Designing MOOCs with VMS (Virtual Microscopic Simulation) for Measurement Student's Level Understanding (LU)

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Abstract

The aims of this research to design Massive Online Open Courses (MOOCs) from now on referred to as Virtual Microscopic Simulation (VMS) to measure the Level Understanding (LU) of the construction of microscopic phenomena electric-field conceptions. The research method used is a mixed-method using embedded design. The research subjects are high school students, and one of the universities in Banten Province. The results of this study are software with features in the form of MOOCs-VMS that are categorized very well based on expert judgment on aspects of usability and learning content. The average score of media expert validation score is 96% with a very feasible category, the average score for material expert validation is 98% with a very decent category, and the average user response rate is 86% with a very good category. It can be concluded that the design of MOOCs-VMS can be used as an alternative media for conducting distance learning and is significant in building the level of understanding students.

Keywords: MOOCs, Virtual Microscopic Simulation (VMS), electric concept

INTRODUCTION

The development of technology, especially information and communication technology today, is overgrowing. The advancement of communication technology indirectly also changes the social fabric of society in its social interactions. This phenomenon provides many opportunities for humans as potential beings to actualize their potential. However, the actualization, of course, requires a methodical device as a condition for building a logical line of thought.

Higher education as an institution responsible for reconstructing the mindset must provide facilities to students and the academic community. These demands are in line with the target of learning achievement in the higher education curriculum based on the Indonesian National Qualifications Framework (INQF). Furthermore, learning outcomes must include aspects of attitudes and values, knowledge, and skills, according to the generic descriptors of the INQF. Axiologically, based on the KKNI (Indonesia standard education), in bachelor education, everyone must be able to apply their fields of expertise and also utilize the science and technology in their fields (Kusminarto 2014). Thus,

as an effort to implement education that is appropriate for development, technological engineering in learning is necessary.

Physics learning is one of the fields in which learning has a systematic relationship. The phenomenon in physics is the key to studying other phenomena, as microscopic systems are very related to macroscopic systems (Gould & Tobochnik 2010). Thus, it can also be said that if a microscopic phenomenon can be understood, the macroscopic phenomenon will also be easy to understand. Furthermore, the study of microscopic physics learning is one of the discourses that desperately needs engineering learning media. Learning media must be presented in multiple representations (Widianingtiyas et al. 2015). Unfortunately, because of its unobservable nature, it is complicated to understand this microscopic phenomenon. This limitation will lead to an understanding of physical phenomena that are not comprehensive (Wibowo et al. 2017).

The development of various visualization media of abstract and microscopic physical phenomena has so far been carried out for the benefit of physics learning, including; simulation about the law of virtual motion laboratory (Potkonjak et al. 2016; Merchant et al. 2014; Macabebe, Culaba & Maquiling 2010; Saglam-Arslan & Deveciogle 2010), online web-based learning (Permatasari & Hardyanto 2019), simulation of optics (Djanette, Fouad & Djamel 2013; Kaewkhong et al. 2010); simulation of electricity and magnetism (Dega, Kriek, & Mogese 2013), and simulations on climate change (Mikropoulos & Natsis 2011) simulation virtual laboratory (Nurhayati & Rohman 2015) and simulation of electric (Sinulingga et al. 2016)

However, based on various studies that have been carried out and various MOOCs that already exist, such as Udemy or RuangGuru, the media have not shown any simulation of microscopic phenomena. Therefore, referring to the findings and results of many studies that have been carried out, it is considered important to develop the design of MOOCs with VMS. The aims of this research to design Massive Online Open Courses (MOOCs) starting now referred to as Virtual Microscopic Simulation (VMS) to measurement the Level Understanding (LU) of the construction of Electrified conceptions of microscopic phenomena.

METHODS

The research method used in this study is mixed. The type of mixed method design chosen in the study was embedded design with the form of embedded experimental one group pretest-posttest design. The design scheme is shown in FIGURE 1. Embedded design is a mixed-method design where a set of data provides support for other data sets that are the role in the main study.
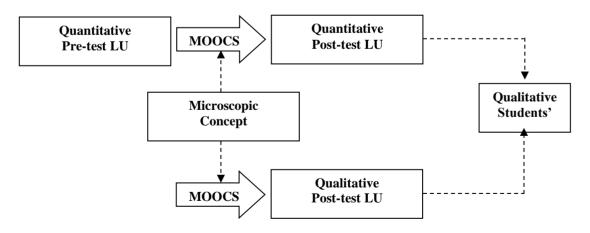

FIGURE 1. Embedded Experiment Design

Based on FIGURE 1, the research procedure consists of field studies, literature studies. This stage is done to prepare everything that will be used in the development of instructional media. Furthermore, the development of the instrument refers to the literature review that is considered relevant for the development of the HOTS model. The instrument is used to get the virgin from experts. Data sources were obtained from field trials to high school students in the city of Serang-Banten that were randomly

selected through pretest and post-test. Besides, research data were also obtained from a questionnaire distributed to determine student responses to the learning media used. Data analysis was performed by comparing the results of the pretest and post-test, while the data from the questionnaire were analyzed descriptively.

RESULTS AND DISCUSSION

The MOOCs-VMS Development Process is carried out, among others, through the following steps.

Need Analysis

At this stage, the thing that is considered is the collection of information through literature studies and field studies. The findings of the information are then used as a reference to design the MOOCs-VMS and the introduction of data collection instruments. Next, the steps taken are to determine the learning material that will be developed into the MOOCs-VMS, namely the macroscopic phenomenon in the form of heat transfer.

Design and Development

Media development is carried out based on the flow diagram that has been determined in the needs analysis process. Media development begins with making a flowchart. Flowcharts are made in the form of a chart to show the presentation of learning material and the flow of learning media in general. Furthermore, media development has undergone a validation process by experts. MOOCs-VMS, which have been validated and revised based on criticism and suggestions from a team of media experts and material experts, then limited trials were conducted. This limited trial was conducted to determine product readiness before large-scale trials and student responses to the media that had been made. In this trial, participants were given a questionnaire sheet consisting of three aspects, namely material, graphics, and language. One form of improvement in media design for input from experts is shown in FIGURE 2.
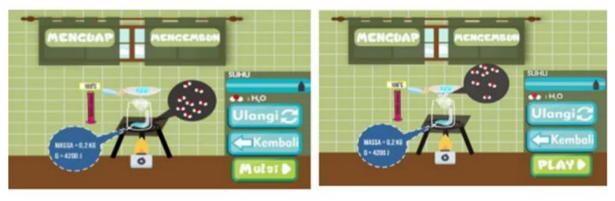

FIGURE 2. Design before repair (left), design after repair (right).

Feasibility of MOOCs-VMS

The feasibility of MOOCs-VMS that has been developed is based on two aspects, namely, aspects of media design quality and media interactivity aspects. Each aspect obtains an average value of 96% with a very decent category, shown in TABLE 1 and TABLE 2.

TABLE 1. Validate MOOCs-VMS by Media Experts

No.	Aspects of Assessment	Score		Total Score	Max Score	Percentage
		Expert 1	Expert 2			
1	Design Quality	35	33	68	70	97%
2	Media Interactivity	19	19	38	40	95%
	Total			106	110	96%

TABLE 2. Validation of MOOCs-VMS by Material Expert

No.	Aspects of Assessment	Score by Expert	Max Score	Percentage
1	Material conformity with the curriculum	30	30	10%
2	Motivation to learn	9	10	90%
3	Material delivery	15	15	100%
	Total	54	55	98%

Based on TABLE 1 and 2, it is known that the quality of design and media interactivity, according to experts, is very feasible because it reaches an average value of 96%. Meanwhile, the material presented in the MOOCs-VMS can also be said to be very feasible because it obtained an average value of 98%. Thus, it can be said that MOOCs-VMS is very valid based on expert judgment.

Implementation and Testing

Implementation and testing are stages of finding out the benefits of the media that have been developed. At this stage, the user is introduced to how to use the learning media that has been made. There are three aspects that are evaluated at this stage, namely, material, language, and presentation. The results of the test can be seen in TABLE 3.

TABLE 3. Student responses to MOOCS-VMS

No	Aspect	Score Students	Max Score	Percentage
1	Material	409	480	85%
2	Language	202	240	84%
3	Presentation	216	360	88%
	Total	927	1080	86%

Based on TABLE 3, it can be said that MOOCs-VMS was developed to be classified as very good because students' responses showed a high percentage. In addition, it can also be concluded that the application of this media can increase the level of students' understanding of material about microscopic phenomena.

The design of a learning media requires proper and correct preparation (Guntara & Wilujueng 2018). The design was carried out so that the development carried out had strong reasons and gave birth to a selective action on the problem at hand. In this research, the same thing is done for that reason and also as an effort to integrate the development of science and technology in the world of education (Darmawan, Wiyono, & Khairudin 2018). The process of validation and development of media design in this study was also quite long. The initial step is to design learning material related to microscopic objects. Furthermore, in the design of animation, researchers must conduct repeated consultations with experts to get the recognition that the material displayed in the animation is appropriate. After that, the researcher must also make a test instrument to measure student understanding based on the material

that has been displayed in the form of the animation. The long validation process aims to improve the quality of media design developed to be better (Shea & Bidjerano 2010).

In the feasibility test, the MOOCs-VMS design shows a relatively high number, both according to the judgment of material experts and the media. The figure of 96%, according to media experts, shows that MOOCs-VMS, which was developed as a medium of learning, is very good. In addition, the figure of 98%, according to the material expert, also confirms that the material delivered is very precise delivered with the media MOOCs-VMS. These conditions indicate a change in response to autonomous learning approaches (Conole 2014). This is influenced by the trend of online learning, which is experiencing significant changes that refers to student-centered approaches with the aim of new challenges for independent learning (McLoughlin & Lee 2010). The quantity of student understanding data obtained from the post-test results was measured using an understanding test instrument on the concept of dynamic electricity in the form of open wrong questions.

TABLE 4. Distribution of Levels Understanding (LU) of Each Electric Concept

LU	Characteristics of Student Answers	Concept Label					
		1	**2**	**3**	**4**	**5**	**6**
		Σ %	Σ %	Σ %	Σ %	Σ %	Σ %
[4] Understand Fully	Correctly answer all items in a question	13 (87)	13 (87)	12 (80)	12 (80)	11 (73)	10 (67)
[3] Understanding Some	Answer correctly some of the questions in a problem	2 (13)	1 (7)	2 (13)	3 (20)	3 (20)	3 (20)
[2] Mistakenly Understanding	Answering with all the questions on a problem but the answer is not clear or the answer is wrong	0 (0)	1 (7)	1 (7)	1 (7)	1 (7)	1 (7)
[1] Don't Understand	Answering all the questions in a problem but the answers given are not appropriate (not relevant) to the question	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (7)
[0] No Answering	Not giving answers to all questions on an item	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Σ　　　　　: Number of students who have a level of understanding
%　　　　　: Percentage of students who experience a level of understanding

Label Concept 1: Ohm's Law
Label Concept 2: Closed electrical circuit
Label Concept 3: Electric power
Label Concept 4: Electric power dissipation
Concept Label 5: Parallel circuit
Label Concept 6: Open circuit

Based on TABLE 4 obtained information that the application of physics conception, construction learning using MOOCs with VMS at the highest level of understanding of MSU on the ohm legal concept and the electrical circuit by 87%. In the implementation of MOOCs media and its testing on a limited scale, this media is also classified as very good. Based on the three aspects of concern, namely, material, linguistic, and presentation, the figure of 86% indicates that MOOCs-VMS is very attractive to students. Furthermore, this value also shows that MOOCs can be used as an alternative for teacher professional development (Garrido, Olazabalaga, & Ruiz 2015). MOOCs can also be used as co-learning in peer communities (Littlejohn et al. 2016). However, the use of MOOCs certainly cannot stand alone. The MOOCs require various other platforms to support its implementation in learning media. The development of the MOOCs-VMS media with very high responses in this study shows that VMS is the right platform for making MOOCs. This happens because there is a match between the conceptualization of VMS and the characteristics of MOOCs as learning conditions.

SUMMARY

Based on the discussion of the MOOCs-VMS design on expert judgment and empirical testing with students, it can be concluded that MOOCS-VMS can be one of the learning media for microscopic phenomena. In addition, MOOCs-VMS as a learning media can also improve students' understanding of the material taught, namely, the material about microscopic phenomena is better than before. MOOCs-VMS can be used as an alternative media for conducting distance learning and is significant in building the level of understanding student.

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