Developing Mathematics Learning Media Based on E-Learning Using Moodle on Geometry Subject to Improve Students' Higher Order Thinking Skills

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Abstract—21st Century teaching and learning strategies related to the various methods used include the use of appropriate tools with the latest technological developments to help students to understand clearly about the content of the subject. Therefore, the need for the 21st Century teaching more focused on the development of students' higher-order thinking skills is increasingly urgent. This study aims to develop mathematics learning media based on e-learning using MOODLE (Modular Object-Oriented Dynamic Learning Environment) software on the geometry of the flat side subject to improve Higher Order Thinking Skills (HOTS) among secondary school students. The analysis in this study is based on the ADDIE Instructional Model (Analysis, Design, Development, Implementation, Evaluation). The respondents in this study were three lecturers who are experts in mathematics education, three teachers in information technology and 70 secondary school students in Yogyakarta, Indonesia was selected using the purposive sampling method. The findings have shown that mathematics learning media based on e-learning using MOODLE very suitable for encouraging students to use the mind to understand, interpret, analyze and manipulate information to find possible solutions for various problems, especially related to the geometry of the flat side subject. Besides, based on mathematics learning media based on e-learning using MOODLE able to encourage students to think, to generate new ideas, to focus and to be active throughout the teaching and learning activities. The results of this study are expected can be one of the teaching tools which can help in learning activities and a catalyst for the improvement of the quality of students' thinking.

Keywords—E-Learning, MOODLE, mathematics education, Higher-Order Thinking Skills, ADDIE Instructional Model

1 Introduction

The 21st Century education requires a holistic transformation in terms of infrastructure, knowledge and teaching strategies that encourage more complex thinking processes. Students need to apply various skills in learning to improve achievement, effective cognitive processes, creative and innovative. Teachers also need to be equipped with a wide range of knowledge including the ability to apply higher-level thinking skills (HOTS) and prepare students in the same direction. The definition of millennium education 21st is related to many aspects of modern life where it focuses on deeper learning and learning, higher-level thinking skills (HOTS) and various challenges in transforming knowledge through teaching activities. HOTS is an important aspect of teaching and learning that enables students to improve their achievement in learning and daily life [1]. To provide competent students, educational institutions need to encourage students to have deep and extensive skills related to the challenges of the 21st century and beyond.

As stated in the Indonesian Qualification Framework i.e., vocational education in Indonesia aims to provide skilled and competent manpower in the career [2]. Besides, based on Malaysian Qualifications Framework, vocational education in Malaysia focuses on the generation of knowledgeable, skilled, competent and highly-skilled graduates to meet the needs of the competent industry [3]. Teaching and learning methods consist of various activities that include knowledge, skills, style and content of varying learning to enable students to understand what is conveyed by teachers and improve academic achievement. In parallel with cognitive learning theory, students are active individuals in teaching and learning activities in the classroom [4]. Students are not passive individuals who only accept a delivered by the teacher without responding but the student is an active individual who has a gesture in responding and acting to what the teacher is teaching in the classroom. The teacher is a key role in managing quality and quantity in students' behaviour. Teachers are encouraged to choose teaching and learning methods that are appropriate to the student's condition to achieve maximum performance [5].

Teachers should use teaching and learning methods that are appropriate to encourage the active student in the class and increase the interest of students to understand the lessons [6]. Teachers need to provide appropriate methods in learning and learning to help students achieve academic success [4, 7]. Without proper teaching and learning methods then the teacher will have problems in delivering the maximum content of the lesson to the students [8]. This can also affect the growth of student achievement. The process of transmitting knowledge through teaching and learning activities will be more easily accepted by students if it is supported by new technology that is suitable and appropriate [9]. Educational technology is a technology that impacts the learning process. Knowledge about technology becomes quickly outdated and becomes obsolete [10].

Mathematics is the basic science, both the applied and the rational aspects play an important role in the pursuit of knowledge and technology [11]. It can be concluded that mathematics is a discipline which is a basic science abstract idea that must be understood to be manipulated into a real idea, so it will be easier to understand. Me-

dia-based learning using the Moodle e-learning is expected to facilitate and increase the interest and enthusiasm of student learning in mathematics because it can be accessed anytime and anywhere with internet media. This study aims to develop mathematics learning media based on e-learning using MOODLE (Modular Object-Oriented Dynamic Learning Environment) software on the geometry of the flat side subject to improve higher-order thinking skills among secondary school students.

2 E-Learning

E-learning can be defined as a learning system that uses an electronic device as a medium [12]. E-learning is learning applications in separate online learning using electronic media as a medium. The advantage of learning via e-learning is creating learning opportunities be enhanced interactivity. There are no restrictions on time and place and learners become more responsible for their success [13]. There are many types of e-learning tools, such as the Modular Object-Oriented Dynamic Learning Environment (Moodle).

Fig. 1. Moodle logo

There are several learning activities supported by Moodle [14] as follows:

- An assignment is used to give the assignment to the participants of online learning.
- Chat, is a facility used to make the process of online conversations (chatting).
- Forum is used to create online discussion forums can be created in discussing a matter of learning.
- Quiz, is a facility used to conduct the test or tests online.
- A survey is a facility used to conduct polls.

Math is a scientific discipline that can improve thinking and problem-solving skills [15]. Higher Order Thinking Skills (HOTS) in 21st Century education encompasses creativity and innovation, critical thinking and problem solving and communication and collaboration skills [16]. HOTS is a skill in using the mind to address a variety of new challenges [17]. Students need high-level skills to acquire and process a variety of important information and new knowledge through a variety of sources [18]. Through mastery of HOTS learning, students can manipulate information and ideas thus translating the meaning and implications of information and ideas [19]. In this regard, HOTS is needed in teaching and learning to encourage students to use their minds to understand, interpret, analyze and manipulate information to find possible solutions to problems or challenges.

3 Methodology

Researchers have conducted discussions and workshops to prepare mathematics learning media based on e-learning using moodle on geometry subject which takes approximately six months. Generally, the ADDIE model has 5 phases whose first phase is Analysis, Design, Development, Implementation and Evaluation. The ADDIE model is a systematic approach to the process of designing instructions and helping designers carry out the process with an organized framework to ensure their products are effective and efficient [20]. The respondents in this study for the implementation phase were 70 secondary school students in Yogyakarta, Indonesia was selected using the purposive sampling method. Besides, the mathematics learning media produced received feedback from three (3) lecturers who are experts in the field of mathematics education and three (3) teachers in the field of information technology.

4 Findings and Discussions

In this study, researchers have applied five phases of the ADDIE model, namely Analysis, Design, Development, Implementation and Evaluation. To develop mathematics learning media based on e-learning using MOODLE (Modular Object-Oriented Dynamic Learning Environment) software on the geometry of the flat side subject to improve higher-order thinking skills among secondary school students it is obtained according to the following phases:

4.1 Analysis phase

The Analysis phase was conducted to obtain detailed research-related information. The planned teaching and learning activities should be in line with the learning objectives. A teacher should focus on using appropriate methods and media to enhance HOTS among students. In the context of mathematical learning media design based on e-learning using MOODLE, the process of analysis needs to involve three main aspects, namely: student, teacher and teaching objectives. Interviews conducted on (3) lecturers who are experts in the field of mathematics education and three (3) teachers in the field of information technology:

Needs analysis of learning media:

- Teachers still find it difficult to present abstract material that is considered difficult for students without the use of media, one of which is the building material of a flat side room.
- The use of computer labs in e-learning-based media adoption has not been maximized.
- The application of HOTS (Higher Order Thinking Skill) in learning is still limited to grade IX material.

From the above, the learning medium is one of the alternative solutions to the problem. The e-learning learning medium can assist teachers in the process of learning on abstract material and can assist in the application of HOTS to the learning of VIII students.

Material analysis: The selection of this material based on the requirements found in MTS Negeri 1 Yogyakarta and SMP Negeri 7 Yogyakarta. The material is chosen according to students needed clear visualization of the learning process about geometry.

Curriculum analysis: Curriculum analysis consists of material analysis, Core Competence, Basic Competence and learning objectives achieved in the learning process.

4.2 Design phase

These forms include general system communication and specific process sequences and make it easier for parties concerned to understand the system's journey and then assess its suitability and potential for continued development. The planning or design step is carried out after the researcher has conducted initial research and information gathering [21]. At the design stage, there are two steps, namely:

Make a design from learning media: This process begins with preparing the flow of making learning media to be developed in the form of a flowchart. Flowcharts are made starting from the initial process of entering learning media until the process of ending the use of learning media.

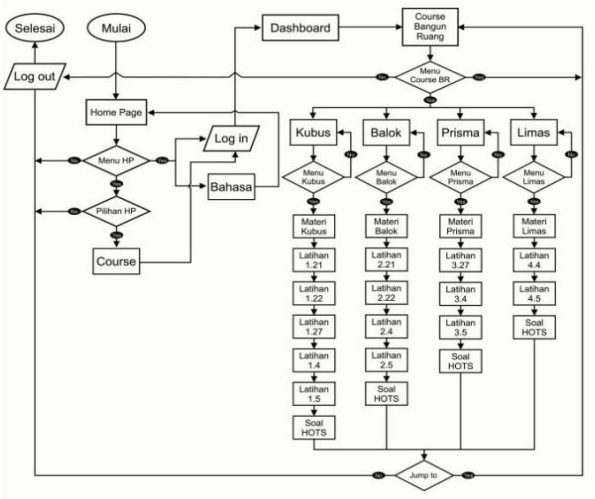

Fig. 2. Flowchart

Arrange instruments to assess learning media: Learning media assessment instrument designed to assess the feasibility of instructional media before they were used in the study.

4.3 Development phase

The development stage or the development of training materials are produced or adapted so that they can be used in conveying the contents or material of the training program to participants [21]. At this stage, a reference study is carried out as a reference in preparing material on the learning media to be developed. Furthermore, the design of learning media that has been made was developed into a learning media website based on e-learning using Moodle. To develop this learning media, compilers use the subdomain http://geometribyfmasetiaji.gnomio.com as the main address for accessing e-learning-based mathematics learning media. Researchers used several support programs such as Microsoft Office Word 2010, CorelDRAW X7, Geogebra Classic 5, www.geogebra.org, http://imagur.com, and http://ezgif.com in developing mathematics learning media based on e-learning. The following are some views of the learning media that have been developed.

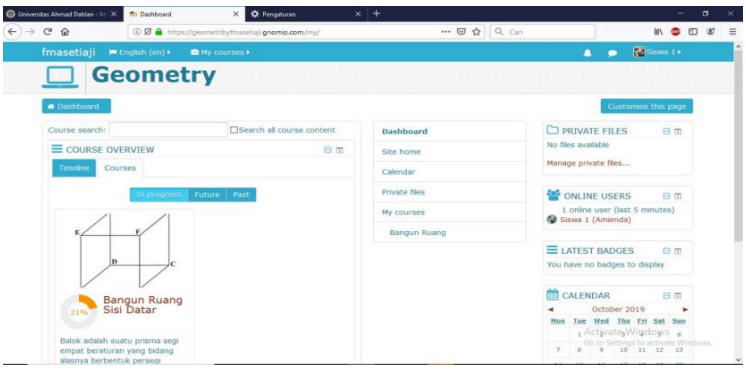

Fig. 3. Dashboard Page

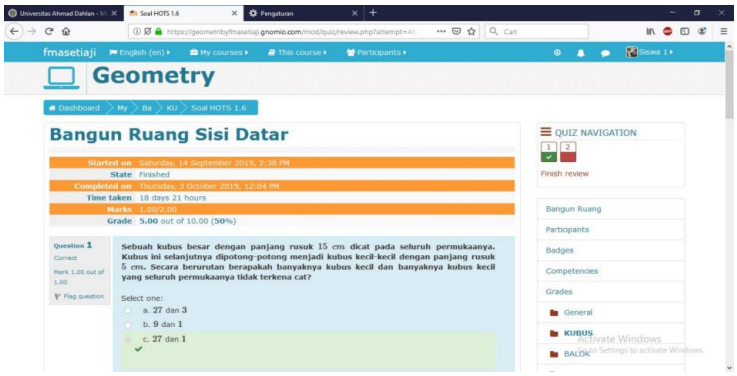

Fig. 4. HOTS Question Page

After the initial product of learning media is finished, the reviewer asks for consideration to get input from the weaknesses and weaknesses of the product for improvement.

4.4 Implementation phase

Implementation of media learning mathematics based on e-learning using MOODLE software on the geometry has been implemented in two schools, namely against 36 students of SMP Negeri 7 Yogyakarta and 34 students of MTs Negeri 1 Yogyakarta.

Fig. 5. Documentation at MTs Negeri 1 Yogyakarta and SMP Negeri 7 Yogyakarta

4.5 Evaluation phase

The last phase in this ADDIE model is evaluation, it will assess the ability of the system based on the objective stated at the ranking analysis [21]. Evaluation is given by three (3) lecturers who are experts in mathematics education and three (3) teachers in information technology. HOTS have an indispensable ability in the process of generating ideas, the ability to combine elements that is interrelated or functioning as one or reorganizing elements into a new pattern or structure [22]. The evaluation was carried out on some parts which are the material, HOTS, a display interface and pedagogic aspects.

Table 1. The evaluation

Material	4,38	Very good
HOTS	4,60	Very good
Display interface	4,13	Good
Pedagogic Aspects	4,12	Good

Educational technology is a technology that impacts delivering learning materials, facilitating communication, and providing assessment and feedback. A teacher should focus on a way to create an awareness of the range of possible learning activities and know how to choose appropriately among, and effectively implement technology into learning situations [10]. Thus, based on the assessment criteria ideal mathematical learning media based e-learning comes about HOTS (Higher Order Thinking Skill) which has been developed to be eligible as a source of learning mathematics on the subject Build Space Flat side for junior high school students of class VIII.

5 Conclusion

The teaching and learning process is an important element in ensuring students can follow the contents of the subject matter delivered. To attract students 'interest and increase the stage of student academic achievement, the learning process must be a process that is fun and capable of giving challenges to students' thinking. The main issue of this study is directed towards mathematical learning for some students is that learning is abstract and difficult to understand. Based on the discussion that has been stated, this shows that the ADDIE model which includes five main phases namely the analysis phase, design, development, implementation and assessment is a model of form of mathematics learning media based on e-learning using MOODLE (Modular Object-Oriented Dynamic Learning Environment) software on the geometry of the flat side subject to improve higher-order thinking skills among secondary school students. This is proven because the phases contained in the ADDIE model have a holistic and systematic nature. The findings of this study have shown that mathematics learning media based on e-learning using MOODLE very suitable for encouraging students to use the mind to understand, interpret, analyze and manipulate information to find possible solutions for various problems, especially related to the geometry of the flat side subject. Besides, based on mathematics learning media based on e-learning using MOODLE able to encourage students to think, to generate new ideas, to focus and to be active throughout the teaching and learning activities. The results of this study are expected can be one of the teaching tools which can help in learning activities and a catalyst for the improvement of the quality of students' thinking. The results of this study can be accessed through https://geometribyfmasetiaji.gnomio.com

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