Implementation of Moodle e-learning in Mathematics

E Kamaruddin*, E Sulaeman, L Nurita and L D Ningtyas
Universitas Negeri Jakarta, Indonesia

*erda_kamaruddin@unj.ac.id

Abstract. The rapid development of science and technology provides opportunities for computer experts to create attractive, interactive application programs. As the 2013 curriculum takes effect on the characteristics of student-centered learning, various electronic learning media have developed to improve the quality of education. One of the interactive media produced is e-learning based on Moodle for Mathematics. Moodle is a learning management system that is designed using web-based applications and provides online learning services. Moodle is equipped with three main elements in the learning process, there are users like teachers, users as students, and the subject matter. Together Moodle can be designed distance education and a modern and productive learning environment. Moodle can build students' creativity in doing problem-solving, including in solving mathematical problems. This will create HOTS for students. Based on these assumptions, it is necessary to conduct a study regarding the implementation of Moodle e-learning in Mathematics. The purpose of this study is to apply Moodle e-learning to the material of linear equations. This research is Research and Development. The results showed that Moodle could improve students' high-level thinking skills in solving mathematical problems. In conclusion, the development of Moodle e-learning can improve mathematics learning outcomes.

1. Introduction
The results of the Program for International Student Assessment (PISA) study state that in general Indonesian students' abilities are very low in terms of (1) understanding complex information, (2) theory, analysis, and problem-solving, (3) the use of tools, procedures, and problem-solving, and (4) investigating. These four abilities are known as Higher Order Thinking Skills (HOTS) [1]. The ability to think at a higher level is one of the essential competencies in the modern world, so every student must possess it. As a result, the findings of this PISA become a significant challenge for the world of education in Indonesia, especially for teachers, because teachers are the spearhead of all educational policies and are crucial in shaping the face of education in Indonesia. Because the teacher's role is so significant, it requires teachers who are professional, creative, innovative, have a high willingness to continue learning, and are literate in information technology so that they can keep abreast of the times [2].

According to Ali and Maat, the mathematics teacher doesn't have any shortcomings in the use of technology when it is implemented in the learning process [3]. Learning supported by information technology that can be used today can make students become more active in the learning process [4]. To be able to carry out this task, it is necessary to improve teacher performance, which is fundamentally determined by the expertise and ability of the teacher concerned.

One of the efforts that can be made to improve the quality of learning, to overcome the problem of the low level of thinking ability of students in Indonesia, is through the development of e-learning based
on Higher Order Thinking Skills (HOTS). Of course, HOTS is needed in learning mathematics. Because HOTS according to Mason et al. is needed in the ability to guess, reason, prove and generalize [5]. While, e-learning is expected to improve students' innovative, creative, and critical thinking abilities. According to Valdez et al., critical thinking is very important for students to analyse, evaluate, and restructure their thinking [6]. Goh et al. suggested e-learning based learning needs to be applied to learning as a form of e-learning practice to strengthen the curriculum [7]. Based on this, research and development are carried out on the design and implementation of HOTS-based e-learning. In this development research, the assessment will focus on the implementation of Moodle e-learning in Mathematics. Based on this study, the formulation of the problem in this research development is: "How is the implementation of Moodle e-learning in mathematics?" The purpose of this study is to implement Moodle e-learning on linear equation material.

2. Theory study

Hamdani states that the module is a media or learning tool that contains material, methods, boundaries of learning material, instructions for learning activities, exercises, and ways of evaluating, which are designed systematically and attractively to achieve the competencies expected and used independently [8]. According to Suyoso and Nurohman, the module is a learning process about a particular unit of discussion that is arranged systematically, operationally, and directed for use by students, accompanied by guidelines for teachers [9]. Whereas Dwiyogo states that the learning module is a source of learning in addition to the teacher being systematically designed by experts in a particular field of study or the teaching profession according to the rules of design to increase effectiveness, efficiency, and increasing student interest in continuing to learn [10].

An electronic module is a learning tool or tool that contains material, methods, boundaries, and ways of evaluating that are systematically and attractively designed to achieve the expected competencies. Excellent teaching materials provide tools that make it easy for users to see their usefulness and use them in practice. Digital teaching materials in electronic form provide opportunities for innovation, even if only to small parts of these teaching materials. Online learning resources can be designed to present learning modules or are referred to as interactive electronic modules, and one of the criteria for interactive electronic modules is self-instructional self-help that makes teaching materials able to learn students independently [11]. Fullick mentions some potential that can be developed from online learning resources in the learning process, namely: drawing on web-based materials to be used by students both within and outside the lesson time; teachers modifying and adapting web-based resources for use with their students; teachers using the internet to support their professional needs [12]. Based on this description, this research will develop a study on the implementation of Moodle e-learning in mathematics.

3. Research methods

This research uses research and development methods that aim to develop Moodle-based e-learning in Mathematics. While the specific purpose of this research is to implement Moodle-based e-learning on the Linear Equation System material based on the Moodle prototype that was developed previously. The process of developing an e-learning prototype has been carried out at the Informatics and Computer Engineering Education Laboratory of the Faculty of Engineering, Jakarta State University. After the prototype development is complete, a feasibility test is conducted by material experts and media experts based on the content validity test using the CVR formula from Law She. The validity of the content is essential to show the extent of the validity of the contents of the material from the prototype so that it can be further developed. Furthermore, this Moodle-based e-learning has also been tested on many respondents and has been declared suitable for use in the classroom.

The stages of this research are implementing Moodle-based e-learning in the Linear Equation System material with twenty-five respondents. There are two instruments used in this study: test and non-test. The test instrument consisted of essay questions about the Linear Equation System with items that had been designed in the form of Higher Order Thinking Skills by Bloom's taxonomy, namely: at the level
of analysis. Non-test instruments in the form of observation sheets of all learning activities, ranging from presence during online learning, enthusiasm in asking questions, responding in discussion forums, discovery learning ability when making a summary of subject matter, problem-solving skills in answering items, discipline during the learning process, honesty, and independence in working on the things.

4. Research results and discussion
Linear Equation System material in mathematics is designed using Moodle with an attractive and comfortable to use user interface. Moodle learning media consists of several features, namely: download teaching materials, online quizzes, and discussion forums. The results of the development of e-learning mathematics learning tools using Moodle can be seen in the following views:

![Figure 1. Creating the main topic.](image1)

![Figure 2. Creating the SPL sub topic.](image2)

![Figure 3. Entering teaching materials.](image3)

![Figure 4. Entering test materials.](image4)
After successfully developing e-learning mathematics learning tools with the content in the Linear Equation System using Moodle, the next step is to ask students to register to access the content. Students must download and develop the content by independent learning using discovery learning methods. When meeting face-to-face, students are expected to have already a basic concept of the subject matter to be followed. Thus the learning process will take place more efficiently and effectively. Moodle also prepares a discussion forum so that interactions in the learning process can continue. The evaluation process is provided through quizzes whose questions are in the form of essays and directed to problem-solving to hone students' higher-order thinking skills.

In this research, Moodle e-learning is implemented in the Linear Equation System material. The evaluation process is done through observation of all learning activities, including presence during online learning, enthusiasm in asking questions, responding in discussion forums, discovery learning ability when making a summary of subject matter, ability to solve problem answering items, discipline during the process learning, honesty, and independence in working on the things. The results of the study can be seen in Table 1.

**Table 1. Analysis results of e-learning Moodle implementation.**

| No | Aspects Observed                                      | Observation result |
|----|-------------------------------------------------------|--------------------|
|    |                                                       | amount  | Percentage |
| 1  | Presence during online learning takes place           | 25     | 100 %      |
| 2  | Discipline during the learning process               | 25     | 100 %      |
| 3  | The ability to solve problems in answering questions | 22     | 88 %       |
| 4  | Independence in working on an item                   | 20     | 80 %       |
| 5  | Honesty                                              | 21     | 84 %       |
| 6  | The ability of discovery learning when making a summary of subject matter | 19 | 76 % |
| 7  | Enthusiasm in asking questions                       | 18     | 72 %       |
| 8  | Give response in the discussion forum                | 18     | 72 %       |

Based on the results of the data analysis shown in Table 1, it appears that students' presence and discipline during online learning is perfect. This is due to the stipulated provision that attendance and discipline during the learning process will affect the results of the evaluation. The ability of problem-solving is good, and it can be seen from the way the students answer the items in an ordered and systematic way. It should be added that the piece has been designed in the form of Higher Order Thinking Skills by Bloom's taxonomy, namely: at the level of analysis. Learning by using HOTS is needed in ensuring that learning by students is effective overall [13]. Despite this, independence in working on the items and the value of honesty still needs to be improved because there are still many answers that are almost the same way to solve them. The ability of discovery learning when making a summary of the subject matter still needs to be improved, it can be seen from the number of references included by some students at the end of the review that is not yet adequate, ranging from three to six library sources. Likewise, the enthusiasm in asking questions and the ability to respond to discussion forums still needs to be improved. This obstacle occurs because students are accustomed to teacher-centered learning. But overall, the observations of all aspects assessed above 70%.

5. Conclusions

Based on the results of data analysis, it appears that the eight aspects assessed have a range between 72% - 100%. All elements are the main components in learning activities, starting from the presence and discipline of students during online learning, problem-solving skills, independence in working on items, honesty, discovery learning ability, enthusiasm in asking questions, and the ability to respond to discussion forums. The results showed that Moodle could improve students' high-level thinking skills in solving mathematical problems. This is supported by research conducted by Ramlee et al., the use of
technology in a learning environment that is enhanced by an appropriate pedagogical approach can improve one's HOTS abilities [14]. According to Wilson-Ahlstrom et al., critical thinking skills are able to help someone in terms of solving problems, making judgments, and decisions [15]. So it can be concluded that the implementation of e-learning Moodle on mathematics can improve student learning activities and outcomes and improve the quality of mathematics learning as a whole. According to Hubalovsky et al., the importance of learning through e-learning will increase the ability to learn independently, responsibility, manage and plan time, and improve the ability to use computers [16].

6. Suggestions

Based on the results of these studies and conclusions, it is recommended that e-learning mathematics learning tools using Moodle can be developed further and continuously, and also applied to all other subjects. To be more interesting in its presentation, it is recommended to complete Moodle e-learning with animations, exciting images, videos, text, and graphics by the context of teaching material. Furthermore, ongoing training on the use of Moodle-based e-learning is needed to produce exciting and varied interactive learning media, to improve the quality of the learning process. The next suggestion is to consider the condition of facilities and infrastructure in schools, especially regarding the completeness of the internet network and other supporting facilities.

Acknowledgments

The authors would like to thank the International Seminar Committee of AASEC 2020 (Annual Applied Science and Engineering Conference) Universitas Pendidikan Indonesia, which has organized this event and accepted this article to be published as reading material in the proceedings. They are also thankful to all the reviewers who gave their valuable inputs to the manuscript and helped in completing the paper.

References

[1] Darwono 2016 “Higher Order Thinking Skills Guru,” [Unpublished]
[2] Raddana 2013 Faktor–Faktor Yang Mempengaruhi Kinerja Guru SMA Negeri Di Nusa Tenggara Barat (NTB) DIA Jurnal Administrasi Publik 11(2) 226–236
[3] Ali S dan Maat S M 2019 Exploring the 21st Century Teaching and Learning Practice among Mathematics Secondary School Teachers International Journal of Academic Research in Progressive Education and Development 8(2) 361–378
[4] Saadé R G, Morin D and Thomas J D 2012 Critical thinking in E-learning environments Computers in Human Behavior 28(5) 1608-1617
[5] Mason J, Burton L and Stacey K 2010 Thinking Mathematically Second Edition (England: Pearson Education Limited)
[6] Valdez A, Mangorsi S, Hambre V, Magdara D and Manalundong M 2013 Effects of HOTS Techniques through Modular Instructions in Teaching High School Chemistry in MSUBalindong High School International Journal of e-Education, e-Business, e-Management and e-Learning 3(4) 326–329
[7] Goh W W, Bay S and Chen V H H 2015 Young school children’s use of digital devices and parental rules Telematics and Informatics 32(4) 787-795
[8] Hamdani 2011 Strategi Belajar Mengajar (Bandung: Pustaka Setia)
[9] Suyoso S dan Nurohman S 2014 Pengembangan Modul Elektronik Berbasis Web Sebagai Media Pembelajaran Fisika Jurnal Kependidikan 44(1) 73–82
[10] Dwiyogo W D 2013 Media Pembelajaran (Malang: Wineka media) p 132
[11] Asyhar R 2012 Kreatif Mengembangkan Media Pembelajaran (Jakarta: Referensi)
[12] Fullick P 2004 Teaching Secondary Science with ICT (New York: McGraw-Hill Education) p 72
[13] Yen S T dan Halili S H 2015 Effective Teaching of Higher-Order Thinking (HOT) In Education The Online Journal of Distance Education and e-Learning 3(2) 41–47
[14] Ramlee N, Rosli M S and Saleh N S 2019 Mathematical HOTS cultivation via online learning environment and 5E inquiry model: cognitive impact and the learning activities International
Wilson-Ahlstrom A, Yohalem N, DuBois D, Ji P, Hillaker B and Weikart D P 2014 *From soft skills to hard data: measuring youth program outcomes* (Washington, DC: The Forum for Youth Investment)

Hubalovsky S, Hubalovska M and Musilek M 2019 Assessment of the influence of adaptive E-learning on learning effectiveness of primary school pupils *Computers in Human Behavior* **92** 691-705