Advances in Engineering Research, volume 209
International Joint Conference on Science and Engineering 2021 (IJCSE 2021)

Improving Scientific Creativity of Teacher Prospective Students: Learning Studies Using aMoodle-Based Learning Management System During the COVID-19 Pandemic

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ABSTRACT
Scientific creativity is a part of higher order thinking skills which is the main goal of 21st century education. It is important to equip students with these skills to face increasingly fierce global competition by utilizing the development of information technology. One of the innovations that can be done to improve the quality of learning is to develop a Moodle-based learning management system (LMS) in lectures at State Universities in Mataram City. The ultimate goal of this research is to produce a Moodle-based LMS that can improve students' scientific creativity in research methodology courses. This research includes development research, using the ADDIE model. The results of the study indicate that: 1) The developed LMS media is valid and suitable for use in lectures, especially in science education research methods course; 2) The Moodle-based LMS used can increase students' scientific creativity; 3) Students' scientific creativity on verbal and procedural indicators obtained an increase with high criteria, while figural and numerical indicators with moderate criteria.

Keywords: *Scientific creativity, Higher order thinking skills, Moodle-based learning management system.*

1. INTRODUCTION

The development of information technology presents opportunities for learning innovation, including learning that can be done more flexibly, anywhere, and anytime. According to Auster [1], Face-to-face and online learning can be combined thanks to advances in information technology. Information technology enhances learning in a variety of ways and provides learning opportunities that should be available to everyone. Information technology has great potential, most of which have not been explored in improving the quality of education [2-3]. Furthermore, Abduvakhidov et al [3] explain that the most significant change in education is a critical view of education and the abolition of all traditional tools that cause education to stagnate and become unable to cope with the most recent technological advances. Possible approaches, strategies, techniques, and existing tools are all things to think about. Information technology can be used to support active learning. [4]. One of them is a Moodle-based Learning Management System (LMS). LMS is used as the most effective approach in learning [5-6]. The success of LMS as an environment for learning and teaching has led to an increasing need to integrate it [7-8].

The development of information technology also provides opportunities to build and use computer programs for learning-oriented towards increasing creativity and developing students' argumentation skills. Creativity cannot develop automatically but requires stimulation from the environment. Kandiko [9] explains that to support and improve these abilities, we can start by exploring how the relationship between sciences which has many features such as argumentation and creativity is understood and taught in higher education. Students who think creatively have the ability to generate new ideas and products that can be useful in their daily lives [10-12]. The category of students' creativity varies according to their level of experience and knowledge [13]. Mishra [14] explains that in recent decades, digital

technology has contributed to the development of creativity.

In the perspective of Mishra [14], students' creativity can be developed. However, generally creative work has the meaning of having to be directly involved in learning. This shows that a change is needed in the learning patterns carried out. This is useful to help prospective teachers have (1) an understanding of what creativity is required; (2) understanding of how to recognize student work; (3) understanding of the types of tasks that can foster creativity; (4) understand creative pedagogy [15]. Creative action is very important for the progress of civil society, so teaching students to think creatively is very beneficial so that they are skilled and excel in the future. Rawat et al [16] stated that creativity is the main goal of education worldwide.

Online learning is defined as a knowledge transfer experience that involves the use of video, audio, images, text communication, software, and the internet network [17]. LMSs such as Schoology, Learnboos, Edmodo, Moodle, and others can be used in the learning process.

In this study, Moodle-based LMS was used as a learning medium. According to Darma et al [18], Moodle is an excellent tool for teachers to use to organize, manage, and deliver subject matter. From a didactic standpoint, using multimedia tools to create engaging activities makes the learning process more enjoyable for students. As a result, these activities pique students' interest in learning. Due to time constraints, lecturers can provide students with a large number of resources that they would not normally be able to present in class.

The importance of providing creativity for students has led to innovations carried out by each institution to prepare future teachers who are creative and able to compete. The ultimate goal of this research is to produce learning using Moodle-based LMS media that can increase students' scientific creativity. The development of Moodle-based LMS media is an alternative to improve the quality of learning and at the same time, it can be used to equip students' higher-order thinking skills.

2. METHODS

This research includes the type of research and development in education. This type of research R&D in education is a process used to develop and validate educational products. This research was conducted in 5 stages, namely Analysis, Design, Development, Implementation, and Evaluation. This stage is usually abbreviated as ADDIE. The purpose of the development stage in this research is to make a product in the form of an LMS that can increase students' scientific creativity. The resulting LMS is in the form of software that will be used by educators in teaching research methodology materials. LMS is made to be used independently by students with the help of other learning resources in the form of textbooks. In general, this LMS can also be used as a presentation medium by educators in the classroom.

The method used at the implementation stage is an experimental method with a one-group pretest-posttest design. The subjects of this research are students at State Universities (PTN) in Mataram City who are taking Research Methodology lectures, totaling 24 students in the 2019/2020 academic year.

The scientific creativity test instrument consists of 20 essay questions according to verbal, figural, procedural, and numerical creativity indicators. The increase in students' scientific creativity was analyzed using a normalized gain score. The creativity test is used to identify the creativity shown by the students' ability to think creatively. The scientific creativity assessment technique was given a score of 0-4. Score 0 for those who did not answer or answered incorrectly, 1 for mentioning/writing one idea, suggestion, or alternative answer, 2 for mentioning/writing two ideas, suggestions, or alternative answers that are not much different, 3 for mentioning/writing three ideas, suggestions or different answer alternatives, and 4 to mention/write down four or more different ideas, suggestions or alternative answers [19].

3. RESULTS AND DISCUSSION

The ADDIE model is used in this study, which focuses on the development stage and includes validity and effectiveness testing. The development of android-based learning media first goes through the stages of analysis, design and development. At this stage of content analysis, a literature review is appropriate. Many aspects are decided in this section, such as the equipment required, the number of instruments to be developed, the type of instrument chosen, and the course material, namely the science education research method. In addition, student analysis, task analysis, concept analysis, and learning objective specification were performed.

The primary goal of the design stage is to prepare a prototype device, which includes media and format selection. At the design stage, the researcher compiles a Moodle-based LMS media product by collecting supporting materials such as teaching materials, creativity instruments, photos and videos. All materials collected are then entered into Moodle-based LMS media with reference to flowcharts and storyboards. Making flowcharts and storyboards aims to provide an overview of the form and content of the display on the LMS media.

Moodle-based Media Learning management system (LMS) has been developed in the research methods course. LMS media was developed based on the principles of instructional media design. Figure 1 below is an example of a Moodle-based LMS display that was developed.

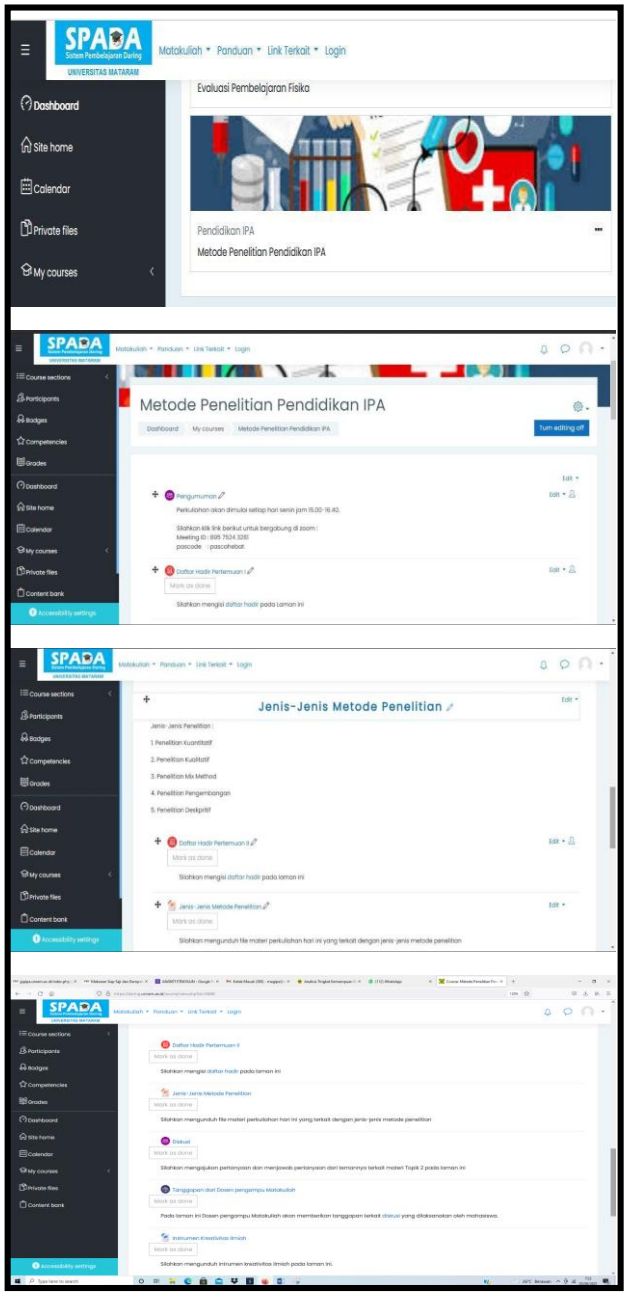

Figure 1 Moodle-based LMS Media.

The LMS media developed includes several features including attendance lists, teaching materials, lecture materials, scientific creativity instruments, discussion forums, forums for collecting assignments. LMS was developed to be a learning tool, especially in science education research methods courses in the classroom by both lecturers and students.

Various learning innovations, as well as efforts to expand teaching materials, have positioned the computer as a tool that contributes positively to the learning process, particularly learning on research methodology materials. Computers can assist teachers with a variety of tasks. LMS is one of the innovations in computer-based learning. A computer-based LMS aids in the delivery of information during the learning process, the implementation of teaching management, and the provision of stimulus to students during the learning process.

Learning management systems validation results

Validation is carried out by three experts who are competent in their fields. LMS was assessed in the form of 7 indicators. The results obtained based on the results of expert validation are listed in Table 1.

Table 1. Learning management system validation results

Indicator	Average value (%)	Criteria
1	4.03	worthy
2	4.00	worthy
3	4.02	worthy
4	3.90	worthy
5	4.35	Very Worthy
6	4.10	worthy
7	4.00	worthy
Average	4.05	worthy

Table 1 shows that the average value of the feasibility of indicator 5 obtained an average value higher than indicators 1, 2, 3, 4, 6, and 7. Indicator 5 obtained an average value of 4.35% with very decent criteria, while the other indicators get an average value with decent criteria. The average value of LMS eligibility is 4.05% with appropriate criteria.

Student scientific creativity data was collected using an essay test instrument. Based on the results of the analysis that has been carried out, the students' scientific creativity scores for each indicator are listed in Table 2.

Table 2. Results of scientific creativity n-gain per-indicator of students

Indicator	N-Gain	N-Gain Criteria
Verbal	0.83	High
Figural	0.51	Medium
Numerical	0.43	Medium
Procedural	0.77	High

Table 2 shows that students' creativity in verbal and procedural indicators has increased with high criteria compared to other indicators such as figural and numerical. Numerical and figural indicators get an increase with moderate criteria.

Learning at home or online is a viable option for completing the learning process during the Covid-19 pandemic. This is an adaptation of knowledge transfer via website forums and digital technology trends as a hallmark of the 4.0 industrial revolution to aid learning during the Covid-19 pandemic [20]. The integration of technology and a variety of innovations are characteristics of online learning [21]. Furthermore, the readiness of educators and students to interact online is critical. This study makes use of Moodle-based LMS media for learning during the Covid-19 pandemic. A properly designed Moodle-based LMS will help to learn because it uses self-service and self-guided services, can collect and deliver learning content quickly, as well as enabling the reuse of knowledge. This model enables lecturers to manage learning and exchange information with students in a flexible and timely manner.

One of the requirements for using LMS in the learning process is that educators and students must be connected to an adequate internet network. LMS has several features that support the online learning process, such as discussion forums, curriculum learning resources, quizzes, assignments, types of academic information, and student data management.

Moodle also makes it possible to interact with students in real time and to solicit student feedback and suggestions. Moodle, as a learning community, allows students to share their knowledge and difficulties with one another via forums and chats. Lecturers can pay attention to which parts of the subject require more explanation of concepts learned in class. Students are hesitant to participate in these activities at the start of the academic year, possibly because they are not used to dealing with new assignments. They gradually increase their visits to the site after that. According to the findings of the study, when lecturers uploaded lecture notes, students began to explore other materials that had previously been uploaded to the LMS. The students then began taking the quizzes, and they even recommended some changes for students who had not yet achieved the minimum passing grade. This is an important point because it is critical that students feel involved in their learning process. Educators can also observe an increase in the number of visits to LMSs over time, indicating that students are interested in such e-learning techniques [22].

LMS presents learning materials with a more attractive and informative appearance. It aims to facilitate and increase student interest in learning. LMS can explain parts of abstract and microscopic concepts that cannot be explained in mopre detail by other learning resources [23]. Computer-based learning can improve student skills [24]. Increased creativity is a positive influence of fun media, so students have a more open mind. Creative thinking skills can improve the quality of learning and reduce student boredom [25].

The creativity test is written in the form of an essay and consists of four types of tests: verbal, figural, numerical, and procedural creativity tests. The results of the average score increase in the initial test and post-test after being given learning using the Moodle-based LMS developed in this study. This shows that LMS can increase students' scientific creativity. Learning with LMS that has been done by Arifin [26] illustrates that learning with LMS can be used to develop students' creative thinking skills. In line with this statement, Ekasari et al [27] in their research also showed that students' creativity can be done by exploring content, software features,

The increase in student creativity is examined using aspects and indicators of scientific creativity. The increase in the average percentage of N-gain for each aspect of creativity in Table 2 shows that verbal and procedural indicators have increased with high criteria. Students' procedural creativity skills related to making and illustrating, students can provide different images of the problems displayed on the LMS.

The numerical creativity indicator is in the medium criteria. According to the test results, students are quite capable of providing answers. Students with a strong mathematical foundation can not only memorize formulas but also solve problems that require the ability to connect various concepts. The lowest numerical indicator is because in lectures there is no training in counting, students' scientific creativity in this indicator is obtained from the initial ability of each student. This is influenced by environmental factors, contributions to other courses, courses related to arithmetic. The ability of numerical indicators is not specifically trained during the research methodology course.

Verbal creativity indicators have increased with high criteria. The verbal creativity test assesses students' ability to explain a case using words [28]. According to [29] verbal ability in learning includes many terms. Some students managed to provide as much explanation as possible about the proposals presented. However, students only gave general explanations, for example, related to the problems, strategies, and solutions of their respective proposals. The findings of Hermansyah, et al [28] prove that the application of virtual media is effective to increase verbal and figural creativity in learning.

The figural creativity test assesses a student's ability to generate images from the proposal material to be presented. Moodle-based LMS can be used in science teaching to help students observe abstract scientific phenomena [30]. Figural indicators in the form of drawings, drawing patterns, and creating designs such as research flowcharts. Each symbol made by students has a different meaning, the habit develops in students. Students are more careful and creative to make something with the same intent, but a different design.

In his research, Garaigordobil [31] gave treatment to stimulate four types of creativity, namely verbal, graphic-figural, constructive, and dramatic creativity. Another researcher, O'Reilly et al [32] described creativity in verbal and figural groups. Verbal creativity can be grouped into indicators of originality, flexibility, fluency while figural creativity can be grouped into originality, elaboration. While Preckel et al [33] stated that creativity can also be grouped into verbal, figural, and numerical creativity.

Several research results on creativity show that creativity is very important to be developed. In Gunawan et al's research [34] it was found that the project-based learning model assisted by virtual media could increase student creativity both verbal and figural creativity, where verbal creativity obtained a higher increase than figural creativity. Meanwhile, Gunawan et al [34] revealed that verbal and figural creativity can be improved through a combination of cooperative learning models with virtual media.

Moodle-based LMS is effective for improving students' scientific creativity skills. This is supported by the statement of Hikmawati, et al [35] which states that learning using LMS can be used to train students' thinking skills. Furthermore, based on the results of Mufidah's research [36], It demonstrates that the use of Moodle in blended learning is effective in terms of student motivation, collaboration, and communication.

4. CONCLUSION

Media Learning Management Systems (LMS) based on Moodle which was developed in the course material for science education research methodology is categorized as suitable for use. Moodle-based LMS used in lectures can increase students' scientific creativity. Students' scientific creativity on verbal and procedural indicators obtained an increase with high criteria while other indicators such as figural and numerical obtained an increase with moderate criteria.

AUTHORS' CONTRIBUTIONS

All authors conceived and designed this study. All authors contributed to the process of revising the manuscript, and at the end all authors have approved the final version of this manuscript.

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