

Original Paper

Developing Analytic Geometry Module and Cooperative Learning Models to Improve Critical Thinking Ability

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Abstract

The third phase of the planned three-year research objected to test and to justify the results of the development of the Analytic Geometry module and cooperative learning models assisted with Macromedia flash animation to improve students' critical thinking skills. Research subjects were students of the Study Program: Mathematics and Mathematics Education, University of State Medan, and Mathematics Education at Muslim Nusantara University, Alwashliyah Medan. This study used developmental research oriented to product development that refers to the 4-D model, which was defining, designing, developing, and disseminating. This third stage produced analytic geometry modules and cooperative learning models supported by Macromedia flash animation as well as instruments of critical thinking skills and positive attitudes toward the justified learning modules and models. These learning modules and models were arranged in the form of lecturer manuals and student books (modules).

Keywords

Cooperative Model, Critical Thinking Skills

1. Introduction

The mathematical mindset as science is deductive, the nature or theorem which is inductively exposed must be proven deductively. Therefore, the proof is the main characteristic of mathematical activities carried out from the time students begin in elementary school to university. This is stated explicitly in the school curriculum so that students have mathematical competence in the form of evidence compilation skills, namely elementary and junior high school students compiling evidence inductively, while high school students compile evidence inductively and deductively. The process of proving mathematics at the tertiary level is more formal and more accurate than proving it in secondary schools, namely by using

the deductive method, namely the implications, contradictions, contrapositions, or direct evidence (Lee, 2004).

One of the abilities needed to prove mathematics is the ability to think critically. This is because in the process of proving it requires the ability to link mathematical concepts that have been learned and relate them to the proven problem. In critical thinking through several stages that begin with the stage of analyzing to arrive at a conclusion or assessment.

Analytic geometry is one of the courses that needed to be special attention, considering that this subject is one of the classes in a group / group of geometries that demands maximum critical thinking ability to understand the material being discussed / studied. From the experience of the researchers while caring for analytic geometry courses, many students experienced errors in the process of finding concepts in analytic geometry courses. For example, to determine tangent equations in an ellipse, students can substitute line equations into ellipse equations to become quadratic equations. But to determine the terms of the ellipse offensive line, students cannot determine the terms of the roots of the quadratic equation that is formed.

The same results were also found by the Task Force Team (2007) through self-evaluation in the Mathematics Education Study Program which included: (1) achievement of competency standards in low creative work skills, (2) teaching and learning process not oriented towards students, quality of academic guidance and guidance low thesis, (3) the implementation of academic evaluation has not applied authentic assessment, (4) the mindset of lecturers has not been synergetic and constructive.

As a lecturer who takes care of analytic geometry courses, the problem must be sought early, taking into account the characteristics of analytic geometry material is very possible to use learning using modules that are designed based on problems of daily life, with the help of Macromedia flash media, as well as evaluations that apply authentic assessment.

Meanwhile, to maximize student interaction between students is done through cooperative approaches with maximizing group learning with classmates. This is supported by the research results of Mulyono and Syafari (2009), competitive grants in the first and Second years of Syafari et al. (2014, 2015) which show that the cooperative learning process is able to improve the ability of proof which means increasing the ability to think critically and student interaction, the results of the study also recommends teaching materials that are designed according to the cognitive level of students and the real world context of students.

The purpose of this research in the third year is to try out and to justify the results of the development of Analytic Geometry modules and cooperative learning models assisted with Macromedia flash animation in an effort to improve students' critical thinking skills.

2. Research Methods

2.1 Place and Time of Research

This research was conducted in the mathematics study program of public and private universities in Unimed and UMN Alwashliyah Medan. The time for conducting the research was from March 2019 to December 2019.

2.2 Research Approach

This research was a development research. The stages of developing the learning model follow the procedure of developing the Thiagarajan, Semmel, and Semmel (1974) learning model which refers to the 4-D model (four D-Model). The 4-D model consists of 4 stages: defining, designing, developing, and disseminating. The development of learning tools include: Lecturer Manual, Modules, RPS, and research instruments namely critical thinking skills tests. This third year which was the development stage (develop) conducted the second trial directly by conducting cooperative learning with the help of Macromedia Flash and used the draft teaching materials / modules as a result of revision-I in the first trial in the second year.

2.3 The Tool of Data Collection

Data for the third stage were obtained from quizzes, questionnaires, lecturer and student notes, tests, interviews, and observation sheets. Quizzes and student notes are used to analyze student learning progress. Tests and questionnaires are used to determine critical thinking skills after attending lectures. While lecturer notes, interviews, and observation sheets are used to determine the degree of application of the learning model used in the classroom. This observation sheet and cooperative learning model have been developed by researchers in previous studies (Syafari et al., 2014-2015).

2.4 Systematic Research

The ability to think critically was one of the abilities that students must have in the process of proving mathematical concepts. Proof of mathematical concepts was carried out by students under the guidance of lecturers. But the ability to think critically in analytic geometry courses was still a serious problem. The problem of critical thinking ability of students was caused by several factors including lecturers, methods / approaches, students, analytic geometry, media and facilities. To achieve this three-year research objective, the activities carried out were described in the research roadmap as shown below.

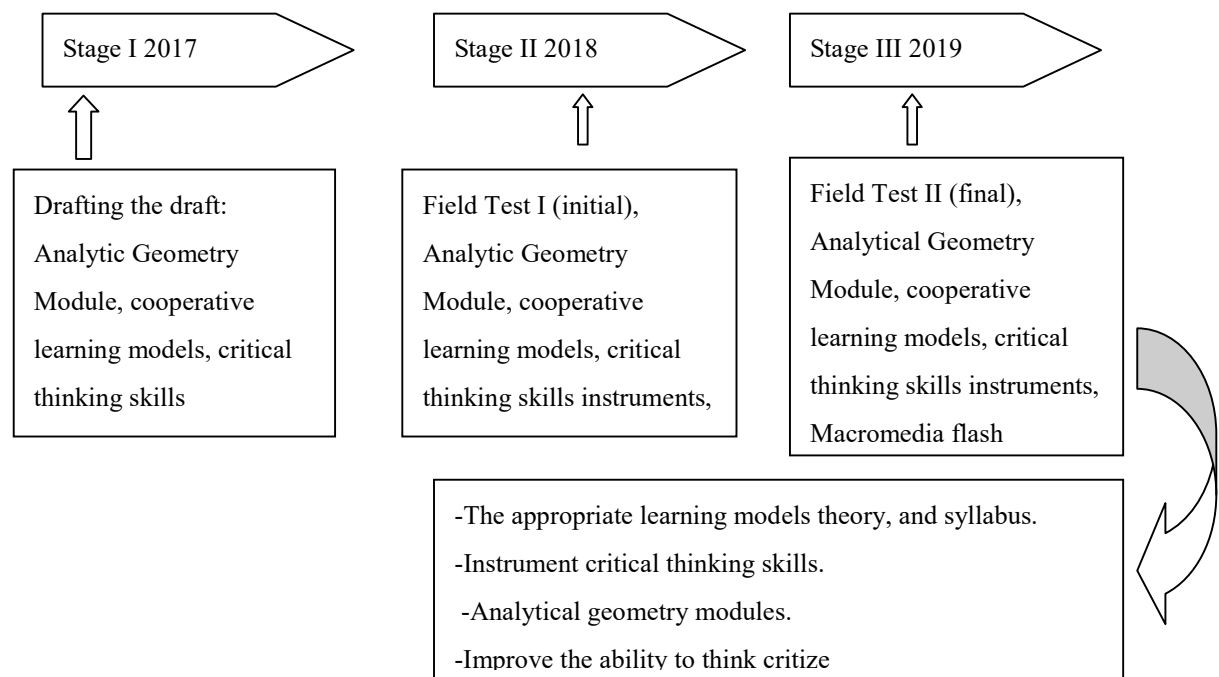


Figure 1. Research Roadmap

Based on the research roadmap above, to obtain results according to the research objectives, the systematic activities carried out in this third stage of research are as follows:

- 1) Conducting a cooperative learning field test with the assistance of Macromedia flash Animation was which the resulted of the revision in stage II.
- 2) In learning using the Analytic Geometry module which is the result of the revision in phase II activities.
- 3) Providing tests of critical thinking skills.
- 4) Analyzing the results of field tests to obtain cooperative learning models assisted with Macromedia flash was animation that can improve students' critical thinking skills.
- 5) Analyze and revise Analytic Geometry modules that can be used by students in Understanding of Analytical Geometry course material

3. Results and Discussion

3.1 Research Results

In accordance with the plan, in the third phase of the research period which is a continuation of the second phase of the period has been carried out in the two classes of research samples namely the Mathematics Education Study Program FKIP Muslim Archipelago Alwashliyah University as many as 29 students and 33 State University of Medan (Unimed) mathematics study programs by implementing modules designed and a cooperative approach with the help of Macromedia Flash produces:

A. Analytic Geometry Module

The resulting Analytic Geometry Module contains the formulation of critical thinking skills listed in the Analytic Geometry module, lecturer handbook (SAP, Lecture Contract, and Lesson Plan), critical thinking ability instruments and positive student attitudes. Analytical Geometry Module was SAP, Lecture Contract and lesson plan (RPP) which were the results of limited studies and trials which were the result of revision in the second phase of research. From this research an Analytical Geometry Module consists of 6 learning activities, namely:

1. Learning activity 1. Parabolic.
2. Learning activities 2. Ellipse.
3. Learning activities 3. Hyperbole.
4. Learning activities 4. Coordinate System.
5. Learning activities 5 . Flat and Straight Line Fields.
6. Learning activities 6. Ball.

B. Students' Critical Thinking Ability

From the critical thinking ability test on each respondent as many as 29 people and 33 students of mathematics education study program FKIP Muslim Nusantara University and FMIPA Unimed obtained the results of critical thinking skills as in Table 1.

Table 1. Values of Critical Thinking Ability

NO	SCORE	FKIP UMN	% Graduation	FMIPA Unimed	% Graduation
1	A	7	24.14%	4	12.12%
2	B	20	68.97%	24	72.73%
3	C	2	6.90%	5	15.15%
4	E (NOT PASSED)	0	0	0	0
Total		29	100%	33	100%

From Table 1 it could be seen that overall respondents successfully graduated and none of the students failed, there were 24.14% of students in the Mathematics Education Study Program FKIP UMN and 12.12% in the Mathematics Study Program FMIPA Unimed graduated with grades A, 68.97% students at Mathematics Education Study Program Faculty of Mathematics and Natural Sciences UMN and 72.73% in Mathematics Education Study Program FMIPA Unimed graduated with a value of B, and there were 6.90% students in Mathematics Education Study Program FKIP UMN and 15.15% in Mathematics Education Study Program FMIPA Unimed graduated with a grade C.

C. Positive Attitudes of Students towards the Learning Process

During the learning process observations were made of students to obtain data about student attitudes towards the learning process. The results of observations and data analysis about attitudes towards the

analytic geometry module and the ongoing learning process show that: confidence, drive for success, attitude towards success, encouragement of the learning approach used, the use of teaching materials, was increasing, while anxiety in learning and towards teaching lecturers were decreasing. Students were getting bolder in expressing their opinions, and this was evident from the results of tests of critical thinking skills showing better results. Some activities in the learning process carried out by students, and lecturers can be seen in the following picture.



Figure 1. A Student Explaining Learning Material



Figure 2. A Student Observing Another Student

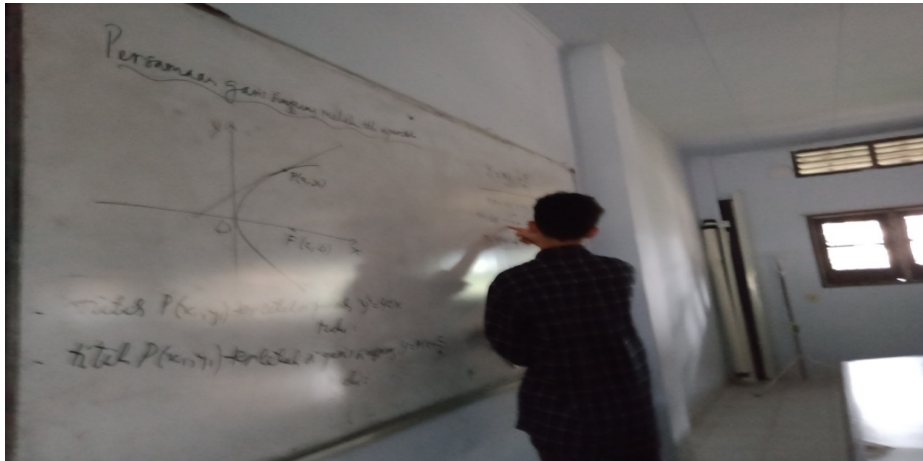


Figure 3. Students Presenting the Results of the Discussion

4. Discussion of Research Results

The resulting of Analytic Geometry module consists of 6 learning activities, each learning activity consisting of learning objectives, material descriptions, examples and exercises. The distribution of material was certainly expected to have fulfilled the characteristics of analytic geometric concepts that were organized in a hierarchical manner, thus it was hoped that learning objectives can be achieved. This is in accordance with the statement of Tjipto Utomo (1990) that learning objectives could be achieved if the module system could be carried out by dividing the lesson material into parts, each of which includes one or several subject matter.

In the module system, the achievement of learning objectives was done by grading a framework system, meaning that the assessment of mastering the subject matter/material was a prerequisite for understanding the next material. According to Tjipto Utomo (1990) in the module system the grading framework grading method was able to minimize failure and was a guarantee that students have understood the contents of the chapter before he continued on the next chapter. The results of this study reinforced the results of previous studies by (Syafari, 2003; Mulyono & Syafari, 2009, 2014).

The results of the critical thinking ability test shown that all students (100%) passed, but there were still 7 people or 11.29% of students who received a C value. These results indicated that the cooperative learning process using modules designed according to the level and media assistance Macromedia Flash animation was able to improve students' critical thinking skills in analytic geometry material. Macromedia flash animation produced was proven to be able to provide assistance in understanding the concepts in analytic geometry, especially related to the concept model and formula deriving.

From the results of data analysis about attitudes towards the analytic geometry module and the ongoing learning process shown positive results, this could be seen from the confidence, and the courage in expressing the opinions of students had increased, in addition to anxiety in learning and towards teaching lecturers was decreasing. Cooperative learning by utilizing the help of Macromedia flash was designed to enable students to interact positively in constructing analytic geometry concepts, students provided

mutual knowledge, concepts, and skills to students in need and each student felt happy to contribute his knowledge to other members in his group.

5. Conclusion

This research results concluded:

- 1) Analytic Geometry Module which consists of six learning activities namely: Learning activities (a) Satellite Dish, (b) Ellipse, (c) Hyperbole, (d) Coordinate System, (e) Straight Line Flat Field, and (f) Ball.
- 2) Overall students (100%) graduate, with a category of 89.71% students got good grades and very good and only 11.29% of students received enough marks.
- 3) Attitudes towards the Analytic Geometry module and the ongoing learning process shown results those were positive.

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