E-Learning Design Based on Moodle to Develop Mathematical Communication Skills of Students

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ABSTRACT

Mathematical communication skills are highly important to student that education should facilitate student to improve their mathematical communication skills. The research aims to analyze and design a learning medium that can facilitate the process of learning activities in optimizing student' mathematical communication skills. As for learning, medium to be developed in the form of Moodle-based e-learning and to be implemented using the Problem Based Learning (PBL) learning model. The research is a development study using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) models. The subject of this research is the VII MTs Muhammadiyah Karangkajen Yogyakarta. Data collection techniques use observation guidelines, interview guidelines, and guestionnaires. Data analysis techniques use qualitative and quantitative descriptive. The results of the study showed that student' mathematical communication skills. Moodle-based e-learning designs score well so that they are feasible making reference in the development of learning media that can improve students' mathematical communication skills. The results of this study can be used as a guide for mathematics teachers in developing e-learning that make students understand mathematics and have mathematical communication skills simultaneously. The novelty of this research is to integrate mathematical communication skills into e-learning. In addition, elearning is designed according to the problem-based learning model.

INTRODUCTION

Mathematics is an important symbol language that every school should learn. Students who study mathematics must have communication skills using the mathematical symbol [1]. Communication is a way to share thoughts and clarify understanding [2]. Communication capability is also one of the 21st century capabilities [3], [4]. The ability to design mathematical models, define arguments, structure ideas and questions surrounding mathematics constitute mathematical communication capabilities [5] -[7]. According to Baroody, there are two important reasons why mathematical communication needs to be developed among students. First, mathematics is as a language. Second, learning mathematics is as a social activity. Thus, mathematical communication is also a social activity and as means of thinking. This ability is recommended by experts in math education to continue in cultivation and be improved among students [8]. The student's level of mathematical communication ability can be seen from the indicator of mathematical communication ability [9]. So mathematical communication skills are also one of the essential mathematical abilities for students to have.

However, students' mathematical ability in Indonesia still needs to be improved. This can be seen from the 2015 PISA data where Indonesian rankings are below the international average [10]. Based on the result of an interview with math subject teachers at MTs Muhammadiyah Karangkajen Yogyakarta on October 12, 2019, researchers get information that students have difficulty in changing the matter of real form into a Keywords: E-learning, Mathematical Communication, Moodle, Multimedia, PBL

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mathematical form or otherwise. In other words, students still lack understanding of mathematical modeling. Based on observation results, researchers found that some students were active in the learning process. Students' liveliness can be seen from activities such as students asking teachers and students to answer teacher questions. But researchers also found some students were not yet able to solve the problems on the board. This suggests that some students still cannot search for a determine strategies in resolving given problems. Students have not been able to propose any ideas or ideas they have. These indicators show that students' mathematical communication skills are classified as low.

Based on a teacher's joint interview a. MTs Muhammadiyah Karangkajen, researchers also get information that the learning sources used are students' books and worksheets. The book is provided by the school whereas the student worksheet created by the teacher for each material. Teacher also uses learning multimedia in the form of power points while learning. Multimedia is very rarely used due to limitations in setting up such power points. In classroom learning, teachers use conventional learning. So, researchers concluded that the learning media used has not been able to optimize students' mathematical communication skills. Other research results showed that students who have low mathematical communication skills will have difficulty explaining and answering question with their own words in math subjects [8]. Mathematical communication skills are essential for students. Therefore, education should facilitate students to be able

Students

to improve students' mathematical communication skills. One medium that can facilitate improved mathematical communication is the e-learning platform. The e-learning platform could potentially improve mathematical communication capabilities because a platform provides many opportunities to design communication situations involving the use of various linguistic resources [11].

E-learning refers to an internet-based learning platform. E-learning become where students and teachers interacted or collaborated. E-learning is a generic term used to refer to computer-based learning. E-learning facilitates anyone, anywhere, and whenever the person can learn. Learning to use e-learning is more fun, easier, and cheaper. The Internet, laptops, tablets, smartphones are proponents of learning [12]. The implementation of elearning leads to the process of learning to teach automatically through the software. The software is known as a Learning Managements System (LMS) [13]. Moodle is an application with various features that supports the Learning Management System (LMS) and corresponds to the current learning needs [14], [15]. Learning with P2BL using e-learning Moodle is effective in improving students' mathematical communication ability [14].

Problem Based Learning (PBL) is a learning model that within its implementation is student-centered. Students learn about subjects in complex, diverse, and realistic contexts [16]– [18]. The level of student mathematical communication ability using PBL learning models is better than conventional learning. This is because PBL learning makes it easier for student communication especially in providing a means to train problem-solving capabilities [19].

Based on the above description, the researcher conducts research aiming to develop a learning medium that can facilitate the learning activity process to optimize the student's mathematical communication capabilities. The learning medium is Moodle-based e-learning and is implemented with the PBL learning model.

METHODOLOGY

This type of research is development research. Thus study used the ADDIE development model. ADDIE has five stages, namely: analysis, design, development, implementation, and evaluation [20], [21]. The stage of the research can be seen in Figure 1.



Figure 1. Stage Model ADDIE

As in [22], the ADDIE procedures performed were only the analysis stage and design stage. The analysis stage is done to analyze or view conditions related to the mathematical learning process. The analysis includes curriculum analysis, teaching material analysis, and analysis of student characteristics. The design stage is done by designing Moodle-based multimedia learning tailored to students' needs and characteristics based on the results of previous analyses. The subject in the study was the VII MTs Muhammadiyah Karangkajen class student. The data collection instrument used to test the eligibility of e-learning development design is a questionnaire. Data analysis uses Miles and Huberman.

RESULTS AND DISCUSSION

The research is done to design Moodle-based e-learning as multimedia of mathematics learning for VII graders. *Analysis Stage*

The Analysis Stage consists of curriculum analysis, teaching materials analysis, and analysis of student characteristics. For curriculum analysis based on interview results on math teachers, researchers get information that learning in schools uses the 2013 curriculum. Researchers conduct learning observations in the classroom. Researchers found that the learning model used by teachers was a conventional learning model and

a method of class discussion.

The results of teaching materials analysis show that for teacher teaching using package books provided by government and publishers other than the government as a source of learning. Teacher use the student's worksheets in learning. Researchers found that existing students' package books and worksheets have not loaded much about-the matters capable of stimulating or students' levels improving of mathematical communication skills. The learning multimedia used in the classroom is Power-Point but this Power-Point is very rarely used in the teaching-learning process. Students are allowed to use Smartphones during the learning process to seek reference outside of the textbook but in teacher permission and supervision.

Further results analysis of student characteristics is seen that the characteristics of the student himself are interested in learning using the learning medium. When teacher ask students to seek reference on the internet, students look more active and enthusiastic. The use of elearning will be suitable for students because in elearning it can be coupled with learning multimedia. Through e-learning, students can view the video, graphic audio interestingly, and real. Besides, the use of elearning in learning makes students able to access subject matter easily anywhere and at any time.

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Design

The design of e-learning in the form of mathematical learning uses Moodle that is accessible via mathku7.gnomio.com address. When students access my

mathku7.gnomio.com address, the login page appears. To be able to access material and all existing content, students must have an account. Accounts are created by admin. The login page can be viewed in Figure 2.

			Log In
matematikaku7.gr	iomio.com	Search Courses	Q
	Log in		
Username	admin)	
Password			
	Remember username Log in		
	Forgotten your username or password?		
(Cookies must be enabled in your browser 🕐		

Figure 2. Login Page

Inside the log on-page, there are columns for search. Search is used to search for necessary courses or content. To access that content, students must enter username and password. Usernames and passwords are created by teachers. Once the student logs in, the main section appears, which is Home. At home, there is a wide variety of menus such as Home, Dashboard, Event, and My course. The inside menu section of the home can be seen in figure 3.



Figure 3. Menu View

In the Home page section, there are also welcome speeches and content images that can be followed. The Home page section can be viewed in Figure 4.

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Figure 4. Home

There are four contents that students can access, namely: teaching materials, exercise, evaluation, and student response. In teaching matter, there are several topics

relating to the material of equations and linear inequalities of any variable. The teaching material can be seen in Figure 5.

MATERI AJAR	1. Kompetensi Inti (KI) dan Kompetensi Dasar (KD) 2. Memahami Konsep Persamaan Linear Satu Variabel
	3. Menyelesaikan Persamaan Linear Menggunakan Penjumlahan atau Pengurangan
	4. Menyelesaikan Persamaan Linear Menggunakan Perkalian atau Pembagian
	5. Menemukan Konsep Pertidaksamaan Linear satu Variabel
	6. Menyelesaikan Masalah Pertidaksamaan Linear Satu Variabel

Figure 5. Teaching Matter

On teaching material content, there is a Core competence and Basic competence. The core competence and basic competence can be seen in Figure 6.

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Kompetensi Inti (KI) dan Kompetensi Dasar (KD)

A. Kompetensi Inti	 Courses
1. Menghargai dan menghayati ajaran agama yang dianutnya 2. Menghargai dan menghayati perjalan jujur, diginlin, tanggungjawah, peduli	▼ MATERI
(toleransi, gotong royong), santun, percaya diri, dalam berinteraksi secara	Participants
erekur dengan ingkungan sosiai dan alam dalam jangkadan pergadian dan keberadaannya.	🝸 Badges
 Memahami pengetahuan (faktual, konseptual, dan prosedural) berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya terkait fenomena dan kejadian tampak mata 	Competencies
4. Mencoba, mengolah, dan menyaji dalam ranah konkret (mengguna-kan,	🎫 Grades
mengurai, merangkai, modifikasi, dan membuat) dan ranah abstrak (menulis,	General
dipelajari di sekolah dan sumber lain yang sama dalam sudut pandang/teori.	Kompetensi Inti (KI)
B. Kompetensi Dasar	🕨 dan Kompetensi
	Dasar (KD)
5.0 Menjelaskan persamaan dan pertidaksamaan inear satu variabel dan penyelesaiaannya.	1. Memahami
4.6. Menyelesaikan masalah yang berkaitan dengan persamaan dan pertidaksamaan	Konsep Persamaan
linear satu variabel.	Linear Satu Variabel
	2. Menyelesaikan

Figure 6. Core Competence and Basic Competence

The delivery of such core competence and basic competence aims to have students know what competencies will be achieved by studying the material of equations and linear inequalities of one variable. In addition to the teaching material, there are also subchapters of matter chapters. One material is the concept of a single variable linear equation presented using the PBL learning model. Problem-giving becomes Starting Point in learning in this e-learning. The issue delivered in the form of Video. Besides, there are some activities to be completed by students. Activity is structured based on PBL learning measures. Such activity can be seen in Figure 7.

Site pages

1. Memahami Konsep Persamaan Linear Satu Variabel





Those activity aim so that students can more easily understand the concept of a single-variable linear equation through a given problem. Furthermore, Exercise content contains issues that students can work on to practice. The workout of the matter consists of two kinds of matters. The workout of the matter is presented in

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Figure 8.



- 1. Persamaan Linear Satu Variabel
- 2. Pertidaksamaan Linear Satu Variabel

Figure 8. Exercise

Those matters can be worked by students outside of the hours of learning as a practice event. Then, some exercises will be discussed during school learning. Evaluation is arranged to find out the student's learning results and also to know the level of mathematical



communication skills of students measured by the gifting of matters. Problem consists of the matter of pre-test. The problems are presented in Figure 9. Problems are arranged based on indicators of mathematical communication capabilities.

1. Soal Pre Test	
2. Soal Post Test	

Figure 9. Evaluation

After students work on the evaluation matter, the student is next scored based on the rubric assessment of the mathematical communication skills that have been composed earlier. Assessment is used to figure out the



students' level of mathematical communication skills. Student response to learning using my math e-learning as multimedia of mathematical learning on SPLSV material is presented in Figure 10 mathematically.

SISWA	Angket Respon Siswa

Figure 10. Student Response

Questionnare student response are used to know the student response to learning by using Moodle-based elearning as learning multimedia. Moodle-based e-learning design as learning multimedia was validated by math subject teachers at Junior High School 2 Kayangan and computer subject teacher at Darussalam Junior High School. Comments and suggestion can be seen in Table 1.

Table 1. Comments and suggestion

Validator	Comments	suggestion

Students		
Laili Indrayani	Students' activities should be adjusted to the learning model	Add the steps of the PBL learning model in completing learning activities
Zainal Abidin	When on the main page there is no available content so it must go to the course menu in advance to see what content/course is available.	Add content or course on the main page

The author improves the learning medium as advised and commentary. The next step is that the feasibility assessment of learning media is validated by the validator by using the feasibility instruments of media experts and material experts. The results of instrument calculations from media experts and material experts can be seen in Table 2.

Validator	Score	Criteria
Laili Indrayani	3.95	Feasible
Zainal Abidin	3.70	Feasible
Total Score	7.65	
Average	3.825 (Feasible)	

Table 2 contains the feasibility assessment provided by validator 1. Validator 1 gave a score of 3.95. Whereas validator 2 gave the score of 3.70. The average score of both validators is 3,825. This suggests that Moodle-based e-learning design as learning multimedia is feasible to develop into a learning medium.

This research can be continued at the development, implementation, and evaluation stages. The cctivities in the development stage, namely: making e-learning based on a developed design, validating e-leaning by material experts and media experts, and revising e-leaning based on comments from validators. The activities in the implementation stage, namely: e-learning is applied in classroom learning and students are asked to provide responses related to practicality, revision of e-leaning based on students' responses. The activities in the evaluation stage, namely: evaluation of e-learning to ensure that e-learning development objectives can be achieved.

CONCLUSION

Research provides some results. First, the curriculum used in school is the 2013 curriculum. Second, students' mathematical communication skills still need to be improved. Third, teachers need to use teaching materials or learning sources that can stimulate students' mathematical communication skills.

Fourth, students are interested in learning using the learning medium. When teacher ask students to seek reference on the internet, students look more active and enthusiastic.

Moodle-based e-learning designs include the login pages, home pages, and content (teaching matter, matter exercise, evaluation, and student response strikers). Student activity in teaching materials is structured based on the steps of the PBL learning model. Activity is designed to have students' mathematical communication skills improved. Moodle-based e-learning designs to improve mathematical communication capabilities meet the eligibility criteria for student use on learning processes.

Further research can be conducted at the development, implementation, and evaluated stages to be generated valid, practical, and effective e-learning.

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