The Mathematical Module of "Analytic Geometry" for Enrichment the High School Student Academic Achievement

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Abstract

The objective of this research was to enrich the high school student academic achievement in mathematics. The mathematical module "Analytical Geometry" was developed. The module was a set of teaching materials which consists of contexts for self-study, exercises and answers, and the instruction manual for a teacher. It was utilized for instructing in M30201-Supplementary Mathematics I at Wangrang-Pittayakhom school, Nakhon Ratchasima, Thailand. There were 17 students, room 5/1 (11^{th} grade), employing the module in the first semester 2010 academic year. In the experiment, the module was efficient at E_1/E_2=84.73/69.02 by the assumption E_1/E_2=70/70. However E_2 was not over 5% less than the given standard, the efficiency level was satisfied. The pretest-posttest showed that the progress of study was increased significantly (p<0.05). It was found that the module was good for teaching a group of students which have a variety performance. Additionally, the students were satisfied by the module highly.

Keywords: mathematics, module

Introduction/Problem

Mathematics is a branch of study that deals with logic, reasoning, deduction and calculation. This is an important subject not only from the point of view of being a basic concept widely used for studying at school or college, but is also a subject that prepares students to have a skill for assumption-making, decision-making, precision-thinking, organizing and problem-solving. It is believed that mathematics is essential for a real life. It helps improving the quality of life by developing human mind, spirit, wisdom and emotion (Department of Curriculum and Instruction Development, 2002). Mathematics is also a tool for science, applied science and technology, agriculture, economics and engineer (Pipitkul, 1987 and Chuchart, 1999). By the giving reasons, it is necessary to enhance mathematics education.

Generally, the aim of mathematics instruction is to make students thinking logically and being capable to apply mathematics in daily life. There are some constructivist based approaches for instruction, e.g. discovery learning, searching learning, problem solving learning, mind-map leaning, cases-studying learning, learning by questions and answers, and learning by making decisions (Department of Curriculum and Instruction Development, 2000). Ideally, the instructor has to find an appropriate method which is most efficient for the students. However, it is impossible to have the only one best method for students which have a variety

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performance. For example, it was found that method of discovery learning is a good active method which is good for specials need students. However, it is less effective because the method requires the class which has the same knowledge background and same rank ability students. Guided discovery learning method is considered. The instructor prepares activities or situations which stimulate and guide students to the purpose. The method links new information to the students' knowledge bases which is good for the class of students who have different ability to follow the contents. Guided discovery learning method, which is utilized in mathematics, composes of using questionnaires, question tags, work sheets, multimedia and mathematics modules. It was researched that it is good of self-studying and more effective (Pukphasuk, 2000).

The module is an educational innovation and technology. It is an instructional package consisted of media which are composed structurally according to the core curriculum. The module is also effective for individual differences. Students may use it as a self-studying material. It is a medium for activities between teachers and students which can be utilized flexibly for an individual and a group. The module can improve the concept of planning and interaction of student-student and student-teacher (Wongyai, 1982). Moreover, the module is user-friendly, for both instructor and student. It helps making a study activity systematically by dividing the content to sub-units which is easier for time management. Multimedia in the mathematical module makes it more attractive to the students. It helps for instructing to a student individually and gradually whereas an instructor just only gives an advice (Silapa, 2004).

For the mathematics curriculum, "Analytic Geometry" is a topic which is a basic content for a more advanced level mathematics study, e.g. conic, vector, complex number and calculus. In the topic, there are sub-contents:

- distance between points,
- midpoint,
- slope and equation of straight line,
- distance between point and line,

which are very necessary for students to understand this concept deeply and can be applied in the future. However, most of Thai students have low achievement on that topic and cannot apply to the consequent contents. This obstructs students to study in higher level course.

The authors developed the mathematical module on the topic "Analytic Geometry". The module was a set of teaching materials which consists of contexts for self-study, exercises and answers, and the instruction manual for a teacher. It was utilized for instructing in M30201-Supplementary Mathematics I. It helps students to study the topic themselves. The module can be reviewed by students easily and any times. The students using it had a better academic achievement and were satisfied by the module highly.

Design/Procedure

The development of the mathematical module on the topic "Analytic Geometry" was divided into 7 steps as follows:

1. Curriculum Analysis

The basic education core curriculum B.E. 2551 (A.D. 2008) of mathematics subject group for senior high school was considered. Course description, academic achievement, unit course and lesson plan were analyzed.

2. Literatures review

Documents of mathematics and media assisted instruction were reviewed in order to find the model of instruction which is appropriate for the selected content.

3. Development and Production

The mathematical module for instructing in M30201-Supplementary Mathematics I was developed. It was focused on the topic "Analytic Geometry" which is one of contents for 11th grade level students (Muthayomsuksa 5). The module consisted of 3 learning sub-units:

- slope
- parallel lines and orthogonal lines
- relation which can be graphed in straight line.

For each sub-unit, there were contexts for self-study, exercises and answers. The instruction manual for a teacher was also a part of the module.

4. Efficiency Measurement Studying

Literatures of mathematics achievement/learning measurement and efficiency of media measurement were review.

5. Lesson Plan

Lesson plan was organized according to learning sub-units and time management. The plan was about teaching 2 hours for each sub-unit topic, i.e. 6 hours for overall.

6. Achievement Measurement

The pretest and posttest for achievement/learning measurement on the topic "Analytic Geometry" were developed. Both pretest and posttest were multiple choice mathematics problems, which consisted of 15 items each. They were parallel tests. A questionnaire on student satisfaction toward three parts was prepared, where the three parts were learning and teaching activities using the module, media and teaching materials, and evaluation. For each part, there were 5 questions as evaluated by using 5 points scale. There were also 10 questions as evaluated by using 5 points scale for attitude test toward mathematics teaching.

7. Implementation

The sample group consisted of 17 students of room 5/1 at Wangrang-Pittayakhom school, Nakhon Ratchasima, Thailand, which was sampling from 35 students of 11th grade level (Muthayomsuksa 5) at the same school. The procedure of the experiment is the following:

- The students were first given the 15 problems mathematics pretest.
- The module was given to each student.
- Instructor taught the class according to the lesson plan.
- The posttest was applied to the students.
- The students filled in the questionnaire and the attitude test.

Finding/Analysis

1. In the experiment, the module was efficient at E_1/E_2=84.73/69.02 by the assumption E_1/E_2=70/70. However E_2 was not over 5% less than the given standard, the efficiency level was satisfied. (See more detail in Table 1)

2. It was found that students had better academic achievement significantly after using the module (p<0.05). (See more detail in Table 2)

3. The students were satisfied by the module highly (4.10 from 5). (See more detail in Table 3)

4. The students had a good attitude to mathematics subjects (4.05 from 5). (See more detail in Table 4)

Table 1 The pretest, in-between test and posttest scores of students using the mathematical module

No.	Pretest	In-between				Posttest
		test-1	test-2	test-3	Total	
	15	24	21	39	84	15
1	2	21	18	34	73	9
2	5	24	20	38	82	12
3	7	10	17	31	58	11
4	2	21	20	35	76	10
5	3	19	20	33	72	9
6	2	23	21	37	81	12
7	2	14	20	21	55	10
8	2	15	19	36	70	10
9	3	23	15	37	75	9
10	2	24	20	37	81	11
11	2	19	21	37	77	11
12	2	21	20	35	76	8
13	2	15	18	36	69	10
14	3	21	20	34	75	11
15	5	16	19	28	63	13
16	4	15	13	29	57	12
17	1	22	16	32	70	8
Total	49	323	317	570	1,210	176
Average	**2.88**	19.00	18.65	33.53	71.18	**10.35**
Percentage	**19.22**	79.17	88.80	85.97	**84.73**	**69.02**

Table 2 The comparison of pretest and posttest of using the mathematical module

Test	Sample	$\bar{X}$	S.D.	t	df	Sig.
Pretest	17	2.88	1.54	-21.70*	16	0.00
Posttest	17	10.35	1.46			

* $p<0.05$

Table 3 The student satisfaction toward the mathematical module as evaluated by using 5 point satisfaction scales (n = **17**).

Evaluated Items	Results		Interpretation
	$\bar{X}$	S.D.	
Learning and Teaching Activities	**4.13**	**0.71**	**satisfied**
1. Students enjoyed participating in classes	4.53	0.51	very satisfied
2. Students felt comfortable and happy in class hours	4.24	0.83	satisfied
3. Students could learn and studied by themselves continuously and the learning atmosphere was not stressful	3.94	0.66	satisfied
4. Students were pleased to find the answers by themselves	3.88	0.7	satisfied
5. Students had enough time to study by themselves	4.06	0.83	satisfied
Media and Teaching Materials	**4.31**	**0.63**	**satisfied**
6. Media and teaching materials were interesting	4.41	0.51	satisfied
7. Media and teaching materials were attempting to learn	4.41	0.51	satisfied
8. Learning from media and teaching materials helped students to better understand and easy to remember	4.24	0.83	satisfied
9. Media and teaching materials encouraged students to study and perform on their own	4.29	0.69	satisfied
10. Media and teaching materials were adequate for all students	4.18	0.64	satisfied
Evaluation	**3.87**	**0.73**	**satisfied**
11. Students were happy and eager to answer questions and they could check the answers immediately	3.94	0.75	satisfied
12. Students wanted to have homework at the end of each class	3.18	0.81	neither
13. Students had the opportunity to know their scores after their perform	4.65	0.61	very satisfied
14. When there was the test, students were always satisfied with their scores	3.71	0.77	satisfied
15. Students were satisfied with the admiration after answering the questions	3.88	0.7	satisfied
Total	**4.10**	**0.69**	**satisfied**

Table 4 The student attitude toward mathematics teaching (n = 17)

Evaluated Items	Results		Interpretation
	$\bar{X}$	S.D.	
1. Students liked mathematics	4.12	0.49	good
2. Mathematics helped people to become logical	4.41	0.62	good
3. Mathematics could be used in daily life	4.35	0.7	good
4. Everybody should study mathematics	4.71	0.47	very good

5. It was not necessary to study mathematics	4.12	0.7	good
6. Mathematics was boring	4.12	0.86	good
7. Students were forced to study mathematics	3.82	1.19	good
8. Mathematics got students stress	3.76	0.97	good
9. Students should study mathematics less	3.41	1	fair
10. I wanted to learn mathematics everyday	3.71	0.85	good
Total	**4.05**	**0.87**	**good**

Recommendation

It can be concluded that the mathematical module on the topic "Analytic Geometry" is an effective tool which enhances student academic achievement. It is useful for not only for a student but also for a teacher.

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