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The Model of Analytical Geometry Interactive Module using Systematic, Active, Effective (SAE) Model to Support Students' Autonomous Learning and Mathematics Education Competence

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ABSTRACT: This study aimed at producing an interactive Analytical Geometry Module based on Systematic, Active, Effective (SAE) e-module model that can build learning independence and competency of students in Mathematics Education study programs. This research employed the developmental research method with the stages of development: preliminary studies, design, development, and testing. This study documented that most of the students were interested in lectures on analytical geometry utilizing module teaching materials in the form of interactive electronics (interactive e-modules) that could build student learning independence and easily understand them. For this reason, it is necessary to develop teaching materials that are easy to understand, namely interactive e-modules in the field of analytical geometry. At the design stage, this study captured the results of the initial draft e-module interactive analytical geometry with systematic: introduction (preface, instructions for using e-modules, material description, prerequisites, learning objectives), learning activities include: a description of the material and examples of questions, practice exercises, summaries, competency tests, practice answer instructions, feedback, and reference lists. At the development stage, an interactive draft geometry e-module product draft was produced. The e-module draft is an interactive analytical geometry that is designed and developed systematically and effectively and enables students to build learning independently by adhering to the principles of developing teaching materials in learning. In the testing phase, the results of the trial on the draft e-module were limited to students, and the overall average score was 3.27, which means that the students considered that the analytical geometry interactive e-module product was good.

KEYWORDS:*pengembangan, e-modul interaktif, SAE (Systematic, Active, Effective), geometri analitis*

I. INTRODUCTION

Analytical geometry is a part of the course taught in the mathematics education study program that combines algebraic material and Euclidean geometry. Analytical geometry is one of the essential fields in high-level mathematics learning because of its application in various areas, including science. Analytical geometry is one crucial component in mathematics learning that must be mastered by students of mathematics education study programs as a teacher candidate used as a basis for teaching in secondary schools.

Analytical geometry is a field of mathematics that has different specifications from other fields of mathematics. In the implementation of analytical geometry, learning is still mostly done conventionally, which is dominated by lectures and exercises that are less programmed. Therefore, for students to understand this course independently, it is necessary to develop teaching materials that are easily studied by students independently, namely in the form of modules. With the module, the material will be described in detail, starting from the description of the material, sample questions, summary exercises, answer questions for the practice and competency test. With this module, students can understand analytical geometry material systematically easily.

Learning material should be material that all students can learn on their own (Dick & Carey, 990). These materials can provide opportunities for students to learn them without relying much on the explanations of others. To overcome the constraints of using learning resources, it is necessary to develop teaching material models that pay attention to differences in students' abilities, support individual and independent learning, and which can facilitate student learning.

According to Hamdani (2011), a module is a learning tool that contains material, methods, boundaries of learning material, instructions for learning activities, exercises, and ways of evaluating that are systematically and attractively designed to achieve the competencies expected and used independently. Daryanto (2013) added that the main purpose of teaching materials in the form of modules is that the reader can absorb the material or teaching materials independently. Meanwhile, according to Prastowo (2011), modules are teaching materials that are arranged systematically in a language that is easily understood so that students can learn independently with minimal assistance or guidance from educators. Modules need to be combined with electronic media, which are often called electronic modules (e-modules). This is done to reduce the saturation of students learning with modules. Deep learning will be realized if it is integrated with e-modules and will produce a better graduate product.

According to Prastowo (2011), digital teaching materials in electronic form provide opportunities for innovation, even if only to small parts of these teaching materials. The development of teaching materials in any form, including in electronic form, is intended to help people learn or facilitate student learning. Therefore, development activities must be based on various theories about people who learn, people who teach, and learning activities themselves. In other words, an understanding of people who learn, people who teach, and learning activities are conditions for every learning development activity. Good teaching materials provide tools that make it easy for users to see their usefulness and use them in practice.

The development of science, technology, and information brings changes and new paradigms in learning materials and learning methods (Darmawan, 2012). Products from technology and information have provided alternative teaching materials that can be used and accessed by students in digital form such as e-modules. Computer-based interactive learning is able to enable students to learn with high motivation because of their interest in multimedia systems. Wena (2010) reinforces this that learning that can utilize teaching materials with computer media will make learning process activities interesting and challenging for students.

Interactive teaching materials are creative, innovative, and adaptive teaching materials for technological development and can make students happy and comfortable so that learning becomes effective and efficient (Prastowo, 2011). According to Hamid (2012), in learning requires a pleasant and empowering interaction. Fun and empowering can be run by integrating the principles of education and entertainment (edutainment), so students or students feel entertained and do not feel easily bored studying. This form of entertainment can be in the form of objects, equipment, or forms of activities that make students feel happy doing learning activities. Munir (2013) added, learning that uses information and communication technology can help educators in delivering material and students in understanding learning material. With multimedia teaching materials, including interactive e-modules, the material can be modified to be more interesting.

E-module is an electronic module that is a teaching material that is presented systematically so that its use can learn with or without a facilitator or teacher (Prastowo, 2011). One of the criteria of interactive e-modules is self-instructional, which makes the teaching material able to learn students independently (Asyhar, 2012). Interactive e-module teaching material is one of the teaching materials whose digital publishing process consists of text, images, or a combination of both. Development of interactive e-modules based on SAE (Systematic, Active and Effective) is a teaching material that can guide students in learning systematically, actively and effectively so as to gain maximum knowledge and understanding of the material.

Autonomous learning is given to students with the intention that students have the responsibility to regulate and discipline themselves and develop learning abilities on their own. This attitude needs to be owned by students because it is a characteristic of maturity of educated people (Rusman, 2012). In independent learning, students must try to understand the contents of the material outside the classroom by themselves, find their sources of information, and solve their difficulties. In learning, students must take more initiative to conduct their own learning activities. However, autonomous learning does not mean self-study. Students may study with friends, discuss with friends or other learning resources in solving the difficulties they face.

This research is expected to produce an interactive Analytical Geometry based SAE (Systematic, Active, Effective) e-module model that can support the learning independence and competence of students in the Mathematics Education study program so that students can learn independently.

II. METHOD

This study applies the development and research method. Developmental research is used to develop and test certain products (Sugiyono, 2013; Borg and Gall, 1989). The usefulness of the results of developmental research is to bridge the gap between researchers who produce educational theories and practitioners as users of educational products (Abidin, 2016). In this research, the stages of development carried out are preliminary studies, design, development, and testing. These stages are the development model of the combination of the Plomp (1997), Thiagarajan (1974), and Tim Puslitjaknov (2008) models.

In this study, the participants involved were 92 students of the Mathematics Education Program at one private university in Malang, East Java, Indonesia, and 92 lecturers teaching analytical geometry. Data collection in this

study was done by questionnaire, literature review, and documentation. The data analysis technique used was both quantitative and qualitative approaches. Quantitative analysis using descriptive statistics of percentages was used. Besides, the qualitative analysis in this model employed an interactive analysis model of three components of analysis, namely data reduction, data presentation, and drawing conclusions and verification, whose activities are carried out in an interactive form with the process of collecting data as a process (Miles and Huberman, 1986).

III. RESULTS AND DISCUSSION

In this interactive analytical geometry e-module, product development research is in accordance with the development model with stages: preliminary study, design, development, and testing. The results of this study are described in accordance with these stages.

The preliminary study phase includes initial analysis, learner analysis, task analysis, concept analysis, and formulation of indicators. The initial analysis was conducted for the study of literature, the preparation of questionnaires, and the distribution of student questionnaires in learning analytical geometry and the questionnaire for lecturers' needs in carrying out the learning process. Learner analysis is done to describe the characteristics of students and student motivation in learning analytical geometry courses. Task analysis is carried out to describe all the tasks needed to study analytical geometry courses so that students can find formulas, concepts, and principles in each material. The concept analysis stage is carried out to describe all concepts related to analytical geometry courses. The formulation of indicators is carried out to describe all indicators that must be achieved by students after students learn e-modules and then to continue the formulation of learning objectives that must be achieved by each student after learning the e-modules.

This study involved 92 students and one lecturer. From the results of 92 students and one lecturer questionnaire conducted in the preliminary study activities to collect data on the identification of student needs and identification of student characteristics as well as identification of lecturer needs data related to analytical geometry courses. Data collected from these activities are then used as a basis for product design and development.

Needs identification is used as a tool to identify problems to determine the right course of action. Needs (need) is the gap between what is expected with the actual conditions (Sanjaya, 2008). In this research, the identification of the need to do to obtain information from students about analytical geometry so far is there a problem, what is the cause, whether the method used by the lecturer is preferred, and whether the solution to the provision of material in the form of interactive e-modules is something needed, and so on.

According to the results of the questionnaire analysis, the needs and character of students showed that 67, 30% of students were happy with analytical geometry courses. As many as 77.71% of students want to study analytical geometry seriously and try to improve learning outcomes. To improve their competence, 73.91% of students wish to the lecture model used by lecturers to vary so that students do not feel bored in learning. If in analytical geometry lectures are developed teaching materials in the form of interactive e-modules that utilize computers or information technology, the majority (60.87%) of students strongly support, some (34.78%) support, and a small portion (4.35%) less supportive. Those who were less supportive, when confirmed they stated that because most of them reasoned they lacked mastery of information technology so they worried they could not make good use of it.In accordance with the results of the questionnaire, the needs of lecturers show that lecturers in analytical geometry still often dominate in learning by placing students as learning objects, but the lecturer states that they support when developing analytical geometry teaching materials arranged in the form of interactive e-modules.

Based on the results of the questionnaire analysis of the needs of students and lecturers, it is portrayed that there is sufficient reason for the development of an interactive analytical geometry e-module model. Although it seems that some students are not proficient in computer technology, this can be overcome by developing e-modules that are easy and not too complicated to operate. With this in mind, students generally think that it is necessary to develop interactive teaching materials in learning that support easier learning and learning independence. The most interesting teaching materials for students are those who utilize computers or information and communication technology. This is confirmed by the opinion of Rusman (2012), that computers can stimulate students to be active in learning and are liked by students who can be used positively as learning tools. However, in the future, they still need lecturers 'presence so that the division of lecturers' roles and the material becomes clear (Wena, 2010). By paying attention to these preliminary studies, the development of interactive e-module products is suitable for students.In accordance with the results of the identification of the characteristics of students shows that the attitudes, interests, and motivations of students are generally good for analytical geometry material. This will greatly support the success of the product to be developed. Characteristics seen from the attitude of students who strongly support the development of interactive e-module products in the field of analytical geometry will facilitate and assist researchers in developing and implementing product development.

Product design phase, including media selection, format selection, and the initial design was done. The selection of media, carried out to describe the media used to design in the development of analytical geometry teaching materials and the selected media is expected to make it easier for students to understand this teaching material. Based on the purpose of this study, the media used to develop teaching materials is an interactive electronic module (e-module). Format selection, done to describe the format used in developing analytical geometrical teaching materials. Based on the objectives of this study, the format used to develop SAE-based teaching materials is teaching materials that emphasize systematic, active, and effective. Systematic means that in every step of the teaching material presented analytically and logically so as to form a systematic teaching material. Active means the content of teaching materials requires students to actively develop ideas in solving problems. Effective means the description of teaching material is presented in an effective written form so that learners can easily understand and solve problems.

The initial design of developing analytical geometry teaching materials includes the preparation of teaching materials for analytical geometry courses in the form of an introduction (preface, instructions for using e-modules, material description, prerequisites, learning objectives), learning activities which include: description of the material and examples of questions, exercises questions (interactive), summaries, competency tests (interactive), practice answer answers, feedback, and reference lists. The results of the analysis of learning materials produce learning topics, namely: (1) Coordinate systems, (2) Straight lines, (3) Circles, (4) Ellips, (5) Parabola, and (6) Hyperbole.

The product development stage is carried out by developing the product by taking into account the results at the design stage. This is consistent with the opinion of Seels and Richey (1994) that development is a process of translating or describing design specifications into physical form, or in other expressions, development means the process of producing learning materials. At this stage, product development is carried out by carrying out the process of drafting an SAE-based interactive analytical geometry e-module device. In this e-module, it is arranged in a complete, clear, and interesting way to make it easier for students to learn independently and not depend on others. E-modules are created using the Kvisoft Flip Book Maker and Quiz Maker programs, which are able to create e-module displays such as the printed module display. The e-module packaging in the form of a compact disk (CD) is accompanied by instructions for use. E-modules can be operated offline using a computer that has Adobe Flash Player software installed. This e-module has the characteristics of a learning module with components, including an introduction (preface, instructions for using e-modules, material description, prerequisites, learning objectives), learning activities include a description of the material and examples of questions, practice exercises (interactively), summaries, competency tests (interactively), practice answer answers, feedback, reference lists. The final result of this stage is the preparation of SAE-based interactive analytical geometry prototype e-modules (systematic, active, and effective).

The presentation and packaging of e-modules in the form of CD pieces is followed by instructions for their use. E-modules can be operated offline using a computer. The results of the development of analytical geometry e-modules include an outer cover, inner cover, initial appearance: preface, instructions for using the e-module, and the components of each module that contain: introduction, learning activities which include a material description and example problems, practice exercises (in terms of interactive), summaries, competency tests (interactively), feedback, reference lists.

The product testing phase, based on the results of product development, was done. In this study, product testing is carried out on a limited trial basis to a small group of students. Trials were conducted on 36 students. Students are asked to do product testing and grade the product through an assessment questionnaire. The results of trials on students in a limited (small group of students) obtained an overall average value of 3.27 (with a score in the range of 0 - 4.00), which means that students are limited to assessing interactive e-module analytical geometry products is good.

This analytical geometry e-module discusses six learning module units, namely: (1) Coordinate systems, (2) Straight lines, (3) Circles, (4) Ellips, (5) Parabolic, and (6) Hyperbole. These materials are arranged with the aim of helping facilitate students in understanding analytical geometry material. This is in accordance with the statement of Munir (2013) stating that modules in learning have roles such as (a) explaining learning material or abstract objects that are concrete; (b) can learn the learning material repeatedly. Learning material can be repeated at another time without having to make another; (c) overcoming the limitations of time, space and senses, both students and educators; (d) increase motivation and enthusiasm for students to learn; (e) develop students' ability to interact directly with the environment and other learning resources; (f) allows students to learn independently according to their abilities and interests; and (g) allows students to measure or evaluate their own learning outcomes.

IV. CONCLUSION

This study was done using a developmental research approach with the stages of development, namely: preliminary studies, design, development, and testing. The results of the preliminary study stage show that based on the results of the analysis of student needs, most students (in general) are more interested in lecturing

analytical geometry using module teaching materials in an interactive electronic form (interactive e-modules) that allow a lot of independent reading and learning. Therefore, it is necessary to develop teaching materials that are easy to understand, namely analytical geometry interactive e-modules.

The results of the design stage, namely the design of an initial draft of an interactive analytical geometry e-module with systematics include an introduction (preface, instructions for using e-modules, material description, prerequisites, learning objectives), learning activities which include a description of the material and examples of questions, practice questions (interactive), summaries, competency tests (interactive), practice answer answers, feedback, and reference lists. The development phase (develop), namely the preparation of a draft (prototype) interactive e-module so that the formation of an interactive analytical geometric e-module draft based on SAE (systematic, active, effective). The draft e-module is an interactive analytical geometry that is systematically designed and developed by adhering to the principles of learning development. At the product testing stage, a limited trial is carried out on the draft analytical geometry e-module. The results of the try out on students on a limited basis (small groups of students) obtained an overall average value of 3.27, which means that students limitedly assess the interactive e-module product in analytical geometry is good. In accordance with the results of this study, several things are suggested, namely: (1) to engender student activeness and creativity, this model is open to be developed by anyone as long as what is developed continues to lead to the development of teaching materials so that learning outcomes become better; and (2) for wider use, it must pay attention to the similarity of environmental characteristics as described in this study.

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