Project-based learning with LMS moodle to promote mathematical problem solving and self-regulated learning

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Abstract. The ability to solve mathematical problems and self-regulated learning is one of the important abilities mastered by students in learning mathematics. However, activities in classroom learning are still direct teaching, which results in a low increase in these abilities. So it takes alternative learning centered on students. This study was conducted to determine the impact of project based learning on mathematical problem solving abilities and self-regulated learning. Quasi-experimental design with three class groups was used: Pretest-posttest Control Group Design. XXX Based on the results of statistical analysis inference the mathematical problem solving ability of experimental class students is better compared to the control class as well as the self efficacy of the experimental class better than the control class. Project based learning with LMS Moodle has a positive impact on improving problem solving skills and self-regulated learning.

Commented [U1]: Please describe your data collection technique, sampling technique and data analysis technique.

1. Introduction

Core to key approaches and ideologies to education such as student-centred and critical pedagogies have been the battle for democratic education [1]. School experience is represented by both interactional contexts and structures of representations about school activities, the self, significant others (teachers, peers, parents) and community [2]. Pestalozzi says the provision of useful, interesting experiences to students was the secret to successful education [3]. In 1918 in September, Kilpatrick wrote a short essay called "The Project Method." [4], [5]. Projects are Ideas for the learning process of the pupil and teacher exercises in different can job objects. Project-based learning (PBL) is a constructivist learning approach [6]. First suggested at the end of the 1890s by John Dewey [7], [8] Dewey's theory focused on children and brought reality into the classroom environment. The knowledge theory of John Dewey in combination with the project-based work methodology of William Heard Kilpatrick strengthens the learning process [9] [10].

Project-based learning has become a form of pedagogical practice for years and includes a broad variety of experimental fields that students typically focus on community learning and present various outcomes [11]. Social interactions that motivate the learning process and promote it takes place on the Moodle platform [12], [13]. LMS Moodle provides an answer to the basic needs of a computerized work environment in Project-Based Learning [14]. Developed Moodle for teachers from the start under the social constructionist pedagogy theory [15]. The integration of ICT as an instructional instrument should be seen as an avenue to improving the teaching process. As a strategic planning tool of high quality, LMS

Moodle enables you to handle all learning practices like e-learning, virtual classroom, and online classes [16], [17]. The LMS Moodle provides suited to Project-Based Learning since it promotes an autonomous information system and builds skills such as critical thinking, collaboration, and communication. Another important impact that can be formed from Project-Based Learning with LMS Moodle, gives students the habit of having responsibilities in completing assignments of learning objectives independently.

Self-regulated learners have four characteristics learning independence, learning efficiency, taking responsibility for learning, and the ability to use problem-solving skills [18]. Solving mathematical problems is a standard activity for learners at all stages of education [19]. Problem-solving is a fundamental aim of mathematics education at school, supported by the major importance of this skill in daily life and at work [20]. Problem-solving capability is a complicated interaction between cognition and meta-cognition [21]. Defines problem-solving as a skill that involves a person in the cognitive process of understanding and solving a problem with a non-obvious solution [22]. Problem-solving in mathematics proposed by George Polya. The problem in Polya "must include (1) numerous elements that must be connected (some of which may or may not be relevant), (2) several steps are taken to find a solution, (3) several possible solutions are available, and (4) knowledge must be obtained from outside the Statement of the Problem to produce a solution [23]. To develop problem-solving skills, mathematical thinking practice is not enough but needs to be accompanied by the development of self-confidence through the problem-solving process so that it has adequate preparedness to face various challenges in real life. On this basis, vocational high school students need to be trained in problem-solving skills.

The process to develop the problem-solving ability can be done through the practice of making decisions and conclusions from a problem based on thinking logically, rationally, critically, accurately, honestly, efficiently, and effectively. So from that process, students are expected to be able to use problem-solving skills in daily life, and in learning various sciences with an emphasis on reasoningactivities, skills in applying mathematics, and forming students' self-confidence [24]. A meta-analysis indicated statistically significant positive effects of computer technology on mathematics achievement [25]. For mathematics education and learning, the importance of the use of technology is significant [26]. The integration of Moodle LMS in project-based learning provides maximum guidance to students in providing mathematics learning experiences so that they not only learn concepts but experience experiences of thought processes. So that as much as is clear, the mathematical objective is not oriented to the mastery of the concept, but provides thoughts and uses in life including technology, social and culture [27].

Providing high instructional guidance as students learn by project-based learning with LMS Moodle can be helpful as the directions help students understand the mathematical concepts they are supposed to learn. Teacher guidance is important for effective learning in the resolution of collaborative issues to achieve learning objectives [28], [29]. Characteristics of vocational high school students in Indonesia do not dare to express opinions or ask questions when they are not familiar with the material presented when asked to solve problems in groups, more students stand by instead of working on problems [30]. Through this learning method, mathematics is expected to be learned in ways that are interesting and more challenging. In this study, the researcher wants to discover the overall impact of Project-based Learning with the LMS Moodle framework in the students'.

2. Method

Quasi-experimental designs are used when there are groups that have a high degree of similarity to the population, in this case, the specific characteristics of the pre-intervention [31]. Based on practical reasons, conditions, and ethics in a quasi-experimental design of a sample cannot be selective [32]–[34]. This is the basis of a quasi-experimental design. Experimental class being taught through Project Based Learning with LMS Moodle and a control class being taught using routine-based learning, conventional. The involvement of experimental and control classes was intended to examine both higher- and lower-order thinking skills by comparing the two groups' achievement of such skills. The impact of Project-Based Learning with LMS Moodle on students' self-regulated learning was also assessed based on perceptions from those students involved in Project-Based Learning with LMS Moodle (the experimental

group). Both groups were taught in parallel by the same teacher to minimize instructor bias. The quasi-experimental design used is shown in **Figure 1.**

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Pretest *Treatment* *Postest*

Figure 1. Pretest-posttest Control Group Design [33]

2.1 Population and Sample Research

The population in this study were all students of class XI SMKN Majalengka, in the academic year 2018/2019. By using a sampling technique that is purposive sampling, the research sample in this study is in the XI A SMKN Majalengka class as an experimental class with 30 students and the control class XI B with 30 students

2.2 Data Collection Tools.

The test carried out in this study is the problem-solving test. The test of the problem-solving test is given in the form of a description consisting of 6 items which are then tested, after being tested it is obtained 4 items that are declared valid, each of each question represents an indicator of creative thinking ability. This test is done as much as once which is only doing posttest which has the same weight and indicators.

2.3 Data Analysis

Data analysis techniques to see the effect of Project-Based Learning With LMS Moodle were done by comparing the results of pretest and post-test problem-solving abilities. Analysis Tests the difference in the pretest and posttest averages of the two study classes by using the Independent Sample t-Test analysis.

3. Result and Discussion

The data obtained in this study are quantitative in the form of mathematical creative thinking test results and self-efficacy scale results. Based on the results of calculations in the previous description that the data is normally distributed and has a homogeneous variant. To test that all three classes have the same characteristics, Independent Sample t-Test analysis is used, **Table 1.** provides information that there are no significant differences in pretest two class.

Table 1. Pretest Mathematical Problem Solving Between Experimental Class and Control Class

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		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Pretest	Equal variances assumed	.208	57	.836	.3933	1.905	-3.392	4.18
	Equal variances not assumed	.208	24.15	.836	.3933	1.902	-3.388	4.17

Based on **Table 1.** because the value is greater than sig. > .05 so H_0 is accepted and Ha is rejected or it can be concluded that the mathematical creative thinking skills between the experimental classes are not significantly different. Based on the measurement results in the following summary that the data from the two classes (the experimental class and the control class) are normally distributed and have homogeneous variants. **Table 2.** provides information related to posttest analysis.

Table 2. Posttest Mathematical Problem Solving Between Experimental Class and Control Class

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t-test for Equality of Means

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Pretest	Equal variances assumed	-2.24	57	.038	-9.43	3.85	-18.23	-.62
	Equal variances not assumed	-2.29	54.85	.034	-9.43	3.77	-17.89	-.86

Based on the findings in **Table 2.** the value means less than sig. < .05 so H_O is rejected and H_a is accepted or it can be concluded that the mathematical creative thinking ability of students for experimental classes and control class in the final test (posttest) is different or not same. Based on the assumption test results that the experimental classes and control classes were normally distributed and had a homogeneous variance, then the independent sample t-test was performed through the significance level of a = .05. After processing the data, the output display can be seen in the following **Table 3.**

Table 3. Score Self-regulated Learning Scale Between Experimental Class and Control Class

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		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Pretest	Equal variances assumed	-3.46	57	.000	-10.53	4.75	-19.43	-.72
	Equal variances not assumed	-3.46	55.35	.000	-10.53	4.77	-18.98	-.97

Based on the findings in **Table 3.** the value means less than sig. < .05 so H_O is rejected and H_a is accepted or it can be concluded that the self-efficacy scale for experimental classes and control class in the final test (posttest) is significantly different or not same. In general, the results of the research prove that project-based learning with LMS Moodle contributes to improving mathematical problem-solving abilities. Pretest results show that there are no significant differences between the two classes. But the results of the posttest addressed significant differences in the two classes. Likewise for the results of self-regulated learning, that there are significant differences in the two experimental and control classes.

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Commented [U5]: Discussion of this research is still very minimal theory, relevant research and expert opinion.

4. Conclusion

This research is quasi-experimental research that aims to see the impact of the process of project-based learning with LMS Moodle on mathematical problem-solving abilities and self-regulated learning. The findings based on statistical analysis results inference produce that the results of the calculation of pretest average data in both classes are not significantly different. This gives information that the mathematical abilities of students in both classes are the same. Then based on the calculation results of the average posttest score scores in the two classes is significantly different. This means that the mathematical problem-solving ability in the experimental class is better because it is the role of the learning model that requires students to be creative and gain experience of thinking. Other results also

provide information to us that student behaviour can also change when the design of the learning process runs clearly and each activity is well designed, this is evidenced by the results of the analysis of the self-regulated learning scale score calculation between the experimental class and the control class is significantly different.

5. Acknowledgements

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