Effect of E-Worksheet With Problem-Based Learning Model On Student's Achievement

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ABSTRACT

One of problems experienced in learning physics is low ability of students to solve problems given by teacher in learning through teaching materials provided from teacher. The presence of Curriculum 2013, followed by Curriculum Merdeka, has accommodated problem-solving exercises in physics learning, one of which is through problem-based learning model. So that the achievement of student competence is still low. Teaching materials have also developed electronically. This study aims to determine whether there is a significant effect on use of e-worksheets with PBL model. This is quasi-experimental research, with posttest only control group design. Find out whether there is a significant difference in use of e-worksheets with PBL model on student competency achievement, it is carried by means of average difference test technique with t test. To find out whether there is a significant effect of using e-worksheet with PBL model, a correlation analysis was between PBL model e-worksheet scores and the post-test scores in experimental class using a determination test. Results of study stated that posttest score in experimental class was 82.29 higher than posttest average score in the control class 79.76. The results of t-test showed a large t-value of 3,18 so that it could be concluded that differences of sample class got a significant difference. Results of correlation analysis between scores for using the e-worksheet with problem-based learning model is 0.80, index value determination is 0,65. So, the research concluded that 65,02% of students effect for use e-worksheets with problem-based learning model had a significant influence.

Keywords: *electronic worksheet, problem-based learning model, student competeces*

I. INTRODUCTION

The development of learning is currently more inclined to demand that learning be carried out based on student activity or student center. Gradually leaving learning in the teacher's presentation or teacher center. For the implementation of learning that demands student activity, teaching materials are used as one of the main things in the learning process. Teaching materials are a source of materials and tools that can support the learning process[1]. In the teaching materials there are competency knowledge, skills, and attitudes with the aim of achieving learning objectives. Without teaching materials, teachers tend to teach using the direct instruction model so that later it will lead to teacher centered. Therefore, in the learning process, the existence of teaching materials is very much needed to achieve the expected competencies.

Various types of teaching materials that are currently developing include handouts, textbooks, teaching modules, student worksheets, brochures, and photos or pictures where these teaching materials can be printed or electronic[2]. The use of teaching materials in the learning process will be able to provide a reference for solving problems that must be solved by students so that students are able to work on these teaching materials directly and independently. The use of teaching materials for solving this problem is in accordance with what is required in the 2013 Curriculum, which is a learning approach based on observation, questions, data collection, reasoning, presentation of results through the use of learning resources[3]. So that the application of learning in the classroom should be in accordance with what is demanded by the curriculum.

One of the teaching materials that pays great attention is teaching materials in the form of student worksheets. Worksheet is one of the learning resources or learning media that can be developed by educators as facilitators [4] which are arranged, designed, and developed according to the conditions and situations of learning activities that will be faced[5]. Worksheet are sheets that contain student guides that are used to carry

out investigation and problem solving activities that require students to be more active and take meaning from the learning process in competency development[6][7][8]. Therefore, the use of worksheet in the learning process can create the expected implementation process.

A good e-worksheet is an e-worksheet that provides and can train students to improve their thinking skills. One such e-worksheet is a problem-based e-worksheet[9]. Where through the e-worksheet students will be given orientation to problems and will be guided until students can solve the problems given. With the use of the e-worksheet, data can be obtained with the hope that later the results from the e-worksheet can reflect the increased student learning outcomes. The following shows the differences in the function of worksheet compared to e-worksheet in Table 1.

Table 1. Differences in function of worksheet compared to electronic worksheet

No	worksheet	e-worksheet
1	Increase student activity in learning	Increase student activity in learning
2	Help develop learning concepts Help develop learning concepts	Help develop learning concepts Help develop learning concepts
3	As a guide for teachers in the learning process	As a guide for teachers in the learning process
4	-	Can load animations and videos that can attract student learning interest
5	-	Can save for paper usage
6	Can train students' communication skills both in writing and orally	Can train students' communication skills both in writing and orally
7	-	Increase teacher creativity in the use of technology

Based on Table 1 it can be seen that there are several superior functions obtained from using e-worksheet compared to using worksheet. This is in accordance with previous studies [3][10][11] and stated that using e-worksheet has a positive influence such as an increase in various aspects of competence possessed by students, especially in the aspect of competency skills.

Looking at the focus of the problem, the use of electronic-based teaching materials is expected to make students skilled in using technology[12]. The teaching materials needed to be able to create a more effective learning process are worksheet[13]. The worksheet will contain process standards and graduate standards[14]. To realize the desired graduate standards can be realized by applying a learning model, so as to increase student competence.

So that teachers can prepare good teaching materials, many efforts have been made by the government with the aim that student-centered learning is fulfilled [15] and learning that is centered on teacher lectures will decrease. Various government efforts to increase curriculum have taken action to improve the curriculum, train teachers, workshops, improve facilities and infrastructure, optimize technology characterized by the use of electronics in learning, and conduct research and development. With the hope that the use of e-worksheet will be increasingly functioning, teaching materials that are more conducive to their implementation and the achievement of student competencies will increase[16].

The reality faced so far is that the quality of physics learning is still not as expected. We can see this from the achievement of knowledge competencies of students who have not met the Minimum Completeness Criteria set by the school as in the Final Semester Assessment on knowledge competencies at senior high school. Based on observations and data analysis that has been carried out at senior high shool, there are several factors that cause students' achievement of competence to be not good. These factors include the achievement of student competence in the realm of student knowledge which is still low[17].

Based on observations, the worksheet used in senior high school has shown good construction of worksheet writing, but the worksheet used is not problem based and the answers from the worksheet answered by students tend to be obtained from book answers[18]. Based on observations of the worksheet used by senior high school teachers that there are titles, subjects, semesters, places, study instructions that are still minimal and less interactive with students, there are competencies to be achieved as well as learning indicators, incomplete supporting information, assignments assignments are still centered on solving physics problems, teaching steps are not clearly visible and still need explanation from the teacher [19]. Based on the various problems above, we can see that the level of student activity in learning physics in class is still lacking which will later cause students' thinking skills to not increase because the learning process of students has not been led to think

actively, due to the incomplete content of learning materials provided by the teacher[20]. It could be that the material is easily presented at a high level and the level of validity of the material presented is not high.

These problems can be overcome by implementing worksheet which can support student activity, where by using worksheet it is expected that the level of student competence can increase. So, on the basis of the explanation above, the research is interested in conducting research with the title "Effect of E-Worksheet With Problem-Based Learning Model on Student's Achievement".

II. METHOD

Seeing the problems and objective above, the type of research conducted is quasi-experimental design research. Quasi experimental research have functions to find out whether or not there is an effect of a treatment given to research subjects or samples. Experimental research methods can be interpreted as research methods that function to seek the effect of certain treatments on others under controlled conditions[21].

This study used a post-test only control group design. For two sample classes were needed, namely the experimental class which was given treatment using problem-based electronic worksheet with a problem-based learning model and the control class by applying printed worksheets in schools. At the end of this research, will be given to both classes to see the achievement of students' knowledge competence. According to a book by Sugiono, this type of research is post-test only control group design, which can be illustrated in Table 1.

Table 1. Illustration Construction of Post-test Only Control Group Design

Class	Treatment	Post-test
Experiment	X	T
Control	-	T

(Source: Ref [10])

Based on Table 1 for "X" has the effect of being treated in the experimental class with the application of problem-based electronic worksheet with a problem-based learning model. "T" is the final test given to both sample classes. The population in this study were all students in class X science of senior high school at Padang in the 2022/2023 academic year. To get sampling of this research is sampling cluster technique. This technique is carried out by collecting initial data in the form of semester 1 final test of semester scores in the knowledge competency of the 2022/2023 school year class X science of senior high school at Padang, looking for a partner using the opportunity technique for all classes, are normality test, homogeneity test, and the two-mean similarity test. mean by t test. Furthermore, to determine the experimental and control classes, a coin was tossed.

Table 2. Research Variables

Variable Research	Research Data
Independent variable	Problem based electronic worksheet
Dependent variable	Student knowledge and skills competence
Control variable	Teacher, learning models, learning materials, time allocation, and number and types question test.

The used data are data needed to test the hypotheses that have been set. In this study there are two kinds of data, namely primary data and secondary data. The primary data in this study is knowledge competency obtained from the learning outcomes data through the posttest in the form of written multiple choice questions. The secondary data in this study are student learning outcomes in the Semester Final Assessment. 2022/2023 of grade X science senior high school at Padang. The questions tested have been refined through trials.

Data analysis was performed to test the research hypotheses that have been proposed. Data analysis was performed for both class sample. For competency skills, the analysis is carried out in form of data descriptions and graphs. For knowledge competency data were analyzed by hypothesis test and regression correlation analysis. Furthermore, to find out whether the two classes have normally distributed data, a normality test is carried out, then whether the variance of the two homogeneous sample classes is carried out by a homogeneity test, and the similarity test of the two averages is used to find out whether there are differences in results of achieving the physics competence of the two class sample. after it was known that there were significant differences from the two sample classes, a simple regression and correlation analysis was then carried out to find how much influence the problem-based electronic worksheet with problem-based learning model used in the experimental class. For competency skills, a hypothesis test was carried out, after it was known that the two sample classes had normally distributed data and the variance was also said to be homogeneous data.

The hypothesis test was carried out using the *t* test because the data for the two samples came from populations that were normally distributed and had a homogeneous variance. Data analysis techniques in this

study were carried out for both sample classes. In the knowledge and skill competencies analysis is carried out in the form of data descriptions and graphs. For the initial step, a trial was carried out for the final test results and the two sample classes on knowledge and skill competencies, namely the normality test, homogeneity, and the two average similarity test. After that, a regression and correlation test was carried out in the sample class with the data used being the final test data which was compared with the problem-based electronic worksheet use value data with the problem-based learning model for knowledge competencies, while for skills competencies the data compared was performance value. student work with student scores in using problem-based electronic worksheet with a problem-based learning model in skill competencies.

The hypothesis test was carried out using the t test, because the data is normally distributed and the variance of the two sample classes is homogeneous with using *t* test.

Linear regression test was carried out to determine the relationship between the independent variable (X) and the dependent variable (Y) in the research data, with the equation Y_{ab}.

The correlation test was carried out to find out how much influence was exerted by (X), namely the problem-based electronic worksheet with the problem-based learning model on (Y), namely the achievement of students' physics competence. After conducting a correlation test and obtaining the price of the correlation coefficient, we can look for the value of the coefficient of determination which shows how much the problem-based electronic worksheet with the problem-based learning model influences the achievement of students' physics competence.

III. RESULTS AND DISCUSSION

A. Results

The research was conducted on April 10, 2023 and ended on June 10, 2023 at senior high school at Padang. The data obtained in this study are in the form of values including knowledge competence and student skill competence. Data were obtained in every meeting in the experimental class and control class. The research data discussed starts from obtaining sample classes to the end of the study and conducting data analysis. Knowledge competence is obtained through written tests at the end of learning with objective questions. Data on competency skills is obtained when carrying out learning activities which are presented through student performance sheets.

From the data collected regarding the final test scores in the domain of knowledge competence for the experimental class with a score range between 64 to 100, the average price was 82.29; standard deviation of 10.86; the mode is 80, and the median is 80. For the control class with scores ranging from 60 to 100, the average price is 79.77; standard deviation of 10.60; the mode is 84, and the median is 82.
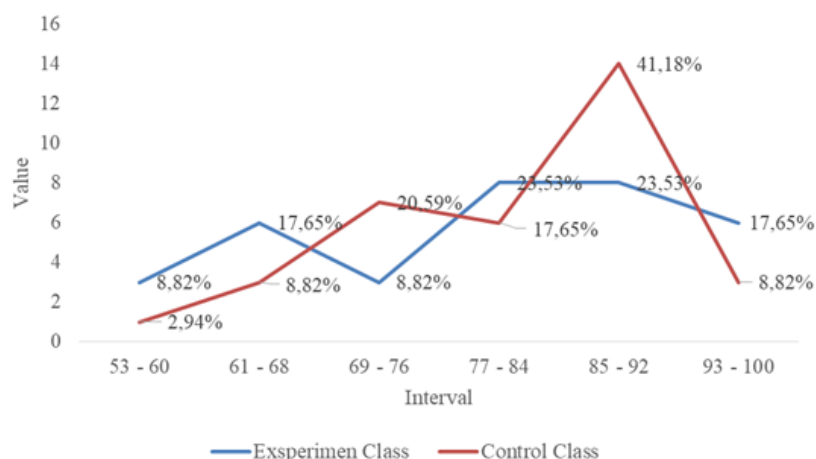

Fig 1. Final Result Of Data Competence Knowledge

Figure 1 shows that the range of values for the experimental class is higher than that of the control class. This can be seen from the range of values of each sample class. It can be concluded that the experimental class is superior to the control class obtained by students using electronic worksheet with a problem-based learning model compared to the control class using worksheets commonly used at senior high school Padang.

From the data collected regarding the final test scores in the skill competency domain of the experimental class with a score range between 72 to 92, the average price was 84.12; standard deviation of 81.85; the mode is 86, and the median is 85. For the control class with scores ranging from 64 to 92, the average price is 81.85; standard deviation of 7.71; the mode is 84, and the median is 84, and the frequency distribution of the two classes is presented in Figure 2.
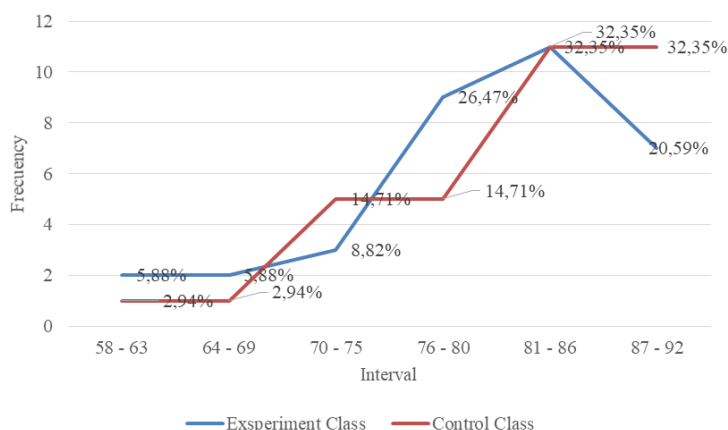
Fig 2. **Final Result of data Skill knowledge**

Figure 2 shows that the range of values for the experimental class is higher than the control class. This can be seen from the range of values of each sample class. It can be concluded that the experimental class is superior to the control class obtained by students using a electronic worksheet with a problem-based learning model compared to the control class using worksheets commonly used at senior high school Padang on competency skills. For more details regarding the average final test results obtained by students in the two sample classes are presented in the graph of Table 2.

Achievement of students' knowledge competence can be seen in Table 2.

Table 2. Analysis Knowledge Competence of Student

No	Statistic Parameter	Class	
		Experiment	**Control**
1	N	34	34
2	X	82,29	79,76
3	S	10,86	10,60
4	S^2	117,85	112,43
5	α	0,05	
6	L_0	0,098	0,116
7	L_t	0151	0,151
8	F_h	1,048	
9	F_t	1,78	
10	t_h	3,18	
11	t_t	2,04	

Table 2 shows that the average value of achieving knowledge competence in the experimental class is higher than that of the control class. The significant level used is 0.05. The normality test shows the result that the value of $L_o < L_t$, the homogeneity test shows the result that $F_h < F_t$, then a test for the similarity of the two averages is carried out with the t test statistic. Based on the t test, it is obtained that Hi is accepted and the area of acceptance of Hi is presented in Figure 3.
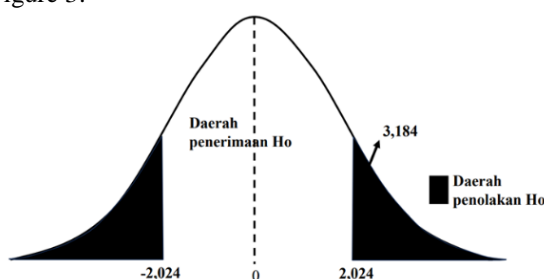

Fig 3. The curve of acceptance and rejection of the null hypothesis on knowledge competence Based on the data collected

Figure 1 shows that the Hi acceptance area is in the shaded area. Based on the similarity test of the two averages, $t_h = 3.184$ was obtained which was in the area of H_o rejection. This means that the working hypothesis on knowledge competence is accepted, that is, there is a significant influence on the use of problem-based electronic worksheet with the problem-based learning model in physics learning in Class X senior high school at

Padang on knowledge competence. The achievement of problem-based knowledge competency and practice value of the electronic worksheet with problem-based learning model in below line.
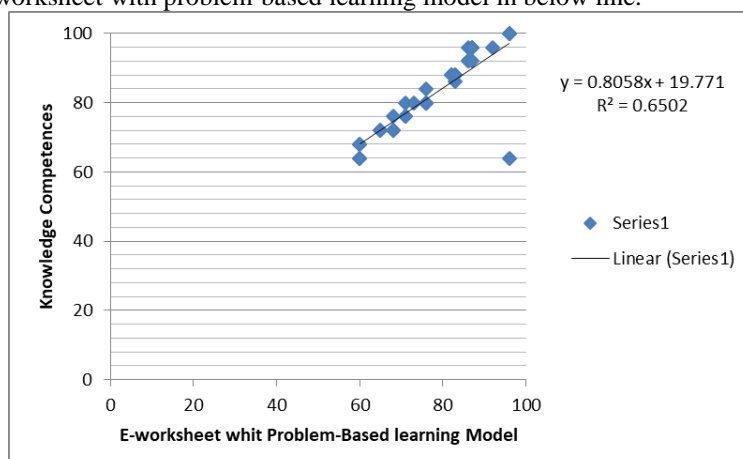

Figure 2. Simple Linear Regression Equation Model of the relationship between the final assessment of the problem-based electronic worksheet experimental class and the problem-based learning model

Based on Figure 2, the transmission diagram shows the relationship between the problem-based electronic worksheet and the problem-based learning model with achieving students' knowledge competencies with the linear regression equation presented in equation 3.

$$\bar{\bar{Y}} = 19{,}771 + 0{,}805\,X \qquad (3)$$

The coefficient of determination (r^2) of 0.650 means that the effect of applying the e-worksheet with the problem-based learning model on increasing students' physics competence in the knowledge competency is 65.02% and 34.98% is influenced by other factors. Achievement of the skills competence of the two sample classes is presented in Table 3.

Table 3. Analysis of skills competence achievement of the two sample classes

No	Statistic Parameter	Class	
		Experiment	Control
1	N	34	34
2	X	84,12	81,85
3	S	5,43	7,72
4	S^2	29,50	59,58
5	α	0,05	
6	L_0	0,07	0,14
7	L_t	0,15	0,51
8	F_h	0,49	
9	F_t	0,55	
10	t_h	3,64	
11	t_t	2,04	

Table 3 shows that the average score for achieving skill competence in the experimental class is higher than the control class. The significant level used is 0.05. In the normality test the result is that the value of $L_o < L_t$, the homogeneity test shows the result that $F_h < F_t$, then a test for the similarity of the two averages is carried out with the *t* test statistic. Based on the *t* test, it is obtained that Hi is accepted and the area of acceptance of H_i is presented in Figure 4.
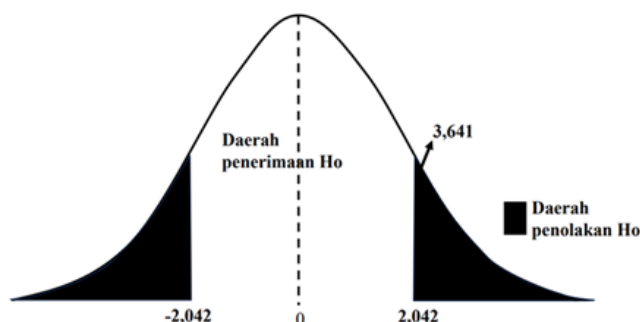
Fig 4. Acceptance and Rejection of the Null Hypothesis Curve on Skills Competency

Based on the data collected, Figure 4 shows that the Hi acceptance area is in the shaded area. Based on the similarity test of the two averages, $t_h = 3.641$ is obtained which is in the area of H_o rejection. This means that the working hypothesis on knowledge competence is accepted, that is, there is a significant influence on the use of electronic worksheet with the problem-based learning model in physics learning in Class X senior high school at Padang on skill competence. Achievement of knowledge competence and electronic worksheet practice values with student problem-based learning models is seen in bellow.
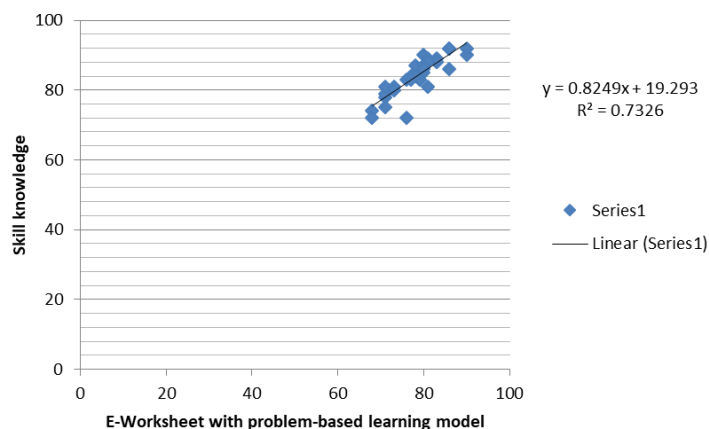
Figure 5. Simple Linear Regression Equation Model between Problem-based electronic worksheet and problem-based learning models with Skills Competency

Based on Figure 5, the transmission diagram shows the relationship between the problem-based electronic worksheet and the problem-based learning model with achieving students' skill competencies with the linear regression equation presented in equation 4.

$$\overline{\overline{Y}} = 19293 \ + \ 0{,}824\,X \qquad (4)$$

The coefficient of determination (r^2) of 0.733 means that the effect of applying the electronic worksheet with the problem-based learning model on increasing students' physics competence in the knowledge competency is 73.26% and 26.74% is influenced by other factors.

B. Discussion

The results of data analysis that has been carried out on knowledge and skills competencies show that there is a significant effect by using problem-based electronic worksheet with a problem-based learning model on the achievement of knowledge and skills competencies of class X science senior high school at Padang before and after the research.

Based on the analysis of student competency data, the working hypothesis which reads: "there is a significant positive influence on the implementation of problem-based electronic worksheet with the problem-based learning model on the competency achievement of class X science senior high school at Padang" is accepted. This happens because the use of electronic worksheet will make learning more focused on solving problems gradually so that later you will find physics concepts in it. In addition, students will understand physics material better because by solving problems students will remember learning more and understand concepts and not memorize. This causes the competence of students in the experimental class to be higher than the control class.

Based on the results of research on knowledge competence, the average value of the experimental class was 82.29 and the average value of the control class was 79.76. Based on the results of the research on knowledge competence, it can be seen that the average value of classes using problem-based electronic worksheet using the problem-based learning model is higher than the class using the existing worksheet at school. These results are in accordance with what was stated by [22] that by using worksheet it will be able to develop the competencies that exist within students by paying more attention to the stages used in learning.

Through activities using the electronic worksheet it can be maximally fulfilled by using the problem-based learning model. The use of this learning model as well as the electronic worksheet and the results achieved until finally students have an increase in solving problems so that it creates a feeling of satisfaction for students so that students are motivated to be able to show the best results.

After testing the significance and relationship of the two variables, it was found that the use of problem-based electronic worksheet implementation with the problem-based learning model had a significant positive effect on students' knowledge competence and there was a relationship between the two. However, there are still

some students who have not participated in learning using the problem-based electronic worksheet with a problem-based learning model. It is known that based on the two-variable relationship test, it was found that 65.02% of students' knowledge competence was influenced by the treatment that the researchers gave and another 34.98% was influenced by other factors. This indicates that the use of problem-based electronic worksheet is not the only factor that influences students' knowledge competence. Other factors such as teacher creativity and learning resources in learning activities also have an important role for students' active involvement. Students who are active in learning will have more competency improvements for good learning and the impact will be that students will gain good knowledge as well.

Based on the results of research on skills competence, the average value of the experimental class was 84.12 and the average value of the control class was 81.85. Based on the results of research on skill competencies, it can be seen that the average value of classes that use problem-based electronic worksheet with problem-based learning models is higher than classes that use worksheet in schools. These results are in accordance with what was stated by [23] that worksheet is very important in carrying out the learning process to achieve the expected competencies so that by carrying out the learning process students' skills will be formed and create students who are independent with the skills they have.

In skill competence, after testing the significance and relationship of the two variables, it was found that 73.26% of students' skill competence was influenced by the use of electronic worksheet with problem-based learning model and there was a relationship between the two. Even though it has a significant positive influence, the use of problem-based electronic worksheet with the problem-based learning model is not the only factor that influences the achievement of student skill competencies. One of the other factors that influence the value of students' skills competency achievement is group cohesiveness in working together.

In the simple harmonic vibration practicum on springs, for example, students are divided into their respective groups and asked to prepare springs and hang masses. Before starting the practicum, students pay attention to demonstrations carried out by researchers, then students are asked to try it out in their respective groups. In some groups, there were some students who did not take part in measuring the vibration of the spring. In another group the researcher also found that some students did the practicum not in accordance with the order of the practicum steps while their other group mates knew about it. However, in general students are able to find knowledge through their own investigations. As stated by [24] that learning is essentially a process of interaction between students and their environment, resulting in changes in behavior in a better direction.

Based on the analysis of data from the two competencies, namely knowledge competencies and skills competencies, it shows that the use of problem-based electronic worksheet with the problem-based learning model influences student competency achievement. In carrying out this research, researchers experienced several obstacles and problems such as limited observers during the learning process, there were still a number of students who were late for class because the study sample class was cut off by the afternoon break, and there were still one or two student members of the group who disturbed other groups, especially after the break.

IV. CONCLUSION

After conducting research and then analyzing the data and discussing the problems in this study, it was concluded that the use of problem-based electronic worksheet with the problem-based learning model had a significant positive effect on the achievement of physics competence in class X science of senior high school at Padang. This affects the two competencies that are considered, namely the competence of knowledge and skills of students with a significant level of 0.05.

The physics competence of students in learning using electronic worksheet with the problem-based learning model in knowledge and skill competencies respectively 82,29 and 84,12; higher than the physics competence of students who do not use electronic worksheet with problem-based learning models, namely 79.76 and 81.86.

There is a significant influence on the application of the problem-based electronic worksheet with the problem-based learning model on the physics competence of class X science of senior high school at Padang, which is acceptable at a significant level of 0.05. This was obtained from the existence of significant differences in the average competency of students between the experimental class and the control class in knowledge and skill competencies. The magnitude of the influence given by the problem-based electronic worksheet with the problem-based learning model on the achievement of students' knowledge competence and physics skills is 65.02% and 73.26%, respectively.

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