the pre-test exam. After that, they studied the content and took assignments.

5.3) Finally step, the students took the post-test exam. The data were collected from the use of the e-Learning of the sample group. Next time, those data were analyzed as follows:

5.3.1) The research studied the effectiveness of e-Learning with cuteness with Meguigan's criteria.

5.3.2) The research studied hearing-impaired students Mean and standard deviation was used to analyze the data.

5.3.3) The research studied students' learning achievements as follows:

5.3.3.1) Comparing students' pre-learning achievement and post-learning achievement with t-test Dependent.

5.3.3.2) Comparing the post-learning achievement of students with different learning styles for each type with an f-test or analysis of variance (ANOVA).

5.3.4) Effectiveness index (E.I.) of Goodman, Fletcher, and Schneider [34] used to find the learning development of students with different learning styles.

## 4. Results

The results of the development of e-Learning with cuteness in science teaching about plants and animals for grade 4 hearing-impaired students with different learning styles

H0: This e-Learning with cuteness was not effective according to Meguigan's criteria.

H1: This e-Learning with cuteness was effective according to Meguigan's criteria.

The average of the pre-test and the post-test was 13.40 and 19.40 respectively. Both scores were used to determine the effectiveness of this e-Learning. It was found that the efficiency was 1.447, higher than Meguigan's criteria. (>=1.00) shown in Table 1. Therefore, the H1 was accepted and H0 was rejected.

***Table 1.*** *Efficiency of This e-Learning with Cuteness.*

| Students (N) | Total score | Average of achievement test | | Efficiency |
|---|---|---|---|---|
| | | Pre-test | Post-test | |
| 15 | 54 | 13.40 | 19.40 | 1.447 |

**The results of the study of the learning achievements of students with different learning styles who studied via e-Learning with cuteness**

1) The results of compare pre-learning achievement and post-learning achievement of students with different learning styles who studied via e-Learning with cuteness.

H0: Students with different learning styles who studied e-Learning via cuteness had not post-learning achievement higher than pre-learning achievement at statistical significance at the 0.05 level.

H1: Students with different learning styles who studied e-Learning via cuteness had post-learning achievement higher than pre-learning achievement at statistical significance at the 0.05 level.

It was found that in 54 full scores, 15 students had a mean score of pre-test at 13.40 and a standard deviation of 4.641. At the same time, they had a mean score of post-test at 19.40 and a standard deviation of 4.404. The difference between the pre-test and post-test scores was 6 points and the standard deviation was 3.422, the t-test value was -6.790, and the p-value was 0.00, which was less than the p-value that had been defined in the hypothesis (reject H0 and accepted H1 and as in Table 2). Therefore, it can be concluded that students' post-learning achievement is higher than pre-Learning achievement at statistical significance at the 0.05 level.

***Table 2.*** *Overall Average Score of Students.*

| Test | N | $\bar{x}$ | $S.D_{\bar{x}}$ | Full score | $\Sigma^D$ | $S.D_{\Sigma^D}$ | T | Sig. |
|---|---|---|---|---|---|---|---|---|
| Pre-test | 15 | 13.40 | 4.641 | 54 | 6.00 | 3.422 | -6.790 | 0.00 |
| Post-test | | 19.40 | 4.404 | | | | | |

*p<0.05

In addition, the study of learning style of sample group using a learning style questionnaire, it found that students could be classified into 3 type of learning style: Most of the 8 students with diverger learning style (53.33%), 6 students with assimilators learning style (40.00%), and 1 accommodator (6.66%). In addition, there was a study of the post-test scores of each group of students. It was found that 54 full score, students with accommodator having the highest mean score ( $\bar{x}$=24.00, S.D. = 0.00). Follow by students with diverger learning style had a mean score at 20.125 and a standard deviation at 4.189, while, students with assimilator learning style had the lowest mean score of 17.666 and a standard deviation at 4.589, as shown in table 3.

***Table 3.*** *The Results of the Analysis of post-test Scores of Students with Different Learning Style.*

| Type of Learning style | N | Post-test | |
|---|---|---|---|
| | | $\bar{x}$ | $S.D_{\bar{x}}$ |
| Diverger | 8 | 20.125 | 4.189 |
| Assimilator | 6 | 17.666 | 4.589 |
| Accommodator | 1 | 24.000 | 0.000 |

2) The results of the study of students with different learning style who studied via e-Learning with cuteness in post-learning achievement.

Ho: The null hypothesis (H0) posited that there would be no significant difference in post-learning achievement among students with distinct learning styles, as determined by a significance level of 0.05.

H1: Post-learning achievement of students with different learning style was significantly different at the 0.05 level.

There was comparing the differences of post-test score of students with different learning style who studied the developed e-Learning. It's found that the students' post-test score was not significantly different at the 0.05 level (see Table 4). As a result of the statistical analysis, the null hypothesis (H0) was accepted while the alternative hypothesis (H1) was rejected. Therefore, it can be concluded that different learning styles of students had no effect on post-learning achievement.

***Table 4.*** *The Comparing the Differences of post-test Score of Students with Different Learning Style.*

| Variance source | SS | Df | MS | F | Sig. |
|---|---|---|---|---|---|
| Between groups | 43.392 | 2 | 21.696 | 1.141 | 0.352 |
| Within group | 228.208 | 12 | 19.017 | | |
| Total | 271.600 | 14 | | | |

*p<0.05

**The results of the study of the learning development of students with different learning styles who studied via e-Learning with cuteness**

H0: Students with different learning styles who studied via this e-Learning had not 50% higher learning development.

H1: Students with different learning styles who studied via this e-Learning had 50% higher learning development.

It was found that the pre-test and the post-test were both 54 full scores. The students with each type of learning style had the learning development as shown in Table 5, the details are as follows:

1) Students with diverger learning styles: They had a total pre-test score of 108 (25.000%) and 161 (37.268%) on the post-test score. The effectiveness index (E.I.) of this e-Learning was 0.1635 (16.35%), which means that the students had a 16.35 percent increase in learning development.

2) Students with assimilator learning style: The total score of the pre-test was 79 points (24.382%), the total score of the post-test was 106 points (32.716%), and the effectiveness index (E.I.) was 0.1102 (11.02 %), It means that students developed learning increased by 11.02 percent.

3) Students with accommodator learning style: It found that the sum of the pre-test score was 14 points (25.925%), while, the post-test was 24 points (44.44%). The Effectiveness Index (E.I.) had 0.2500 (25.00%), which means that students had increased learning development by 25.00 percent.

From the above information, it can be concluded that H0 was accepted and H1 was rejected because the learning development of the students is less than 50 percent, which is not following the predetermined assumptions.

***Table 5.*** *Students' Learning Development.*

| Learning Style | N (1) | Full Score (2) | (1)*(2) | All total score | | Percent of test's total | | E.I | Percent |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Pre-test | Post-test | Pre-test (%d) | Post-test (%d) | | |
| Diverger | 8 | 54 | 324 | 108 | 161 | 25.000 | 37.268 | 0.1635 | 16.35 |
| Assimilator | 6 | 54 | 432 | 79 | 106 | 24.382 | 32.716 | 0.1102 | 11.02 |
| Accommodator | 1 | 54 | 54 | 14 | 24 | 25.925 | 44.44 | 0.2500 | 25.00 |

## 5. Conclusion and Discussion

**H1: The development of e-Learning with cuteness in science teaching about plants and animals for grade 4 hearing-impaired students with different learning styles was effective according to Meguigan's criteria.**

The hypothesis 1 or H1 is accepted. The developed e-Learning has been designed and developed with content, assignments, and structured systems according to the principles of instructional design (ID), which they had appropriate processes and methods to deliver content to students. There is also a matter of content accuracy and learning objectives that are accepted by experts, and there is an interesting sequence of content in presenting lessons, that make the students learn according to the objectives effectively. As well as previous research that has researched and applied instructional design principles to the lesson content and found that the lessons were more effective than Meguigan's criteria [35-39]. Therefore, it can be concluded that the design and development of content, learning objectives, assignments, the system structure are important for the effectiveness of the learning materials. These lead to creating learning to achieve the desired objectives.

**H2: The students with different learning styles who studied via e-Learning based on cuteness had higher post-learning achievement than pre-Learning achievement with statistical significance at the 0.05 level.**

The second hypothesis, H2, is accepted. Learners with different learning styles who studied via e-Learning with cuteness had higher post-learning achievement than pre-Learning achievement, which is according to the assumptions. Because developed e-Learning encourages students to learn by presenting content with multimedia (text, Thai sign language, and animation) that interacts with students. There is the matter of selecting the appropriate font size, font color, and background color. This is consistent with what Lailang, Saksiri, and Sunthorn [40] said: "The development of media for the hearing impaired requires a combination of various media, such as sign language videos, images, symbols, and meaningful interactions, to help this group of students be more easily recognizable." Similarly, research by Gentry [41] found that multimedia consisting of text, images, and sign language video helped students understand the content better than text alone or text and sign language videos. However, designing the appearance of the characters and images based on the cuteness principle, such as having cute, big eyes, a big head, a big belly, and small limbs, etc., will cause interest and invite students to follow and gain more understanding of the content. This is consistent with the research of Hiranrat and other [16] who studied the design and development of computer teaching games that used cuteness to enhance knowledge in English. It was found that most of the students were 60.17 percent satisfied that the characters had large heads and small body shapes because the character designs are cute, delicate, and baby-like. It can stimulate and create interest in learning as well, especially for children. There is also other's research that studied about cuteness principle and found that character design with cuteness consist of childlike cuteness, fragility of shape, the small

proportions of character, big head and eyes and the mouth and nose are small, which these features resulted in people who saw them feel fascinated [13], [15].

**H3: The alternative hypothesis (H3) proposed that there would be a statistically significant difference in post-learning achievement among students with diverse learning styles, as determined by a significance level of 0.05.**

H3, or hypothesis 3, is rejected. However, the result showed that the students with different learning styles had no effect on post-test achievement. The finding is consistent with previous research by Ruksasuk [31] found that different learning styles did not contribute to learning achievement. However, teachers should consider the learning methods of individual students as well in teaching and learning. As well as research by Thongruang [27] suggested that if the teacher manages the teaching and learning in accordance with all the learning styles of the students, it may be difficult. He has proposed guidelines for teaching and learning activities in accordance with the four types of learners, which the teacher must organize teaching and learning activities with aim to encourage students to learn all the components of the experiential learning process which consists of concrete experience, reflective thinking conclusive thoughts, and practice. As stated by Srisurakul [26] and teaching and learning must be consistent with personalized learning because each student has a different method of learning, particularly with students with hearing impairments who have received special education. Therefore, it is very important for those involved in learning design to correspond to the learning style of students with hearing impairments to achieve lifelong learning.

**H4: The learning development of students with different learning styles who studied via e-Learning with cuteness had 50% higher learning development.**

The fourth hypothesis, or H4, is rejected. However, when considering the learning development of learners, it was found that hearing impaired students had learning style of diverger, assimilator and accommodator which developed at 16.35, 11.02, and 25.00 percent, respectively, not according to the assumption. This is because they use the same developmental criteria as normal learners. It may be difficult for this student to have a score that meets the above criteria. The finding is consistent with studied of Arayawinyu [5] that many children with hearing impairments have low academic achievement. This may be due to the fact that the teaching methods and current measures are more suitable for use with normal children. Some methods are not suitable for hearing-impaired children. Moreover, children with hearing impairments have language problems, which can be a hindrance in taking the exam because someone who does well in the exam must have a good knowledge of the language. On the other hand, a comprehensive analysis and planning of content restructuring, along with the measurement and evaluation of the curriculum tailored for students with hearing impairments, may hold the key to achieving the desired developmental goals for this group.

## 6. Suggestions

### 6.1 The Research Study's Findings

1. The study via e-Learning with cuteness resulted in higher learning achievement for learners. Therefore, the principle of cuteness should be applied for designing online learning in other subjects for students with hearing impairments in order to pique people's interest in learning However, in order to organize a variety of teaching activities, other techniques may be considered.

2. Most of the students have diverger learning style, therefore, the teaching and learning management should be designed in accordance with the learning style. However, learning materials should be designed and developed to accommodate learners with different learning styles. This is, because each type of instruction has an impact on the learner's style.

### 6.2 Suggestions for Future Research

1. One recommendation for future research is to conduct a comparative study on the learning outcomes of learners who utilize e-learning incorporating the cuteness principle versus those who do not.

2. A suggestion for further research is to conduct a comparative study on the learning achievement of learners with varying

levels of learning achievement who use e-learning incorporating the cuteness principle.

3. Another recommendation is to develop lessons that are adaptable for use on mobile devices, to facilitate easy access and to keep pace with the rapidly evolving landscape of technology and innovation.

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