

***Using GSP in Creating Concept Image on the Topic Theory Graph
for Eighth Grade Students***

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Abstract

The purposes of this research were to creating concept image, to study the achievement and to study the attitudes towards on the topic Theory Graph by using GSP. The research samples were 26 schooling eighth grade students for gifted child in science and mathematics curriculum from Valaya Alongkorn Rajabhat University under the Royal Patronage Demonstration School in the second semester of the 2017 academic year. The design of this study was the one group pretest-posttest design. Tools used in this research were Lesson plan by using GSP, the achievement test and the attitudes towards questionnaire. The achievement test had Reliability 0.78, Item Difficulty 0.31-0.71 and Discrimination Power 0.36-0.77. Time taken for this experiment was 23 hours. From evaluating the knowledge of students on the topics Theory Graph, students had the average score from total score 120 in pretest and in the achievement test equal to 83.42, and 108.88 respectively. After study, the students had better achievement at the level of significance .05. The students had average learning develop at 78.51% and lesson plan on the topic Theory Graph by using GSP had efficiency were at 96.64/90.74%. Students have a very positive attitude towards learning Mathematics by using GSP.

Keywords: Concept Image, Theory Graph, GSP, Gifted Child in Science and Mathematics Curriculum

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Introduction

Mathematics contents are abstracted by their natures and they are communicated with symbols that are not so easy to learn and to understand instantly. Thus, in Mathematics teaching, the students must be instructed so that they have reasonable, systematic and creative thinking abilities in solving problems. To induce such skills in class, it is necessary for students to know and understand the original of each topic. There are many problems in everyday life. Modeling using graph theory is an interesting solution because it makes it easier to understand the problem. Then, remove the model response explaining the situation that occurred in the real issue. Students can create a problem model using points and lines. This is the source of graph theory.

For the topic Theory Graph, its contents involve Graph, Degree of dots, Walk, Euler's Graph, and Application of Graph. Formerly, teachers usually tell the properties of Theory Graph and ask students to remember such properties. This teaching did not help students to understand and to memorize the concept; therefore, students were not able to apply their knowledge in solving problems. Hiebert & Lefevre (Hiebert, 2012), referred that both procedural and conceptual knowledge are considered as necessary aspects of mathematical understanding. In creating mathematics concept, it is necessary for students to have the "concept image", because students cannot solve various problems well by only attempting to memorize the concept definition. The concept definition differs from the concept image: the concept definition is to define mathematical meaning in form of words or messages whereas the concept image composes of more components stimulated by corresponding stimuli; Visual Representation, Mental Pictures, Experiences, and Impressions. (Tall, D. & Vinner, 2014) wrote that The concept image consists of all cognitive structure in the individual's mind that is associated with a given concept. The procedure of creating the concept image based on the Action-Process-Structure Theory which was developed by Heingraj has five steps: Interiorization, Coordination, Reversal, Generalization, and Encapsulation. (Heingrag, 2010) Students can apply these five steps in creating their own understanding for solving mathematics problems and link to new knowledge.

GSP is software that can be used in teaching geometry, algebra, trigonometry, and calculus. It was found from many resources that the GSP software can efficiently improve mathematical thinking skills and learning attitudes of the learners. However, for last 10 years, there are only 14 GSP-based reports in Thailand's databases and all appeared in geometry-area. The number of researches is very few when compare with research in field of educational technology.

Body

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Activity and instruction documents were used during learning in class, where as practice document was used out of class. Problems in instruction document and practice document and achievement test are resemblance, but problems in achievement test are more complicated.

There are three groups of questions in all documents except in activity document. Such questions are used to evaluate level of knowledge associated with the concept image as follows:

level 1 (Action conceptual understanding). In this level, the students can describe what are given in the problems and what are the questions of the problems.

level 2 (Process conceptual understanding). In this level, the students can step-by-step manipulate the given information in form of imaginative image in order to make proper solutions and know possible relationships among the information.

level 3 (Structural conceptual understanding). In this level, the students can give the correct answers to the problems.

The students were asked to perform pretest before class. In the class, students have to do the activity according to the concept image creating steps as follows:

Step 1 (Interiorization). This step involves explanation, comparison, and reflection of students' thinking that related to the given information. The students should have the ability to find out the conclusions from the given information and use them to create any corresponding images.

Step 2 (Coordination). In this step, the students should be able to create new information from existed information by creating possible connections between available information and created images in order to make new conclusions. This means, the students should be able to explain relationships between the created images and the given information.

Step 3 (Reversal). In this step, the students should be able to write down results obtained from the images that created under the given instructions.

Step 4 (Generalization). In this step, the students should be able to generate their conclusions or create new images in imaginative forms.

Step 5 (Encapsulation). This step is the explanation of the imaginative images in message forms. The students should be able to write down new corresponding conclusions in concept definition.

There are cooperative-learning between teacher and students during the activity. Some of students can chair their idea to others on each subtopic by presenting in front of the class. Two examples of problems in activity document are illustrated. In each example, students were asked to do step by step and gave the answers of each

question. Students were asked to explain “What do they learn from this activity”, and to give the conclusion in concept image and concept definition.

After that, they had to do the achievement test in 3 hours and also to complete a multiple choices satisfaction questionnaire. The achievement test has 20 problems with total scores 120. Each problem has 4 questions. Question number 1 and number 2 measures the action conceptual understanding, Question number 3 measures the process conceptual understanding, and Question number 4 measure the structural conceptual understanding. The score in question number 3 are three times of others questions.

Example of Activity and content on the topic Theory Graph is illustrated as follow.

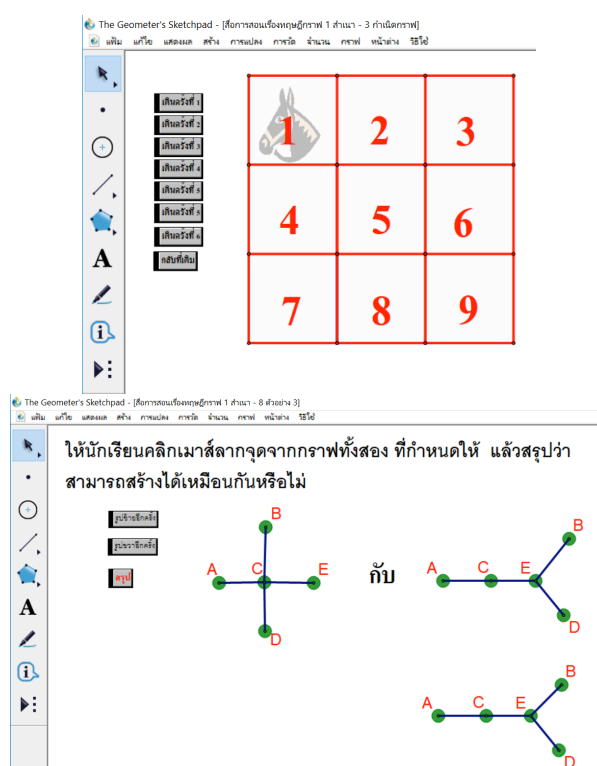


Figure 1: This is the Walk of Graph image.

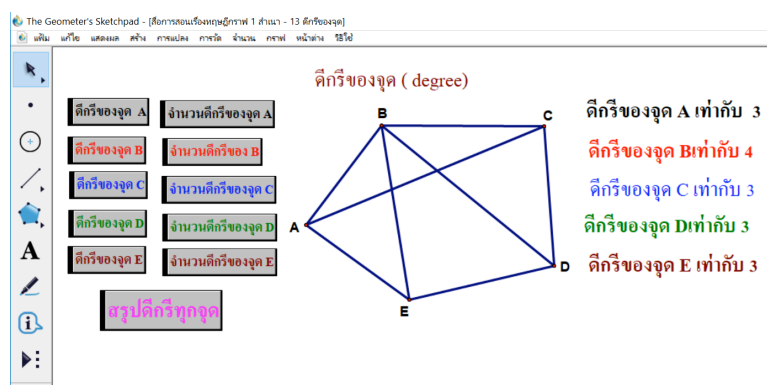


Figure 2: This is the Degree of Dots image.

It was seen from this example that the content is a little bit difficult than others in the instruction document. Students have to use the knowledge that they learnt from activity document and also their previous knowledge about the angle between the parallel lines.

For evaluating the students in the aspect conceptual understanding, learning achievement, learning behavior and attitude towards the topic Theory Graph and GSP utilization, we use the following criteria:

Level of knowledge associated with the concept image from achievement test

Table 1. Length of scores for evaluating the concept image.

Action conceptual understanding		Process conceptual understanding	Structural conceptual understanding	Range of knowledge
Q.1	Q. 2	Q. 3	Q. 4	
16– 20	16– 20	46– 60	16 – 20	Excellent
11– 15	11– 15	31 – 45	11– 15	Good
6 – 10	6 – 10	16 – 30	6 – 10	Satisfactory
0 – 5	0 – 5	0 – 15	0 – 5	Unsatisfactory

Level of learning achievement

Table 2. Length of scores for evaluating students' knowledge

Pretest and knowledge Test	Instruction document	Range of knowledge
91 – 120	127 – 168	Excellent
61 – 90	85 – 126	Good
31 – 60	43 – 84	Satisfactory
0 – 30	0 – 42	Unsatisfactory

Level of learning behavior

- 3.26-4.00 : very often practice;
- 2.51-3.25 : often practice;
- 1.00-1.75 : occasionally practice;
- 1.00-1.75 : rarely practice.

Level of attitude towards the topic Theory Graph and GSP utilization.

- 4.21-5.00 : highest satisfactory;
- 3.41-4.20 : high satisfactory;
- 2.61-3.40 : moderate satisfactory;
- 1.81-2.60 : low satisfactory;
- 1.00-1.80 : lowest satisfactory.

Conclusion

The average of the achievement of students after studying is higher than before at the level of significance .05. From total scores 120, the average score in pretest is 83.42 where as in the achievement test equals to 108.88. The learning achievements scores before and after class, of 26 students, are shown in Fig. 3.

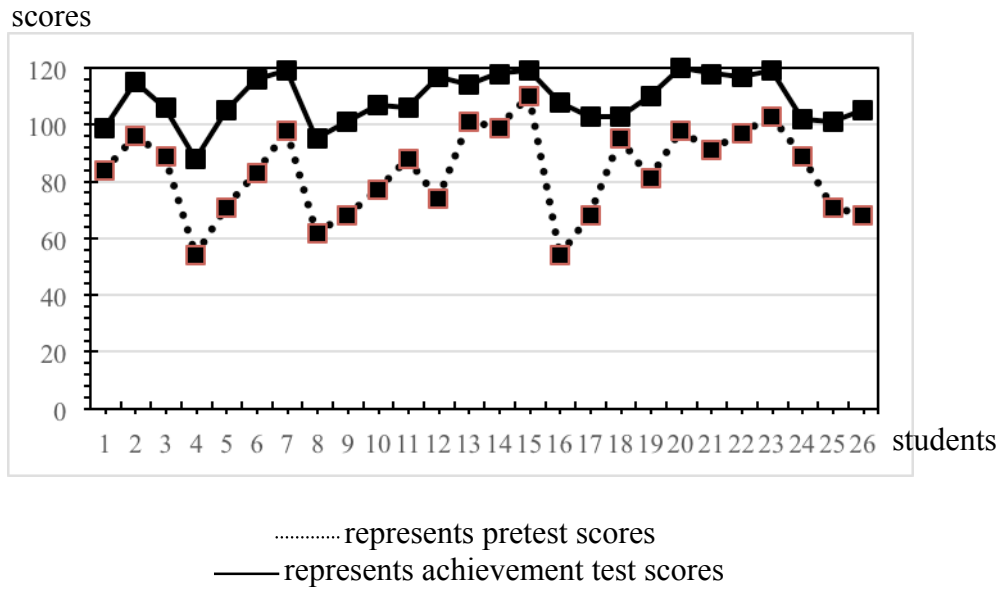


Figure 3. Learning achievements scores before and after class

From analyzing the various understandings, it was found that the average score of answering questions number 1 and 2 equals to 18.23 and 19.46, which means that students had “Excellent” in Action conceptual understanding. The average score of answering questions number 3 and 4 equals to 53.12 and 18.08 respectively, which mean that they had “Excellent” in Process conceptual understanding and had “Excellent” in Structural conceptual understanding. This indicated that the students are able to describe the information given in the problems and know what the problems ask for, and can express their thinking process; therefore, they can give the answers. Percentage scores of achievements test, classified by image concept understanding of 26 students, are shown in Fig. 4.

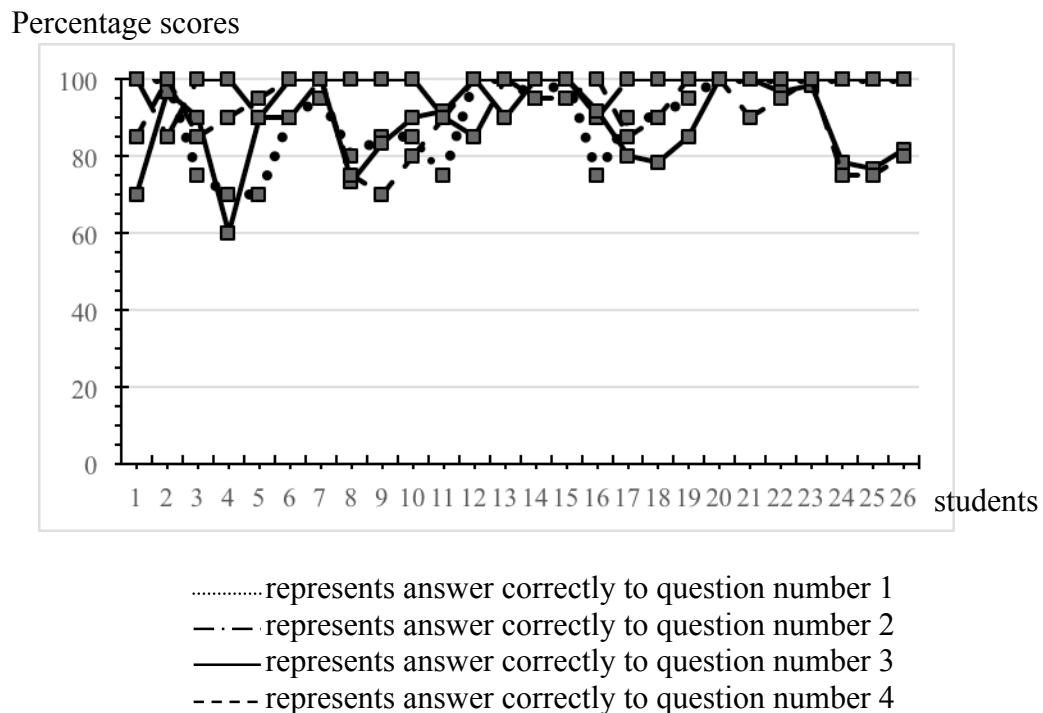


Figure 4. Percentage scores of images concept understanding

The students had average learning develop at 78.51% and lesson plan on the topic Theory Graph by using GSP had efficiency were at 96.64/90.74%, which means that the knowledge of students during engagement with instruction is in “Excellent” range. Therefore, the effect from learning activity can support the students to do their work in instruction document.

Four issues for discussion are considered.

1. Learning achievement before, during, and after class. It was observed that the average score of pre-test is in Good range, the average score during class is in Excellent range, and the average score in the achievement test is in Excellent range. This may be due to:

1.1 The problems assigned in instruction document are not too hard and not complicate. Most students can immediately give the answer after finished reading each item. The problems in the examination paper are difficult and complicate. Therefore, the students did not know how to use their formerly knowledge to build the concepts for analyzing and solving the problems. Such problems are very hard for students who have range of basic mathematics knowledge in an intermediate and weak level.

1.2 Time spent for studying in instruction document is longer than that one spent in examination. During the class, the students can relax and exchange their idea to each other, but for examination period, students have pressure from such given time. However, 15 hours for studying in class were not enough for the students to understand the lessons, because they have to learn about using GSP software and to study in new form of learning activity that they were not familiar with. This may be hard for the students to study both things simultaneously.

From the result of the achievement test, students are considered into two groups; the first one was a group that has the improvement in the level Good, and the second group has the improvement in the level Excellent. Students in first group understand the process associated with the concept image, they can illustrate their thinking and calculate for the solution correctly. Students in the second group also understand in the same manner but did not completely correct. Some knew the way to think but did not know how to explain.

2. Learning behavior, although students had good learning behavior both in class and out of class, but the performance was still lacked in intensity and continuity because of friend influences. Students should intend to practice exercise by themselves and to understand the content instead of remembrance, so that they are able to solve other problems differing from the given examples. If the behaviors are changed in proper way and are always done both inner and outer class, the students will gain more learning achievements.

3. Attitude in learning mathematics, it was clear that third years mathematic students majoring of education department can understand the nature of mathematics and appreciate to its values and advantages. However, the students still require more learning time which needs to be served. Additional period provision may be an

appropriate way in helping students for better understanding the contents and increasing their self-confidence.

4. The GSP usage, from using GSP in studying topic Theory Graph, it was found that students were able to understand the relationship between concept definition and concept image, but some of them were not able to use the software properly; they did not know how to use command and when one should use that. Using computer software in learning process will help learners to have an idea in solving problem. Enhancing of learning activities by technologies is a good idea; mathematics teachers should apply computer software as a tool for creating learning media of other topics in the future. (IPST, 2016) However, the most importance thing is the preparation of teachers. Teachers should have the ability both in using the context and choosing the suitable technology.

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References

Heingrag, C. (2010). *Roles of Geometer's Sketchpad in Students' Processes of Geometrie Conceptual Construction on Translation; A Case Study*, Paper presented at the Thailand International Conference on 21st Century Information Technology in Mathematics Education, held at Chiang Mai Rajabhat University, Chiang Mai, Thailand, 2010.

Hiebert, J. & Lefevre, P. (2012). *Conceptual and Procedural Knowledge in Mathematics: An Introductory Analysis*, In J. Hiebert (Ed). Conceptual and Procedural knowledge: Case of Mathematics, Hillsdale, New Jersey: Lawrence Erlbaum, 1-27.

Institute for the Promotion of Teaching Science and Technology. (IPST). 2016. *The Basic Education Core Curriculum B.E. 2551 (A.D. 2008)*, The Ministry of Education, THAILAND, 1 (1), 64-105.

Research Department. (2017). *Results of the research project The Third International Mathematics and Science Study Repeat; TIMSS 2016*, The Institute for the Promotion of Teaching Science and Technology (IPST), retrieved from <http://research.ipst.ac.th/index>, THAILAND.

Tall, D. & Vinner, S. (2014). *Concept Image and Concept Definition in Mathematics with particular reference to Limits and Continuity*, Educational Studies in Mathematics, 12, Macmillan, New York, 2014, 151-169.

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