

Organizing Mathematics Learning Activities on Two-Dimensional and Three-Dimensional Geometric Figures According to the Self-directed Learning Theory for Mathayom 1 Students at Schools in Rural Thailand

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Abstract

This research is a quasi-experimental research with the objectives to 1) studies the efficiency of organizing mathematics learning activities on two-dimensional and three-dimensional geometric figures according to the self-directed learning theory for Mathayom 1 students. 2) To compare the learning achievement before and after learning mathematics in the subject of two-dimensional and three-dimensional geometric figures according to the self-directed learning theory. 3) To study the students' satisfaction towards the learning activities according to the self-directed learning theory. The sample group used in the study consisted of 40 Mathayom 1 students at schools in Ongkharak District, Nakhon Nayok Province, in the first semester of the academic year 2017. The tools used in the study were 1) learning activity sets, 2) a learning achievement test, and 3) an assessment form of student satisfaction towards the organization of learning activities according to the self-directed learning theory. The statistics used in data analysis were percentage, mean, standard deviation, and dependent samples t-Test. The results of the study found that 1) organizing learning activities according to the self-directed learning theory has an efficiency of 90.17/82.23, in line with the required 80/80 criteria. 2) The mathematics learning achievement after learning the subject of two-dimensional and three-dimensional geometric figures according to the self-directed learning theory is higher than the achievement before learning, with a t-Test value of 26.713, statistically significant at the .01 level. 3) The students had a high satisfaction level towards the organization of learning activities according to the self-directed learning theory.

Keywords: Mathematics Learning Activities, Self-directed Learning, Two-Dimensional and Three-Dimensional Figures, Bachelor of Education Program in Mathematics

Introduction

Mathematics is an important subject for complete physical, emotional, social, and cognitive human development, it helps humans think rationally, systematically, and methodically. This leads to thorough and careful analytical thinking in problems and situations. As well as helps to predict, plan, decide, and solve problems correctly and appropriately. Furthermore, mathematics also involves creative thinking which can be efficiently used in real life. Therefore, the teaching and learning of mathematics must develop students to their full potential and develop the students' various skills to maximum efficiency (Puncreobutr and Rattanatumma, 2016; Ministry of Education, 2017).

However, the learning of mathematics for students at various levels in Thailand found that it has not yet been successful (Puncreobutr et. al., 2017). The national mathematical ability test results are low, for instance, the O-NET: Ordinary National Educational Test (National Institute of Educational Testing Service, 2017). As well as the international mathematics learning assessment results, which are also low, for instance, student evaluation results in the TIMSS: Trends in International Mathematics and Science Study project by the IEA: International Association for the Evaluation of Educational Achievement, or student assessment results in the PISA: Programme for International Student Assessment by the OECD: Organization for Economic Co-operation and Development, while the mathematics assessment results of students in most Asian countries are high (The Institute for The Promotion of Teaching Science and Technology, 2017).

In solving such problems, it begins with reforming the teaching of mathematics by Thai teachers, where the teachers must apply learning theories in the organization of learning activities. The teachers must design learning activities that prioritizes the learners. Students must learn from real life situations and become creators of knowledge, with teachers sparking curiosity in learning, facilitating,

and creating an atmosphere for students to exchange knowledge (Puncreobutr et. al., 2017). Students will develop in a balanced manner, from having interactions and experiences with the natural environment, and experiences related to logical and mathematical thinking (Piaget, 1972).

Self-directed learning management is a learning activity management that prioritizes the learners, where the learner is the one who practices, and the teacher organizes the learning activities, guides, and gives advice so that the learners can learn and interact during the learning process, between students and between teachers. The learner connects previous experiences with new experiences, leading to new knowledge which can be summarized through the learner's own understanding (Fosnot, 1996). It is a learning management that encourages learners to have a desire to learn, become eager to know, find answers to what they want to know independently (Candy, 1991), and become practical by interacting with the environment rather than memorizing what the teacher says (Grow, 1991).

Self-directed learning management is a means of organizing learning activities that puts the needs of the learners first. The students take action while the teachers arrange the learning, provide direction, and offer advice to ensure that the students can learn and interact with other students and with teachers throughout the learning process. The learner makes connections between old and new experiences, creating new knowledge that can be distilled in the learner's own understanding (Fosnot, 1996). It is a learning management system that promotes the learners' desire to learn and their inquisitiveness and encourages them to independently find solutions to their queries and concerns (Candy, 1991), and become practical by engaging with their environment rather than remembering what the teacher said (Grow, 1991).

To systematically develop the students' mathematical skills, the researcher believes that student development should begin at Mathayom 1 in Thai rural schools, a group with low mathematical ability test scores, by creating a set of learning activities according to the self-directed learning theory from this concept. The researcher therefore proceeded to create a set of mathematics learning activities on two-dimensional and three-dimensional geometric figures for Mathayom 1 students according to the self-directed learning theory. The researcher expects that once the students have completed the learning activity set, the students will use mathematical skills to work and live with others, as well as develop knowledge-seeking skills that improve the students' mathematics learning achievement and are beneficial in developing the abilities of mathematics teachers at schools in rural Thailand for effective teaching.

Research Objectives

1. To study the efficiency of organizing mathematics learning activities on two-dimensional and three-dimensional geometric figures according to the self-directed learning theory for Mathayom 1 students at schools in rural Thailand.
2. To compare the learning achievement before and after learning mathematics in the subject of two-dimensional and three-dimensional geometric figures according to the self-directed learning theory for Mathayom 1 students at schools in rural Thailand.
3. To study the satisfaction of Mathayom 1 students towards the learning activities according to the self-directed learning theory at schools in rural Thailand.

Research Methodology

This research is quasi-experimental with the following details:

1. Population and Sample

The population is Mathayom 1 students of Ban Ongkharak School in Ongkharak District, under the Secondary Educational Service Area Office Prachin Buri Nakhon Nayok, Nakhon Nayok Province. The 3 classrooms, totaling 120 students, are normal classrooms organized according to the curriculum of the Ministry of Education and are taught in Thai.

The sample group is 1 classroom of Mathayom 1 students in the first semester of the academic year 2017 at Ban Ongkharak School in Ongkharak District, under the Secondary Educational Service Area Office Prachin Buri Nakhon Nayok, Nakhon Nayok Province. The classroom which consisted of 40 students was sampled by cluster random sampling.

2. Variables in the Study

2.1 The independent variable was the organization of learning activities according to the self-directed learning theory.

2.2 The dependent variable was the mathematics learning achievement and the satisfaction of Mathayom 1 students towards the organization of mathematics learning activities on two-dimensional and three-dimensional geometric figures according to the self-directed learning theory.

3. Research Instruments

3.1 Five mathematics learning activity sets on two-dimensional and three-dimensional geometric figures according to the self-directed learning theory, each set consisted of a learning management plan, activity set, and student learning checklist.

3.2 A mathematics learning achievement test on two-dimensional and three-dimensional geometric figures for Mathayom 1 students. The test, which comprised of 30 questions, had a difficulty value between 0.36 - 0.80, a discriminatory power value between .278 - .685, and a reliability value (KR-20) of 0.892.

3.3 An assessment form of student satisfaction towards the organization of learning activities according to the self-directed learning theory. The 20 questions have been tried out with students who have studied it before. It has a discriminatory power value between .372 - .813 and a reliability coefficient of .879.

4. Data Collection

4.1 The researcher conducted a pre-test with a mathematics learning achievement test on two-dimensional and three-dimensional geometric figures for Mathayom 1 students. The test, which comprised of 30 questions, takes 50 minutes (and was conducted 2 weeks before the learning activity experiment).

4.2 Conducting a mathematics learning activity experiment on two-dimensional and three-dimensional geometric figures according to the self-directed learning theory for Mathayom 1 students, using a teaching period of 10 lessons, 50 minutes per lesson, and conducting sub-tests at the end of each learning management plan when teaching is completed in each learning plan.

4.3 When all the learning management plans have been completed, the post-test was conducted to see the learning achievement after the experiment, with the same test the students took before learning. In addition, the students were asked to fill a satisfaction assessment form towards the organization of learning activities according to the self-directed learning theory.

4.4 The researcher then analyzed the attained test results using statistical methods and summarized the research results.

5. The statistics used for analysis were percentage, mean, standard deviation, and dependent samples t-Test.

6. The researcher collected data during June - October 2019.

Study Results

The results of organizing mathematics learning activities on two-dimensional and three-dimensional geometric figures according to the self-directed learning theory for Mathayom 1 students at schools in rural Thailand are as follows:

1. The Efficiency of Organizing Learning Activities

The results of the study of the efficiency of organizing mathematics learning activities on two-dimensional and three-dimensional geometric figures according to the self-directed learning theory are shown in Table 1.

Table 1 The mean, standard deviation, and percentage of the efficiency of organizing learning activities according to the self-directed learning theory on two-dimensional and three-dimensional geometric figures

Score	Number of Students	Full Score	Mean	S.D.	Percentage	E ₁ /E ₂
During Learning (E ₁)	40	30	27.05	1.085	90.17	90.17/82.23
After Learning (E ₂)	40	30	24.67	.971	82.23	

From Table 1, it was found that the efficiency of organizing mathematics learning activities according to the self-directed learning theory on two-dimensional and three-dimensional geometric figures for Mathayom 1 students was 90.17/82.23, which passes the required 80/80 criteria.

2. Mathematics Learning Achievement

The results of the comparison of mathematics learning achievement in the subject of two-dimensional and three-dimensional geometric figures for Mathayom 1 students according to the self-directed learning theory, before and after learning, are shown in Table 2.

Table 2 The mean, standard deviation, and comparison of mathematics learning achievement, before and after organizing learning activities according to the self-directed learning theory

Procedure	Sample Group	Full Score	Mean	S.D.	t	df	p
Pre-test	40	30	17.00	1.739	26.713*	39	.000
Post-test	40	30	24.68	.971	*		

* $p < .05$ ** $p < .01$

From Table 2, it was found that the students in the sample group had a mean of 17.00 and a standard deviation of 1.739 before the organization of learning activities according to the self-directed learning theory, and a mean of 24.68 and a standard deviation of .9719 after the organization of learning activities according to the self-directed learning theory, with a t-Test value of 26.713 before and after learning, statistically significant at the .01 level. This indicates that the students' mathematics learning achievement after learning the subject of two-dimensional and three-dimensional geometric figures is higher than the achievement before learning, after organizing learning activities according to the self-directed learning theory.

3. Student Satisfaction

The results of the study of Mathayom 1 students' satisfaction towards the learning activities according to the self-directed learning theory on two-dimensional and three-dimensional geometric figures are shown in Table 3.

Table 3 The mean, standard deviation, and students' satisfaction towards the learning activities according to the self-directed learning theory (N=40)

Aspect	Mean	S.D.	Satisfaction Level
Freedom in Learning	4.04	.483	High
Receiving Support from Teachers	3.98	.509	High
Changing the Students' Learning Behaviors	3.90	.515	High
Ability to Apply Knowledge in Everyday Life Situations	3.89	.415	High
Ability to Impart Knowledge in One's Own Words	3.88	.379	High
Overall Student Satisfaction	3.94	.373	High

From Table 3, it was found that the overall satisfaction of students towards the organization of learning activities according to the self-directed learning theory is high (mean 3.94, S.D. 373). When considering each aspect, it was found that in all five aspects, the students were highly satisfied. The mean was between 3.88 - 4.04. The students were most satisfied with the aspect of freedom in learning and the aspect of receiving support from teachers respectively. The students were least satisfied with the aspect of the ability to impart knowledge in one's own words and the ability to apply knowledge in everyday life situations.

Simulation supported teaching methods in biology is much more effective than the traditional teaching methods (sasikala, p and Yanyong, S, 2016). Academic achievements of female students have been significantly increased in DNA replication. The results of the different sections revealed and evidenced that statistically significant variation between the means of control and experimental group students of education. Hence, that animated based simulation-supported strategic teaching methods in genetics and DNA replication is much more effective than the traditional teaching methods science education domain (Reddy, M., & Mint, P. P. 2017).

Association between students' perceptions and their attitudes on problem solving difficulties and individualized physics classes, trainee teacher interpersonal behaviours on problem solving and physics laboratory experiments to encourage the students to learn how to solve the problems in science show significance as an indicator of students' attitudes toward physics. Having a standardized set of items for the assessment of achievement was shown to give more comparable sample results. Physics laboratory classes' attitudes had a positive effect on both the five scales of ICEQ and PLEI. In terms

of the QTI scales, the influence and proximity students in highly motivated classes had a more favourable perception of their teachers (Reddy, M., & Panacharoensawad, B. 2017).

Summary of the Results

The results of the study can be summarized as follows:

1. Organizing mathematics learning activities according to the self-directed learning theory on two-dimensional and three-dimensional geometric figures for Mathayom 1 students has an efficiency of 90.17/82.23, which passes the required 80/80 criteria.
2. The mathematics learning achievement of Mathayom 1 students after learning the subject of two-dimensional and three-dimensional geometric figures is higher than the achievement before learning, statistically significant at the .01 level, after organizing learning activities according to the self-directed learning theory.
3. The overall satisfaction of Mathayom 1 students towards the organization of learning activities according to the self-directed learning theory on two-dimensional and three-dimensional geometric figures was high, which is consistent with the research hypothesis.

Recommendations

Recommendations for the Application of the Research Results

1. A hands-on practice activity set by grouping students with mixed learning abilities found that some groups of students were slower learners who could not keep up with other groups. This problem may stem from the students' learning behaviors and prior basic knowledge. Therefore, in applying this activity set, teachers should organize groups based on the students' learning behaviors. In addition, teachers should assess the students' prior knowledge and/or review prior knowledge before learning according to the activity set.
2. Organizing learning activities according to the self-directed learning theory requires teachers to always support the learners by observing their behavior. If it is found that students take a long time to do an activity, teachers should stimulate learning using questions, ensure that the students remain committed and continually strive to learn, and encourage students to want to learn in the next step.

Recommendations for Further Research

Mathematics learning activities according to the self-directed learning theory should be applied to other Mathayom 1 mathematics content, such as linear equations in one variable, graphs, linear relationships, and more.

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