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Use of Problem-Based Electronic Worksheet on Hooke's Law Materials to Increase Creativity of Students

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Abstract: This research aims to find out the use of problem-based Electronic Worksheets with problem-based learning models in Hooke's Law subject material to increase the creativity of students. The population of this study was all students of class XI IPA State High School 1 Rumbia. The sample in this study of students was in class XI IPA 1 amounted to 34 as an experimental class, and students in class XI IPA 2 numbered 34 as the control class. The research design used was Non-Equivalent Pretest Posttest Control Group Design. The data were tested with N-gain analysis, normality test, homogeneity test, Independent Sample T-test, and Effect Size test. Based on research that has been done, using the Independent Sample T-test sig value. (2-Tailed) less than 0.05 which was 0.00. The average N-gain of experimental class critical skills of 0.76belonged to the high category, while in the control class of 0.61 it was included in the medium category. Based on the effect size test obtained results of 1.39 showed that the use of a problem-based electronic worksheet with a problem-based learning model was effective to increase the creativity of students.

Keywords: Creativity, Electronic Worksheet, PBL

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INTRODUCTION

The 2013 curriculum was more oriented towards the character formation of students reviewed through spiritual, social (affective), knowledge (cognitive), and skills (psychomotor) attitudes (Mustafa &Dwiyogo, 2020). In addition to the cognitive real of students must also hone their skills in the psychomotor realm, one of which was by developing their creativity. Problem Based Learning (PBL) was a learning model that applies relevant problems as context for students to learn about how to think and solve problems, and can obtain essential knowledge and concepts from subjects (Hidayah et al., 2020). Interesting teaching materials can help students in learning one of them was the Student Worksheet because it can make it easier for students to conduct investigations to understand the concept (Fitriani et al., 2017). Preliminary research data that has been conducted on physics educators in State High School (SMA) 1 Rumbia was known that during this pandemic the implementation of learning was carried out online with the use of teaching materials only books from the ministry of education only. Based on interviews, it was known that the learning process was not veriative and tends to confuse students, especially when practicums that did not use worksheet, although the facilities and infrastructure supported learning activities such as libraries and laboratories are available, but cannot be utilized due to online learning.

Problem-based electronic worksheet with PBL learning model becomes a solution that educators can use to increase the creativity of students. worksheet elektronik was able to train students to be independent, active and creative (umriani, 2019). PBL was better than using conventional models, so it can be said that the use of PBL learning model was effectively used to increase the creativity of students (Abdurrozak et al., 2016). Creativity in physics learning was needed in observing, assembling tools and materials, analyzing data, and solving physics problems (Hapsari, 2020). Creativity has a relationship with the learning outcomes of students (Sholikhah, 2018).

Electronic worksheet was a printed worksheet that was converted into a digital form by utilizing computer technology (Nasution, 2020). Electronic worksheet was characterized through its form, namely electronics that use computers, as well as smartphones (Putriyana, 2020), Electronic worksheet was presented digitally, so that combined with text, images, slides, videos, and audio provides an interactive and interesting display (Haqsari, 2014), done digitally and done systematically and continuously over a period of time (Ramlawati, 2014). Electronic worksheet can be used as an alternative teaching material that can be accessed by all students with more interactive and interesting, and anywhere (Purnama, 2020), can access this Electronic worksheet through online platforms (Lathifah et al., 2021). Problem-based electronics used as teaching materials are able to increase the attractiveness, understanding, and learning outcomes of students, so that the learning process becomes effective (Selviana, 2020).

PBL was one of the learning models that educators can choose in learning as a model. Susilawati (2012) PBL was one of the learning models associated with contextual learning. According to Pusparini et al (2006), PBL learning was based on many problems, with real solutions to real problems. There are five processes in the application of PBL according to Arends (2010) as follows; a) Phase 1 Presenting the

problem; b) Phase 2 Planning the investigations; c) Phase 3 Conducting the investigations; d) Phase 4 Demonstrasion learning; e) Phase 5 Reflecting and debriefing.

Creativity was a means to increase the creativity of individuals, groups, and organizations (Althuizen & Wierenga, 2014). To produce a new way or thing in looking at a problem or something, there are standards that are improved indicators of fluency, flexibility, and elaboration (Treffinger et al., 2002), In producing a new way or thing of looking at a problem or something, creativity was seen as an ability to enable individual activities (Hargrove &Nietfeld, 2015).

The use of problem-based Electronic worksheet with the PBL learning model becomes one of the alternative solutions to increase the creativity of students, so research was carried out to find out the influence of the use of problem-based Electronic worksheet with the PBL learning model on Hooke's Legal material on increasing the creativity of students.

METHOD

Research Design & Procedures

This research design was Non-equivalent Control Group Design, because one experimental class was given special treatment and one more class was used as a control class with conventional learning. The manipulation of class behavior in this study was a situation or action to find out how it affects it. The first meeting was held face-to-face, the teacher opened the learning, the students conducted a pretest to measure the initial ability of students on Hooke's Law material. The pretest problem consists of 5 points of essay. The second meeting was held face-to-face, learning using the PBL model with 5 learning phases. The learning process begins with classroom conditioning, the teacher opened the learning process, checking the presence of students while providing Electronic worksheet links to students, teachers provided perceptions to students, teachers conveyed learning goals, teachers conveyed learning indicators that must be achieved by students, then did learning with Electronic worksheet. The third meeting face-to-face, students conducted a posttest to measure the final ability of students after being given treatment in the form of the use of problem-based Electronic worksheet with the PBL learning model on Hooke's Law material. The posttest problem consists of 5 points of essay questions, the results of posttest.

Population and Sample

The population in this study was all students of class XI IPA SMA Negeri 1 Rumbia consisting of 5 classes. The sample in this study was selected using the Purposive Sampling technique, selected based on a relatively similar range of values, then selected class XI IPA 1 as an experimental class and class XI IPA 2 as a control class.

Data Analysis

The N-gain data analysis technique was used to determine the difference in pretest and posttest values between the experimental and control classes. To analyze quantitative data students used normalized gain scores.

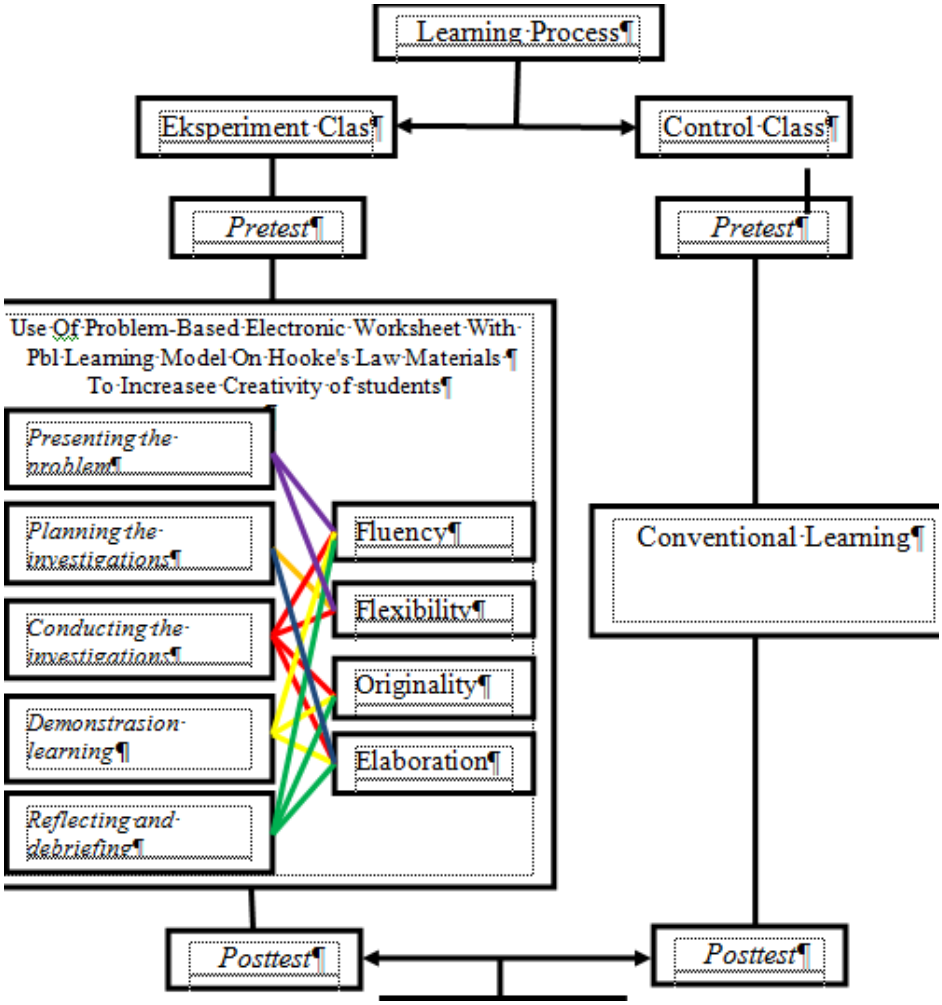

Figure 1. Research Flow

Description: if the N-gain value was $0 \leq$ N-gain < 0.3 then it falls into the low category, if N-gain was $0.3 \leq$ N-gain < 0.7 then it falls into the medium category, if N-gain was $0.7 \leq$ N-gain ≤ 1 then it belongs to the high category. (Hake, 1998) The data obtained was then analyzed by conducting:

1. Normality test was conducted to find out a sample of research, distributing normally or otherwise. Description: If the Sig value or probability value > 0.05, H0 was accepted. It can be concluded that the data was normal distribution. If the Sig value or probability value ≤ 0.05, H0 was rejected. It can be concluded that the data was not normally distributed.
2. Homogeneity test was conducted to find out the homogeneity of the sample given in this study. Description: If the sig value or probability value > 0.05, it was declared homogeneous or similar. If the sig value or probability value ≤ 0.05, it was declared not homogeneous.
3. Creativity value data was tested statistically using the Independent Sample t-Test method. The Independent Sample t-Test test in this study used SPSS software at a real 5% level. Description: If the Sig value or probability value < 0.05, H0 was

accepted. If the Sig value or probability value ≥ 0.05, H0 was rejected. (Suyatna, 2017).

4. Effect size was applied to measure how knowledgeable the learning strategies that have been applied in the research sample. Description: if $0.2 < d \leq 0.5$ then it fells into the category of not weak, if $0.5 < d \leq 0.8$ then it fells into the medium category, and if $0.8 < d \leq 2.0$ then it belongs to the strong category. (Cohen et al., 2007).

RESULT AND DISCUSSION

Result

After getting the results of learning students in the form of pretest and posttest, N-gain tests and statistical tests will be conducted to get results that show an increase or absence of creativity.

Table 1. Learner Outcomes

Learner Outcome	**N**	***Min***	***Max***	***Mean***	***Std. Deviation***
Pretest Experiment	34	10	40	25.29	7.876
Posttest Experiment	34	70	95	82.21	6.178
Pretest Control	34	10	40	25.00	7.487
Posttest Control	34	50	85	70.44	9.076

The increase in the creativity of students can be known from the comparison of pretest and posttest grades in experimental classes and control classes. Here were the results of recapitulation of pretest and posttest results based on the results of N-gain tests and statistical tests:

Table 2. N-gain Test Results

N-gain	**experimental classes**	**control classes**
Min	0.61	0.33
Max	0.91	0.76
Average	0.76	0.61
Category	High	Medium

Table 2 of N-gain test results showed that the experimental class increased by 0.76 where in the N-gain test the experimental class using problem-based Electronic worksheet with the PBL learning model fell into the high category. In the control class experienced an increase of 0.61 where in the N-gain test control classes using conventional learning media fell into the medium category.

Table 3. Normality Test Results

Kelas	***Shapiro-Wilk***		
	Stat	***df***	***Sig.***
***Pretest* Experiment**	0.952	34	0.138
***Posttest* Experiment**	0.939	34	0.059
***Pretest* Control**	0.943	34	0.074
***Posttest* Control**	0.957	34	0.198

Table 3 of normality test results showed that all data in experimental classes using problem-based Electronic worksheet with PBL learning models and control classes using conventional learning media had sig values of 0.138 (Pretest Experiment), 0.059 (Posttest Experiment), 0.074 (Pretest Control), and 0.198 (Post Test Control) > 0.05. Based on normality test guidelines, it was shown that all data was normal distribution.

Table 4. Homogeneity Test Results

Homogeneity	*df1*	*df2*	*Sig.*
Based on Mean	1	66	0.053
Based on Median	1	66	0.062
Based on Median and with adjusted df	1	54.786	0.063
Based on trimmed mean	1	66	0.049

Table 4 homogeneity test results showed that sig value. 0.049 < 0.05, so it can be said that the creativity value data of students in experimental classes using Electronic worksheet and conventional learning media had variants not the same or not homogeneous, therefore at the time of independent test the sample t-test uses Equal variances not assumed.

Table 5. independent sample t-test results

		F	Sig.	t	df	Sig. (2-tailed)
Learner Outcomes	**Equal variances assumed**	3.886	0.053	6.248	66	0.000
	Equal variances not assumed			6.248	58.176	0.000

Table 5 independent sample t-test results using equal variances not assumed with sig values. (2-tailed) of 0.00. Based on the determination of decision making if the value sig. (2-tailed) 0.00 < 0.05 then Ho accepted, it can be stated that there was an influence on the use of problem-based Electronic worksheet with the PBL learning model on Hooke's Law material to increase the creativity of students.

Table 6. results of the effect size test

Class	N	Mean	Std. Deviasi	Varian	Effect Size
Experiment	34	82.21	6.178	38.618	1.39
Control	34	70.44	9.076	82.375	

Table 6 results of the effect size test above, it can be seen that the effect size value was 1.39 with a large category. So that it can be concluded that worksheet Electronic problem-based with PBL learning model used was very effective to increase the creativity of students.

Discussion

Figure 2 in the experiment class averaged the pretest score at 25.29 and the posttest at 82.21. In the control class the pretest grade point average was 25.00 and the postest score was 70.44. Based on figure 2 it was seen that the increase in the experimental class by 56.92 was higher than in the control class which increases by 45.44. This was indicated based on the gradient of increasing pretest and posttest values, in the experimental class students are required to be active independently and indivu, analyzing and solving themselves problems or problems available with the guidance of problem-based Electronic worksheet. the increase in student creativity was due to the use of maslah-based electronic worksheet that has been specialized at each stage adjusting to the indicators of creativity.

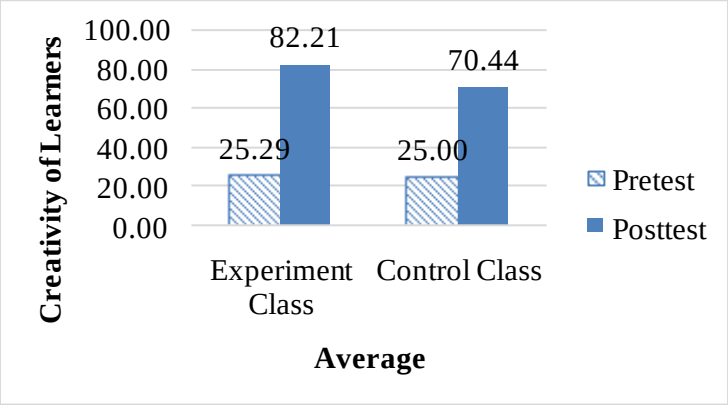

Figure 2. Increase in Pretest and Postest Average Scores

Figure 3 and Figure 4 show that the average ability of creativity indicators was poured into pretest and posttest. The average achievement of item indicators about pretest experimental and control classes has mixed results. Increased indicators of creativity in experimental classes and control classes made significant differences. The highest increase in creativity indicators in the experimental class and control class both occurred in the elaboration indicator, but in the indicator of elaboration of improvement in the experimental class was more than 82.36 compared to the control class of 54.41, this was because the learner was more antuasias and motivated by his friends when studying in groups, seen at the time of the study, students are very active when working in groups to conduct simulations and experiment, When experiencing difficulties seen asking each other questions and discussing during activity reporting, it was due to the simulation feature with phet and activity reporting was carried out directly in problem-based Electronic worksheet. In the indicator of originality of experimental class students and control classes both obtained the lowest ability score compared to other indicators of creativity, in the experimental class and control class the increase was equally 30.88, This was because students do not dig themselves the things given by the teacher, so did not find other things that were newer, seen at the time of the study, reports of the activities of each learner when practicum independently in their respective homes, the reports submitted tend to be the same. The flexibility indicator increased in the experimental class was higher by 53.67 compared to the control class of 44.76. On the indicator of fluency the increase in the experimental class was higher by 62.50 compared to the control class of 50.00. The achievement of improvements in the

indicator of flexibility and indicators of eloqueance was relatively close together, this was because the level of fluency and flexibility between students was relatively the same, seen at the time of fluency when using problem-based Electronic worksheet and worksheet, smoothness in doing activities, and smoothness in finding sources when given a question. The average achievement in the item indicator of the experiment class posttest question has a higher percentage of achievement than the control class. This showed that overall the increase in creativity of experimental class students has increased higher than the control class, due to the application and use of problem-based Electronic worksheet with the PBL learning model that made students active and easy to find their own concepts and better understand the concepts or materials of physical learning in hooke law materials.

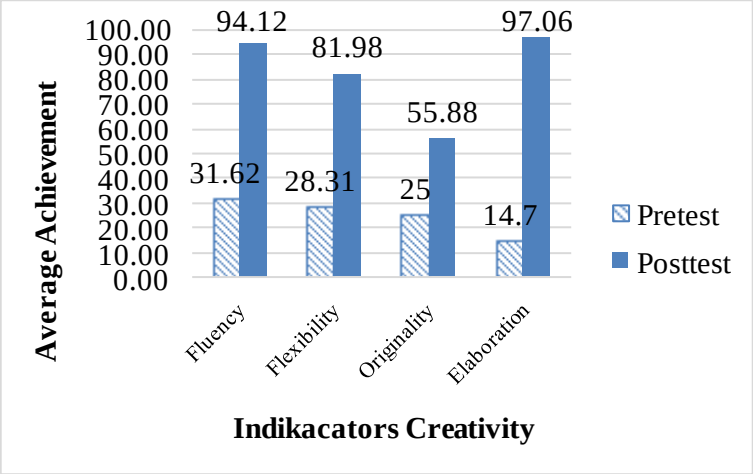

Figure 3. Average achievement of control class creativity indicators

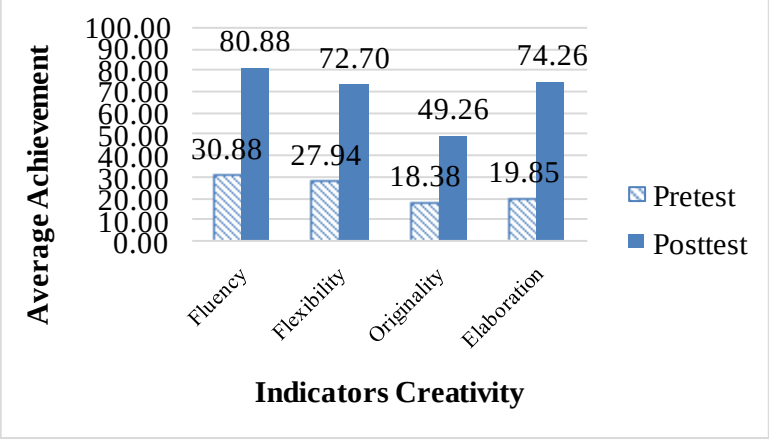

Figure 4. Average achievement of experimental class creativity indicators

Based on the results of data analysis in Table 2, it was known that the experimental class obtained an N-Gain score of 0.76 with a high category, and in the control class obtained an N-Gain score of 0.61 with a medium category. This shows that problem-based Electronic worksheet with PBL learning models applied to experimental classes was more effectively used compared to conventional learning materials applied to control classes, in terms of increasing the creativity of students. The Effect Size test shown in Table 6 obtained Cohen's value of 1.39 with a large category. This showed

that there was a great influence in terms of effectiveness to increase the creativity of students with the use of problem-based Electronic worksheet with the PBL learning model. Directly proportional to the relevant theoretical and research framework that stated electronic worksheet can help students to better understand the material provided by educators so that learning goals can be achieved (Lathifah et al., 2021). Problem-based worksheet used as teaching materials has been shown to increase the attractiveness, understanding, and learning outcomes of students, so that the learning process becomes effective (Selviana, 2020), Electronic worksheet was considered necessary because it was able to train students to be independent, active and hone creativity (Umriani, 2019). PBL was better than using conventional models, so it can be said that the use of PBL learning model was effectively used to increase the creativity of students (Abdurrozak et al., 2016). Creativity in physics learning was needed in observing, assembling tools and materials, analyzing data, and solving physics problems (Hapsari, 2020). Creativity has a relationship with the learning outcomes of students (Sholikhah, 2018).

Table 7. Comparison with relevant research

References	**Title**	**Result**	
		N-gain	**Effect Size**
Astawan et al, 2022	Use of Problem-Based Electronic Worksheet With PBL Learning Model on Hooke's Law Material to Increase Creativity of Students.	0,76	1,39
Widya, dkk. 2019	The Influence of Project Based Learning Model Assisted by Student Worksheets on the Creativity of Elementary School Students	0,5	-
Wandari et al, 2018	Student Worksheet Development on Culture-Based Geometry Material Jambi to Increase Student Creativity.	0,7	-
Lestari. 2018	Improving the Students' Creative Thinking using Problem Based Worksheet on the Topic of Environmetal Pollution.	0,73	0,92

Table 7 shows that problem-based Electronic worksheet has relatively the same n-gain score as other studies. the n-gain range was close together because of the small average pretest value, it can be caused by the low level of initial knowledge from students, and the average posttest value obtained was high. Similarities between pretest and posttest questions, as well as questions taken from books and exams that have been conducted, can affect N-gain scores. In Table 7, it also showed that the use of problem-based Electronic worksheet was carried out up to the effect size test stage, it was to find out the small influence of problem-based Electronic worksheet on the increase in student creativity. The results of the effect size test showed that Electronic worksheet has an effective effect on increasing student creativity, and greater than other relevant research, this was because the use of problem-based Electronic worksheet with PBL learning models was more effective to increase the creativity of students, compared to other media and models in relevant research.

CONCLUSION

Based on the results of the study, it can be obtained that there is an influence from the use of problem-based Electronic worksheet with PBL learning models on Hooke's law material to increase student creativity, the effect is large. The indicator that has the most influence on increasing student creativity in this study is the indicator of originality which has the least effect on increasing student creativity. The resut showed that the experimental class obtained an N-gain value of 0.76 in the hight category, and the control class obtained N-gain value of 0.61 in medium category, there was a significant difference in the experimental class's N-gain value with N-gain at control class. The effect size obtained is 1.39. it was developed that the problem-based Electronic Worksheet with the PBL learning model was effectively used to increase the creativity of students.

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