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The Effectiveness of Internet-based learning management model to improve math problem-solving skills in Junior High Schools

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Abstract: *The purpose of this study was to determine whether the implementation of Internet-based learning management model is effective to improve the ability of problem-solving in mathematics in terms of three aspects. First, it was the improvement of mathematical learning outcomes significantly based on the result of pretest and posttest. Second, it was adequate student activities. Third, in general (more than 65%) students responded positively to learning of internet-based learning management model. This research was quantitative research with a quasi-experimental method, with the design of one group pretest & posttest design. The used significance level (α) was 0.05. One class was taken s the research samples by using Cluster Random Sampling technique. Data were collected by using some techniques. The first was testing for math problem-solving skills. The second was observations for student activities. The third was questionnaires for student response data. Data were analyzed by using descriptive statistical test and inferential statistic test with t-test of N-Gain. Hypothesis test result with t-test of N-Gain (α = 0.05) shows that there is the improvement of the problem-solving ability of students based on pretest and posttest results. It is also found that student activity is adequate. In addition, 93.94% of students responded positively by applying internet-based learning management model. Thus, it can be concluded that the internet-based learning management model is effective to improve students' math problem-solving skills in junior high schools.*

Keywords *- Problem-Solving, Learning Management, Internet*

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I. Introduction

In this era of globalization, the use of learning technology is present as a medium to facilitate students to learn independently, especially if the learning time is insufficient in school. Internet media has its own interest by students in junior high school because the number of internet users in Indonesia continues to increase. The survey results in 2016 found that there were around 132.7 million or about 51.8% internet users from Indonesia's current population of 256.2 million (APJII 2016). If age reviews it, approximately 75.5% are aged from 10 to 24 years old, and if it is viewed in terms of employment about 69.8% are learners. If it is viewed in terms of internet user content about 93.8% is education. Users of email addresses used are the highest about 61.7%.

One of the objectives of mathematics learning mentioned in the Curriculum 2013 and KTSP 2006 is to solve mathematical problems that include the ability to understand problems, mathematical design models, solve models and interpret the solutions obtained. This objective is in line with the Partnership for 21st Century Skills which initiates the seven skills needed in the 21st century. The first is critical thinking and problem-solving skills. The second is communications skills. The third is creativity and innovation skills. The fourth is collaboration skills. The fifth is contextual learning skills and information and media literacy skills. The fifth is information and communications technology literacy. The sixth is life skills consisting of leadership, ethics, accountability, adaptability, personal productivity. He seventh is personal responsibility, people skills, self-direction and social responsibility [1]. Therefore, mathematical problem solving is a strategic competency that must be demonstrated by students.

Based on the objectives of learning and mastery of the 21st-century skills mentioned above, the priority in the learning performed by teachers today is learning oriented to the development of high thinking skills and problem-solving as well as the utilization of computer and ICT media. Mathematical problem solving is a strategic competency shown by students. Student's mathematical problem-solving skills are measured through understanding the problem, choosing the right problem solving, solving problems according to the created or selected model, and summarizing the results according to the problem statement [2].

Various models have been made to solve mathematical problems such as [3]. The Polya model is a widely cited model until now and is widely used in solving math problems at schools in Indonesia. However, various research results such as [4]–[6] revealed that high thinking ability and problem-solving ability of

mathematics students in Indonesia in general and in Kota Parepare, in particular, are still weak and low. It happens due to some reasons. First, there is the limited time at school for children to train their ability to solve math problems. Second, there is a lack of problem-solving exercises according to Polya's steps. Third, the students are less active in constructing the understanding of mathematical concepts so that the ability to think and the reason is also low. Fourth, the teacher is not creative in choosing the learning model according to the characteristics of the mathematics material taught to the students [5].

The low results of PISA and TIMSS as described above according to [7] indicate the weakness of high students thinking ability at the elementary level (SD & SMP). It also shows an indication that our students are not accustomed to solving non-routine problems. Our students are only commonly faced with the problems that have been discussed in the classroom. They face difficulties when they are faced with new problems [8]. Based on the material tested, the provided materials are non-routine (a mathematical problem requiring reasoning ability). The measurement is not only the ability to count but also the ability of mathematical literacy. It is the ability to analyze, reason, and convey ideas effectively, formulate, solve, and interpret mathematical problems in various forms and situations [9].

In addition, Indonesian students are good at working on a problem that is memorizing [7]. However, in applying and reasoning, they are still low. Learning at school, which starts with daily tests and school exams, does not exercise reasoning. Learning through subjects is not only to master knowledge but also to build competence. In the 21st century, basic literacy (Science, Mathematics, reading, and technology) must be mastered. The mastery of critical thinking skills, creative, communication, collaboration, and character is also required. However, PISA and TIMSS use assessments that focus on real-life issues, outside of situations or problems that are often discussed in the classroom. Aspects which are assessed in TIMSS are knowledge of facts, procedures, and concepts, application of knowledge and understanding of concepts. The aspects which are assessed in PISA are problem-solving, reasoning, and communication skills. Therefore the results of TIMSS and PISA above can be used as information that there are still many students who cannot answer the material of international standard of mathematics test.

The problems like in PISA and TIMSS are not yet familiarized in students in learning mathematics in school. During this time, the emphasis of learning mathematics is on giving formulas, examples of problems, and exercise routine questions. Students only do the exercises that are solved immediately using the formula and algorithms that have been given so that the students are only trained in recall and like mechanics. The consequence is that if they are given no routine problems, they make many mistakes. In learning mathematics, problem-solving ability is very important. Problem-solving skills are at the heart of mathematics, and mathematical problem-solving abilities can be applied in other fields of study and everyday life [10].

The main problem in Indonesia related to learning is the low mastery of teachers in mathematics skills that can improve students' math problem solving skills. Therefore, learning is too focused on the transfer of knowledge rather than building deductive thinking skills [8]. In fact, the learning should be directed to the establishment of a meaningful experience of grammaticalness, but it is not merely the delivery of meaning facts that do not support the growth of reasoning skills. As a result, the students are weak in modeling real situations to math problems and interpreting mathematical solutions to real situations. The math skills that the world demands are a fully math skills: from modeling, finding mathematical solutions, interpreting to the original problem. Students are generally accustomed to solve mathematical problems solely without interpreting them to real-world problems. It means that students focus on the world of mathematics alone. It is not complete with the experience of interacting between the real world and the world of mathematics. A logical thread encapsulates (comprehension) and analyzes are very less. It means that the sophistication of reason demanded by the world is higher than the thing which runs in Indonesian math learning practice. On the contrary, the demands of the world on the skill of solving the intricate a calculation have been reduced. There are still many teachers or lecturers who teach using Teaching Center Learning approach (TCL) which tends to make students drowsy because the interaction model is one way [5]. As a result there is no exploration by students. In fact, the exploration by students means involving students looking for information about the theme of topic of learning. Therefore, students need to be facilitated in order to learn independently that is learning activities on their own initiative in internalizing knowledge, attitude and skills without depending on others or teachers.

Low math problem-solving ability of students is caused by several things. First, it is inadequate process components by teachers as educators, as well as by students, as beneficiaries of the educational outcomes themselves. Second, it is the lack of reasoning ability and understanding of students' mathematical concepts. Third, learning performed by the teacher is monotone. Fourth, it is teacher-centered learning (71% of teachers use direct learning models). Fifth, it is lack of reading references or readable material to master concepts. Sixth, it is lack of quality time and space to develop students' reasoning ability. Seventh, it is lack of motivation of teachers to develop reasoning and thinking power [5].

The above description shows that the learning process is not in accordance with the standard learning process that contains the learning principles. First, it develops a learning culture (reading and writing). Second,

it encourages the active participation of students, namely learning that is designed to be student-centered to promote motivation, creativity, responsibility, cooperation, independence, and love of learning mathematics. Third, it applies information and communication technology.

The standard of the education process in Indonesia is in line with the learning organization (LO) system developed by [11] namely, learning, people, organization, knowledge, and technology. Such referrals suggest the utilizing ICTs in learning activities. In addition to learning technology, the quality of education problems also lies in the management of learning. Thus, one of the alternatives to streamline learning to improve the quality of learning in such a way and it is also to improve students problem-solving skills is the model and learning tools that can be supported by technology and managed with the management system.

Therefore, it is predicted that one of the effective models to overcome the above problems, is learning by utilizing computer and internet network in learning so that students can utilize quality time outside school hours by using Google class application and Gmail usage on learning mathematics in junior high. It means that internet-based learning management model is predicted to increase student activity in learning.

II. Literature Review

2.1 Problem Solving Model

The most famous problem-solving model is the Polya model [2]**,** in his book "How to Solve It" which consists of four phases namely, understanding the problem, devising a plan, carrying out the plan, and looking back. an overview of the Polya book and the details of the problem-solving processes have been made [12]. The first is understanding the problem, including labeling or identifying what is known and identifying what is being asked, terms, what is known (data), and determining the solution of the problem. The second is creating a plan, which means describing prior knowledge for the appropriate engineering framework of completion, and rewriting the problem if necessary. The third is resolving the issue, using the selected settlement technique. The fourth is checking the truth of the solution obtained and put the problem and the solution into memory to be used in solving the problem in the future.

If the problem-solving process and the aspects that influence it are linked, three aspects influence the solving of mathematical problems. The first is cognitive aspects, including conceptual knowledge, understanding, and strategies for applying that knowledge. The second is affective aspects that are an aspect that influences the student's tendency to solve problems. The third is skills aspects, including the ability to organize his thoughts [13]. These three aspects are important aspects of attention in problem-solving learning. It is because the problem solving is inseparable from one's consciousness to control and check his learning, what he thinks can help him to solve a problem. On the other hand, training the students' skills in solving problems must also be supported by reasoning and proofing capabilities, mathematical connections, mathematical communication and references. This ability cannot be easily obtained by students. It takes time for it, and it takes patience attitude from educators to give the opportunity to students to develop their potential independently.

Some research results from various models made by mathematics education experts in improving students' math problem-solving skills are constrained on problem analysis. It is due to the lack of time to explore and collect students' understanding of the issues [5]. Many teachers have already applied problem-solving, especially in junior high school in accordance with Polya steps, but the result is not maximal yet. Based on the root of the problem that children need quality time to train themselves in solving problems, a new model for the development of the application of Polya Theory needs to be raised. The researchers provide an outlet by incorporating the elements of management, and students are trained and controlled through learning technology, ie, the internet. In the learning management teachers are expected to implement the learning through some steps. They are planning, implementation, evaluation and follow-up learning, and supervision to achieve the goal of learning effectively and efficiently. Therefore, in this learning management, the educators act as the manager, who has some responsibilities. They act as a planner, organizer, director, and evaluator. In relation to the learning process, there are some abilities of educators that should be owned [14]. They are planning the learning program, implementing, leading, or managing the learning process, assessing the progress of the learning process, giving follow up, and mastering the materials.

In the model of Internet-based management (Lemansisnet), it has been developed by the researchers and applied by using a scientific approach. It is because the scientific approach can spur high-level thinking of students. The managerial processes of the implementation of learning are as follows:

Table 1. The relationship between Lemansisnet Model, Scientific Approach, and Polya Steps in Improving the Mathematical Problem Solving

No.	The steps of Lemansisnet Model	The steps of Scientific Approach	The steps of Polya Model
1.	Planning	Observing and asking	Understanding the Problem
2.	Managing	Associating, classifying, analyzing	making Model of solving the problem
3.	Controlling	Trying	Solving the Problem
4.	Evaluating	Communicating	Solving the Problem
5.	Reflecting	Communicating	Re-check the results of the solution
6.	Following-up (Online Task)	Creating	Repeat

2.2 Internet as a Learning Media for Growing Mathematical Problem Solving

Aspects of learning include discussion, reading, assignment, presentation, and evaluation [15]. If these aspects can be held with a matching composition, it is expected to occur optimal learning process. Educational experts claim that the achievement of the objectives of learning is largely determined by the balance between these aspects [16]. In reality, the internet can be used in learning settings at school, or outside the school. It is because it has some distinctive characteristics. It is an interpersonal medium and a mass media that enables one-to-one and one-to-many communication. It has interactive nature. It allows synchronous or asynchronous communication. Therefore, it allows the implementation of the three types of dialogue or communication which is the requirement of the implementation of a learning process.

Some research results indicate that web-based math learning provides the positive response from learners [17], [18]. It is revealed that internet activities such as problem-solving, mathematical search can help learners in achieving three goals [19]. It is an extraordinary tool for solving everyday problems. It facilitates children's learning. It establishes a child's confidence to have a good understanding and ability in the use of ICT. Furthermore, it is said that internet usage is very interesting to make learners more interesting in discussion and stay focused. ICT-based constructive biology learning model is attractive and effective for improving learning motivation, cognitive and metacognitive ability of learners [20]. In addition, cognitive abilities and metacognitive ability can improve the mathematics problem-solving ability in high school students in Pare-Pare City [6].

2.3 Effectiveness of Internet-based Learning

The effectiveness of the learning process is viewed from the relationship of certain teachers who teach certain groups of students, in certain situations in an effort to achieve certain instructional goals [21]. The effectiveness of the learning process means the success rate of teachers in teaching certain groups of students by using models, approaches, and specific methods to achieve certain instructional goals. The effectiveness of learning has two characteristics [22]. The first characteristic is to "make it easier for students to learn" something useful, such as facts, skills, values, concepts or desired to learning outcomes. The second characteristic is that the skills are acknowledged by competent judges, such as teachers, supervisors, tutors or students themselves. According to [23] teacher strategy to improve the effectiveness of learning in the classroom is by describing the effort to improve the effectiveness of learning is based on several things. The first is the purpose of instructional instruction which has been determined and the preparation for evaluation. The second is growing motivation to students. The third is creating good communication (interaction). The fourth is using good and varied learning media. The fifth is using a good and varied learning model. The sixth is summarizing material and or handout. The seventh is learning and mastering the lesson material to be delivered. The eight is making a summary or outline of what will be delivered. Furthermore, it is stated that learning is said to be effective when it achieves the desired goals, both in terms of learning objectives and maximal student achievement [24]. According to [25], some indicators can be used to determine effectiveness in the learning process. They are a good material organization, effective communication, mastery and enthusiasm on the subject matter, positive attitude toward students, fair values, flexibility in learning approaches, and good student learning outcomes. Based on the description mentioned above, it can be concluded that the effectiveness of learning is the level of success that can be achieved from a particular learning method in accordance with the planned learning objectives.

Some indicators become benchmarks of the effectiveness of learning in this study. The first is frequency time of student activities including ideal category. The second is the posttest results (mathematics problem-solving skill which is in the medium category). The third is the significant improvement between pretest and posttest results. The fourth is the students' response which is in the adequate category.

III. Research Methods

In relation to the purpose of research, the type of research used is a quasi-experiment with one group design model pretest and posttest design in which O1 pretest, O2 Posttest, and X are treated by the lemansisnet model.

O_1	X	O_2

[26]

The population of class VIII SMP Negeri 2 Prepare consists of 8 classes. The samples were taken by one class using the technique of classroom random sampling. The data were collected using test instrument (pretest and posttest), as well as the rubric of assessment of problem-solving skill based on phases proposed by Polya on two linear equations. Data were analyzed using descriptive statistical analysis that is to find the average, percentage, and distribution of the percentage of students' ability in solving mathematical problems. Furthermore, to strengthen the change of pretest and posttest result, Gain Normalized analysis was used. Furthermore, for the purposes of interpretation of research results, the researchers used paired t-test analysis with the following decision-making criteria. H0 is accepted if significant value $P \geq \alpha$ and H0 is rejected if significant value $P < \alpha$ with $\alpha = 0.05$. The research hypothesis is that there is a significant improvement in the students' math problem-solving skills after being taught with the lemansisnet model. Furthermore, student activity is said to be ideal, if seven of the eight criteria of tolerance limit of achievement of ideal time is fulfilled.

IV. Results And Discussion

In this research, the test is conducted twice. The first test is given to the students before the experiment with Lemansisnet model. The second test is conducted after learning as much as five times meeting. Based on the analysis, the result of percentage analysis of problem-solving skill for each aspect has been improved which is summarized in the following figure.

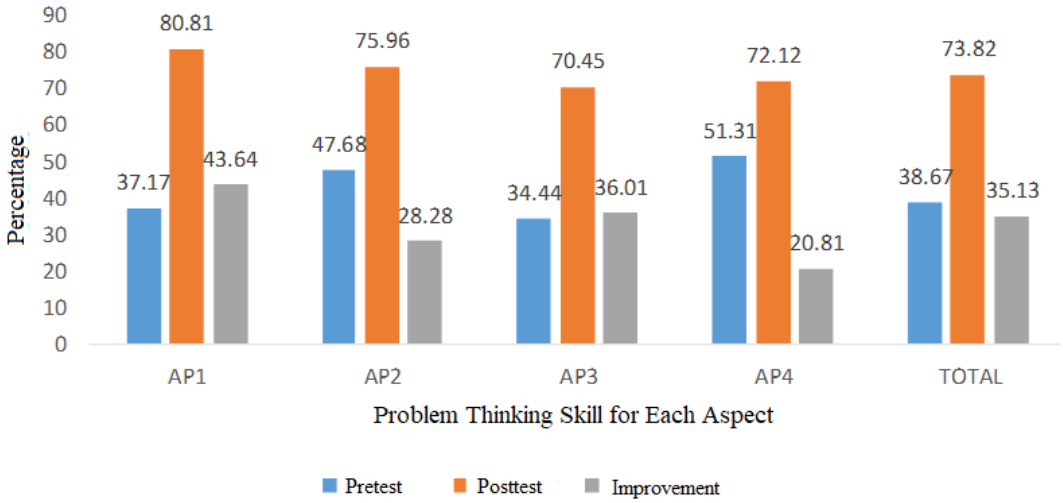

Figure 1. Problem Thinking Skill for Each Aspect

Figure 1 shows that students' mathematical problem-solving skills have improved both overall and for every aspect. The highest improvement is the aspect of understanding the problem that is about 44%. Then, the aspect of problem-solving increased about 36%. For the aspects of planning or strategy or making a mathematical model of the given problem, it increased about 28%. The last aspect that is concluding, or returns the result of problem-solving to the given problem is only about 21%. If it is reviewed entirely without looking at the aspects of problem-solving skills, it improves about 35%.

Based on the result of SPSS 21 analysis, the result of N-Gain normality test for pretest and posttest score, it is obtained probability value $0.17 > \alpha = 0.05$ for pretest, and probability value $0.14 > \alpha = 0.05$ for posttest. Hence, Ho is accepted. It means that the samples are normally distributed (for details it can be seen table 1.)

Table 1. The Results of Normality Test of N-Gain Pretest and Posttest

Case Processing Summary

N-Gain	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Pre-test	33	100.0%	0	0.0%	33	100.0%
Post-test	33	100.0%	0	0.0%	33	100.0%

Tests of Normality

N-Gain	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.169	33	.17	.929	33	.032
Post-test	.173	33	.14	.926	33	.027

a. Lilliefors Significance Correction

On the table above, it can be seen that Pretest Probability Value 0.17> α = 0.05, and Posttest Probability Value 0.14> α = 0.05. Therefore, H0 is accepted which means the sample is normally distributed. Furthermore, after the requirement of hypothesis analysis of t-test of N-Gain is fulfilled, then the next step is that the hypothesis is tested. It shows that there is a significant improvement in pretest result score and posttest result score based on the result of T-Test of N-Gain analysis in table 2.

Table 2. The Results of t-test of N-Gain Pretest and Posttest

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
N-gain Pre-test - Post-test	-36.18182	12.62056	2.19696	-40.65687	-31.70676	-16.469	32	.000

Based on table 2, probability value is obtained that is 0.000 <α = 0.05. Then the statistical hypothesis is rejected, and the hypothesis of the researchers is accepted. It means that the problem-solving ability of PLDV and SPLDV mathematics material has improved after applying internet based management model.

Moreover, the results of the observation data of students' activities in learning from two experts have been analyzed and the results can be seen in the following table 3.

Tabel 3. The persenyage distribution of students' activities

Number of items (Indikators)	Available Time/ Meeting	Ideal Time	interval tolerance PWI (%)	Persentage of the activities	Categories
1	10 minutes	11% dari WT	6 – 16	9.81	fulfilled
2	20 minutes	20% dari WT	17 – 27	19.38	fulfilled
3	10 minutes	17% dari WT	6 - 16	12.91	fulfilled
4	20 minutes	11 % dari WT	17-27	19.14	fulfilled

5	20 minutes	11 % dari WT	12-22	17.67	fulfilled
6	10 minutes	10 % dari WT	6–16	10.71	fulfilled
7	10 minutes	10% dari WT	6-16	7.76	fulfilled
8	0 minute	0% dari WT	0-5	2.91	fulfilled

Notes:

PWI is the percentage of indicator time
WT is the time available at each meeting

Based on table 3, it shows that all students' activities starting from the first to the last indicator are fulfilled in which the percentage of student activity on learner with applying of internet-based management model is at interval tolerance PWI (%). Therefore, it is stated that the student activity on the PLDV and SPLDV learning with the Lemansisnet model is ideal.

Furthermore, the result of the questionnaire of student responses to internet-based management model on this research is measured through several things. The first is student's response to the implementation of learning with Internet-based learning management model. The second is student's response to teaching materials. The third is student responses to student activity sheets and online tasks.

The results of data analysis of the response of 33 students of class VIII-2 semester one SMP Negeri 2 Parepare toward the application of lemansisnet model consisting of 17 items show that there are 31 students or about 93.94% give the positive response. Furthermore, the results of data analysis of the students' response to the material of PLDV & SPLDV which consist of 5 indicators show that 84.85% give the positive response. The results of the student's response to activity sheet of student activity of online task which consists of six aspects show that there are 78.79% has the positive response. The three indicators of student responses are above 65%, and it means that the students have a positive response to Internet-based learning management model that can improve students' math problem-solving skills including adequate categories.

V. Conclusion

Based on the results and discussion of the research, it is found that internet-based learning management model is effective to improve students' mathematics problem-solving ability, student activity. In addition, the students have a positive response. In the learning, the students participate actively and enthusiastically. However, in this study, the students use the Google class application intensively the first time. It strongly supports the existence of space and time quality for students that can take advantage of outside school hours. Therefore, the problem of less time to be able to think and explore the thinking results can be overcome. In addition, some facilities from Google APP can support learning performed by students outside school hours with the use of internet technology.

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