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The Effectiveness of Problem-Based Electronic Worksheet to Increase Student Creativity in Hooke's Law

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Abstract: This study aims to determine the effectiveness of problem-based electronic worksheets to increase students' creativity in Hooke's law at SMAN 2 Bandarlampung. The population is all students of class XI MIPA, and the sample is 20 student of XI MIPA 4, with group pretest-posttest research design. The data analysis techniques used are normality test, paired sample t-test, N-Gain test, and effect size test. The difference between the average pretest and posttest is 7.4. The N-Gain score obtained is 0.2 with low criteria. The results of the effect size test obtained a score of 0.8 with the criteria of having a large effect. Based on the results of the study, it can be concluded that problem-based electronic worksheets can increase student's creativity.

Keywords: problem-based electronic worksheets, hooke's law, student's creativity

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INTRODUCTION

The 2013 curriculum requires students to be active, the teacher is no longer the center of learning but only as a facilitator in learning (Suryadi & Rahmawari, 2019). Students who become the center of learning are expected to have various competencies, one of which is creativity. Creativity requires a balance between synthetic, analytical, and practical (Alvira, Hidayah, & Chusniah, 2016) which has a positive and significant influence on student achievement.

There are 4 indicators of creativity that can be used to measured student creativity, Fluency, Flexibility, Originality, and Elaboration (Treffinger, Young, Selby, & Shepardson, 2002). Creativity in learning physics is needed in observing, taking tools and materials, assembling tools and materials, analyzing data, and solving physics problems. Creativity is also considered capable of influencing learning outcomes (Hapsari, Sunarno, & Sukarmin, 2020). In this study, all indicators of student creativity will be examined by giving pretest and posttest by referring to all the indicators.

Creativity can be increased through problems. If the class is taught by posing problems, it will improve students' ability to think creatively as well as their understanding of the problem or task given (Akmalia, Pijastuti, & Setiani, 2016). Problem-Based Learning is the learning models with problem-solving syintax that can be used to increase creativity. Students experience an increase in the ability to think creatively after being given learning with a PBL (Wibowo, Suyanto, & Nyeneng, 2021). This is because students' creative thinking skills using the PBL learning model are better than using conventional models, so they are suitable for increasing students' creativity (Abdurrozak, Jayadinata, & Isrok'atun, 2016). Learning with the PBL makes students actively seek knowledge and information, as well as integrate it and involve it in the learning process (Syahidi & Fartina, 2020). The syntaxs of PBL are described by Arends (Arends & Kilcher, 2010) which are presented in Figure 1.

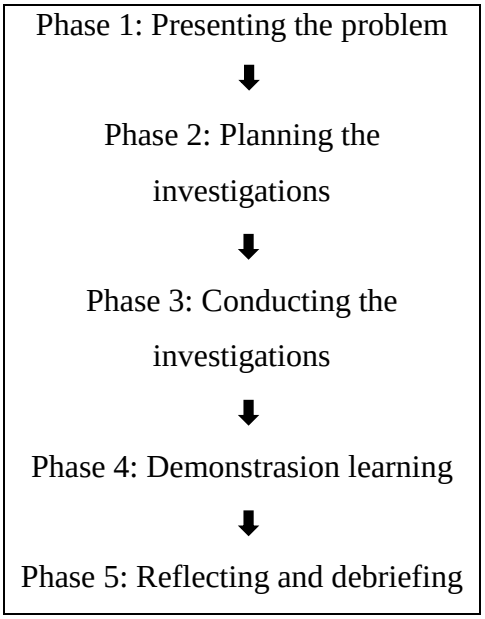

Figure 1. The Syntax of PBL

The application of PBL in learning, especially physics learning, can be applied in the practicum method. The implementation of the practicum requires a guide. In the Student worksheet there are practical instructions, experiments that can be done at home (Elwi, Festiyed, & Djusmaini, 2017), materials for discussion (Agustina, 2019), portfolio assignments, and practice questions, as well as all forms of instructions that can invite students to be active in the learning process (Widodo, 2017). The student worksheet can make students to active, help develop concepts and process skills (Umbarwati, 2016), and make it easier for teachers to monitor students' success in achieving learning goals (Lestari, Alberida, & Rahmi, 2018). Based on the 2013 Curriculum, one of the physics that needs to be experimented is Hooke's law. This is because students still have difficulty in connecting the concepts of Hooke's law when it is connected to everyday life which occurs because so far students have studied physics which is less associated with life (Hidayatulloh, 2020).

The Minister of Education and Culture of the Republic of Indonesia, Nadiem Anwar Makarim, direct the learning process to be carried out at home (Kemendikbud, 2020) because COVID-19 outbreak. The solution of that problem is information and communication technology that can used to held the process anywhere and anytime (Cholik, 2017). Thus, the guide to the implementation of physics experiment on Hooke's law in the form of electronic worksheet can be used as a solution to guide students to experiment at home with tools and materials that are around in order to continue to increase student creativity even though they are not at school. The electronic worksheets used is a problem-based electronic worksheets where each component is formed based on the syntax of Problem-Based Learning. The application of problem-based electronic worksheet is highly recommended in physics learning since it can improve the student's learning outcomes as well as their scientific attitudes (Serevina, Sunaryo , & Raihanati , 2018). This is because the PBL learning model can help students increase creativity (Astuti, 2016).

Problem-based electronic worksheets have been developed in temperature and heat (Serevina, Sunaryo , & Raihanati , 2018). Based on the literature review, it is known that there is no problem-based electronic worksheets in Hooke's law material, so research is needed to measure the effectiveness of problem-based electronic worksheets, which is used to increase student creativity in Hooke's law.

METHOD

Research Design & Procedures

In this study, the researcher was used One group pretest-posttest research design to research the sample. The research was carried out at SMAN 2 Bandarlampung on August 23, 2021. There was only the experimental group. The experimental group was given a pretest and posttest.

Population and Sample

The sampling technique uses purposive sampling. The sample in this study was class X MIPA 4. The choice of class as a sample also has reasons to make it easier for

researchers to provide treatment because the class is studying the same chapter as the chapter that will be given by the researcher.

Data Collection and Instrument

The instruments used include problem-based electronic worksheets, pretest and posttest questions, and assessment questionnaires. All instruments used have gone through the validation stage so that they can be used in research. The problem-based electronic worksheets used has 3.6 validity score with very valid criteria.

Data Analysis

The pretest-posttest's result were analyzed using the Paired Sample T, then N-Gain, and last, Effect Size test. The conversion of the N-gain score is presented in table 1 and the effect size is in table 2.

Table 1. N-Gain Test Score Conversion

g -score	Criteria
(<g>) ≥ 0,7	High
0,7 > (<g>) ≥ 0,3	Medium
(<g>) < 0,3	Low

Table 2. Effect Size Score Conversion

Effect Size		
Small	**Medium**	**Large**
0,20	0,50	0,80

(Cohen, 1992)

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RESULT AND DISCUSSION

The application of electronic worksheets in learning is carried out after students work on pretest questions so that it can be seen the influence of electronic worksheets with students working on posttest questions. In the data obtained in the form of the average results of the pretest and the average posttest, the normal distribution test was carried out. The normal distribution test was conducted to determine the choice of further statistical analysis, so that it became a prerequisite for statistical analysis, and the results are presented in Table 3.

Table 3. The Results of Normal Distribution Test

Parameter	Pretest	Posttest
Asymp. Sig. (2-tailed)	0,228	0,208

Table 3 shows that Asymp. Sig (2-tailed) or the significance value in the pretest is 0.228 and the posttest is 0.208, both of which are more than 0.05, so the average

results obtained both pretest and posttest are normally distributed. The next test is the paired sample T test.

Paired sample T test measured the distinction between pretest and posttest which are paired data because they are owned by the same person, and the results are presented in Table 4.

Table 4. The Results of Paired Sample T test

Posttest Results-Pretest Results	
Mean	7,4
Standard Deviation	9,47240
Sig (2-tailed)	0,002

Table 4 shows that the significance value of the pretest-posttest results is 0.002, which is less than 0.05, so it can be concluded that after the implementation of learning using electronic worksheet, there was an increase in the posttest average value than the pretest average value.

The increase in the average posttest value compared to the average pretest value was statistically using the N-Gain test. The N-Gain test is a test to compare the increase in the average posttest score with the pretest average value. The results of the N-Gain test are presented in the following equation. Based on Table 1, the scores obtained meet the low criteria. This shows that the increase in the average posttest score due to the use of electronic worksheet in learning is low.

$$< g > = \frac{(S_f - S_i)}{(100 - S_i)}$$

$$< g > = \frac{(69{,}0 - 61{,}6)}{(100 - 61{,}6)}$$

$$< g > = 0{,}2$$

The next test is the effect size test to measure the effectiveness of problem-based electronic worksheets, which is used to increase student creativity in Hooke's law. It is tested using the following equation.

$$d = \frac{m_A - m_B}{\sigma}$$

$$d = \frac{7{,}4}{9{,}5}$$

$$d = 0{,}8$$

The effect size obtained a score of "d" which based on Table 2 shows that there is a large influence of problem-based electronic worksheets to increasing student

creativity. The results of the N-Gain test and effect size test are compared with other studies which are presented in Table 5.

Table 5. Comparison with Other Research

No	Research	N-Gain	Effect Size
1.	Problem-Based Learning Module of Environmental Changes to Enhance Students' Creative Thinking Skill (Anjarwati, Sajidan, & Prayitno, 2018)	0,44	-
2.	Development of Student Worksheet Based on Problem Based Learning Approach to Increase 7th Grade Student's Creative Thingking Skills (Febriani, Sudomo, & Setianingsih, 2017)	0,72	-
3.	Improving the Students' Creative Thinking using Problem Based Worksheet on the Topic of Environmetal Pollution (Lestari, Fadiawati, & Jalmo, 2018)	0,73	0,92
4.	Problem-Based Electronic Worksheet to Increase Student Creativity in Hooke's Law	0,2	0,8

Table 5 shows that the electronic worksheet has a lower N-Gain score then the other studies. The low N-Gain is due to the small increase in the range from the average pretest value to the average posttest value. This could be due to the high level of initial knowledge of the sample, so the average pretest score obtained was high. The similarity between pretest and posttest questions, as well as questions taken from books and exams that have been carried out, can affect the N-Gain value. The low N-Gain can also be caused by the difficulty of following the lesson, because the sample is only given a little time to understand the lesson. Table 5 also shows that the development of the electronic worksheet was carried out up to the effect size test stage. This is to determine the size of the influence of the electronic worksheet to increasing student creativity. The result of the effect size test shows that the electronic worksheet has a big effect to increasing student creativity. The increase in student creativity is shown by comparing students answers to one of the pretest-posttest questions. Students are asked to mention the use of elastic objects in everyday life. At the time of the pretest, students were only able to name two types of objects including a slingshot, and a spring mattress. During the posttest, students were able to name up to five types of objects including slingshots, spring mattresses, dynamometers, scales, and resistance bands.

The increase can occur because the electronic worksheet has been specially designed at each stage with the components of creativity indicators, so that the problem-based electronic worksheet is effective for increasing student creativity.

CONCLUSION

Problem-based electronic worksheets on Hooke's Law that have been developed based on the creativity indicator reference, are able to effectively increase student's creativity with an Effect Size test score of 0.8 with a large influential category.

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