

The Effect of Project Based Learning with Photonovela to Ability Student in Solve Problem Warming Global

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Abstract. This study is a quantitative study that aims to see whether there is an effect on the problem solving abilities of students who are taught by a project-based learning model with photonovelas media on global warming materials. this study used in this study was a multiple choice test to measure students' problem solving abilities. The population taken in this study was seventh grade students of SMP Negeri Bongomeme. The sample used was 50 students, namely, 26 students in the experimental class and 24 students in the control class. The analysis used in this study uses Rasch modeling SPSS 16.0 applications, namely hypothesis testing with the Wilcoxon test. Introduction

1 Introduction

According to Greenstein (2012), the thinking skills needed in Century 21 include critical thinking, problem-solving, creativity, and metacognitive. The solution to the problem is the Wrong ability Which important in learning science. Problems science is the idea of Which role builds capacity and splits problem students Greenstein (2012); it makes lessons science more pleasant and can motivate students for more achievement. The ability to solve problems is not only used in settlement problems and science in the form of mathematics but How to solve problems to the phenomenon- phenomena That happen in the environment around us. Problems the solved by students with the use of concepts of science That they understand. Students Who own the ability to solve problems will be capable of applying the knowledge they have in the context problem They face [1].

However, in reality, the problem-solving abilities of students in science are still low[2]. The low proficiency of students in everyday science problem-solving can be attributed to the teaching practices employed by teachers in schools. Most teachers have not implemented a learning approach that allows students to develop their problem-solving abilities to their maximum potential in everyday science[3]. Teachers often begin the learning process by providing explanations and presenting predetermined questions, followed by practice questions taken from student textbooks, which are far removed from the real-world problems that students encounter.

Based on observations conducted at SMP Negeri 1 Bongomeme and interviews with science teachers, it was found that project-based learning as a learning model is not yet optimal, and students' problem-solving abilities are still classified as very low. The low proficiency in problem-solving skills is not only limited to Indonesia but is also widespread. The inadequate development of problem-solving abilities can be attributed to the prevailing teacher-

centered learning approach, which necessitates further enhancement. To address this, an effective and appropriate learning model is required to foster independent learning while considering cognitive, affective, and psychomotor aspects. One such model is Project-based Learning (PjBL), which involves students engaging in projects to address real-world problems or issues. These problems are complex and require the integration of various subject matters or learning materials to find viable solutions. Through PjBL, students are trained to analyze problems, conduct explorations, gather information, interpret findings, and evaluate their work while working on projects directly related to the studied problems.

Project-based learning, also known as Project Based Learning (PBL), is a learning approach where students are assigned projects relevant to real-world problems. This learning method involves a relatively extended period and engages students in designing, creating, and presenting a product that addresses the identified problem in the real world [4].

In science learning, following the K13 curriculum, the instructional process applies a scientific approach. The selection of approaches such as thematic, integrated thematic, scientific inquiry, attitudes (discovery), and problem-solving-based learning (Project-Based Learning) is tailored to the specific competencies and educational levels. The implementation of the Santif approach in science learning aims to make it easier for students to comprehend scientific concepts by connecting the subject matter directly with their environment. The science curriculum integrates content from biology, physics, and chemistry[5].

The science learning process in this research using the Project Based Learning model Learning (PjBL) learning based project help Photonovela. Learning-based projects follow steps: preparation/planning, implementation, making reports, communicating results activity, and evaluation. Based on the statement, the learning Project-based Learning (PjBL) process uses several stages[6,7]. Stages in model

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Project-based Learning (PjBL) help Photonovela can make it easy for students to analyze something problem.

Using model Project-Based Learning (PjBL) can enable students Because, from the beginning until the end of learning, the student will discuss and create a project as a fotonovela[8]. Making projects help media fotonovela used as media can help the learning process become more accessible and familiar to students. Differences in fotonovela media with other media in the form of photographs said and a story[9,10]. Media from fotonovela can make it easy for students to remember and analyze something learning compared to text.

According to Rahayu et al. (2013), fotonovela is a medium that resembles comics or stories pictorial, using photographs as replacement picture illustrations. On study This, students will create a fotonovela project on the theme warmup Global. Furthermore, students will analyze because of the consequences of existing incidents. This learning process can make passive students active because from the beginning until the end, all students will solve problems and produce a product[11].

Students are encouraged to be more creative in participating in learning activities, the teacher is only a facilitator and evaluates the results of student performance including outcomes that can be displayed from the results of the projects students are working on. Students in self-development, creativity, and talent in the child need to be developed because the creativity and talent they have can make a creative person.

2 Method

2.1 Type of Research

This research is a type of research experiment. That is a form of research that seeks to influence model learning to the ability to solve problems. Study this, including category experiment pseudo (Quasi experiment).

2.2 Subject

The subject in this study is Class VII students of SMP Negeri 1 Bongomeme totaling 76 students. The research subject consisted of 50 students from class VII. The experimental class (PJBL learning model) consisted of 26 students, and the control class (conventional) consisted of 24 students.

2.3 Procedures

This research is a type of research experiment. Study This includes category experiment pseudo (Quasi experiment). Study This involves two groups; that is experimental group was taught using PjBL, whereas the control group was taught using conventional practices in school.

This research was conducted in the second semester of seventh grade, 2021/2022 school year. The research was conducted at SMP Negeri 1 Bongomeme, an A-accredited school. The research at the school was carried out after obtaining a letter of approval or permission to conduct the research from the local government with a total sample of 50 class VII junior high school students. The experimental

class (project-based learning model) consists of 26 students, while the control class (conventional) consists of 24 students.

2.4 Data, Instruments and Data Collection Techniques

The instrument used is a closed multiple-choice instrument, a distractor presented in Fig. 1.



In the greenhouse effect, CO₂ can collect in the air and form layers. The factor that causes CO₂ to float in the air and collect in the atmosphere is...
 a. CO₂ can bind with free oxygen in the air.
 b. Because CO₂ gas is lighter than air.
 c. High levels of ultraviolet radiation in the atmosphere.
 d. CO₂ easily binds in the air with other gases.

Fig. 1. Closed multiple-choice questions are distractors.

After depicting the spread of items and gathering information from the defined items to be measured, this stage categorizes the various answers given by students. For the instrument, when students choose a double answer, the correct answer is given a score of 1, and the wrong answer is given a score of 0. Prior to this, the instrument has already undergone validation by three experts.

Next, data collection is conducted before the study begins, including observations between the researcher and the Science Teacher present at the school. The data obtained is derived from the results of the pre-test and post-test. The pre-test is conducted prior to the treatment, while the post-test is conducted after the treatment. The construction of the pre-posttest items remains the same. Each item is individually responded to by students, who write their answers on the provided answer sheets. All students are required to complete all of the items within the allocated time frame.

The construct map presents a substantive definition of the construct to be measured. The instrument measures the variables related to the ability to solve problems in the application model of Project-Based Learning (PjBL) with the media of fotonovela. The construct map is shown in Table 1.

Table 1. Construct Map

Variable	Measured Aspects	Items
Understanding global warming	Students can explain why CO ₂ can float in the air and gather in the atmosphere.	1
	Students can explain the causes CO ₂ can float in the air and gather in the atmosphere presented.	3

Variable	Measured Aspects	Items
	Students can identify the causes of ozone layer damage.	10
Impact of global warming	Students are able to analyze climate change due to the greenhouse effect.	2
	Students can analyze the causes of global warming related to world carbon emissions and fossil fuels.	5
	Students can analyze the causes of global warming based on carbon dioxide emission graphs.	6
	Students can analyze evidence of climate change, based on graphs of rainfall patterns.	7
	Students can predict the state of ecosystems if all ice melts in Indonesia based on interactive maps.	8
	Students can predict the state of ecosystems in Kalimantan and Sumatra based on interactive maps.	9
Efforts to tackle global warming	Students can describe how to reduce global warming.	4

2.5 Data Analysis Technique

a. Test validity

The validity test on the test instrument was carried out in order of questions That used valid so that all valid data could be obtained. Instrument validity is done by testing the validity of the construct[12]. Where used opinion experts about the instrument made in the study. Amount power expert Who can validate instrument minimum 3 person expert. To see the validation of the items with the used model Rasch. On test validity, This is done with the help of Winstep software, seen in this case, namely based on Outfit Mean Square (MNSQ), Outfit Z- Standard (ZSTD), and Point Measure Correlation (Pt Mea corr). With criteria as follows: (1) mark Outfits Means Squire (MNSQ), Which accepted $0.5 < MNSQ < 1.5$, (2) Outfit Z- value standard (ZSTD), Which accepted $-2.0 < ZSTD < +2.0$, and (3) Point Measure Correlation (Pt Mea corr) $0.4 < Pt Mea Corr < 0.8$.

b. Test Reliability

In this study reliability is also used analysis *rasch model* with program *winstep* through *table summary statistics* Which will give information in a manner overall about How quality respondent in a manner thoroughly and also the quality of the instrument to be used or interaction between items and person. According to Sumintono & Widhiarso (2015), *Alpha Cronbach* value grouping (measuring

reliability namely the interaction between research items and persons)[13].

c. Stacking And Racking Rasch Model

Analysis of data is done in eight stages. Stages based on approach analysis ratings RASCH model : (1) copy earnings score student on every item. Data generated is a data dichotomy in form ranking or ratings with score 1 (Correct), score 0 (Wrong), (2) tabulate data dichotomy using format EXCEL, based on experimental classes and control, difference type sex. Data pre-test and posttest separated, (3) convert data with soft device model WINSTEPS version 4.5.5[14], become data the intervals have the same measurement scale, (4) estimate effectiveness instrument measurement, based on validity And reliability person And item, (5) estimate the validity of the item use testing, (6) use results testing person measures pre-test And posttest For test hypothesis difference effectiveness learning in class experiment And control. The test used tests statistics nonparametric that is, Test Mann-Whitney u and test sign Wilcoxon posttest student between classes and intra-classes [15], (7) diagnosing level differences mastery ability students on pre-test nor posttest between student man And Woman, and (8) diagnose change a measure of students' problem-solving abilities pre- test And posttest student class experiment And control.

3 Result and Discussion

a. Effectiveness Instrument Measurement Reliability Person and Items

The first step is to conduct reliability testing to determine the extent to which the measurement produces consistent information in uncovering latent characteristics (Latent Traits) or unidimensional characteristics of the variables being measured[16]. The results of the analysis are presented in the form of a statistical summary in Table 2.

Table 2. Displays The Reliability of Persons and Items.

	Person	Item
Reliability	0.51	0.91
Separation	1.03	3.19
Measure (SD)	0.73	0.00
INFIT MNSQ	1.00	1.01
INFIT ZSTD	0.1	0.1
OUTFIT MNSQ	0.93	0.93
OUTFIT ZSTD	0.1	-0.2
KR (20) = 0.68		

Based on Table 2, it is known that the person reliability value is 0.51, which is equivalent to a person separation index value of 1.03 for the class. This indicates inconsistent responses from weak students. The Cronbach's coefficient value (KR-20) of 0.68 indicates a weak interaction among students. This means there is a poor correlation between student responses and items, where student knowledge tends to be fragmented[17]. Additionally, the item separation index value of 3.19 is quite high, equivalent to an

item reliability value of 0.91. This indicates that item consistency is better, or the items can be considered to meet the criteria of unidimensionality, meaning the items are able to define the measured variable very well.

Validity

The second step measures the validity of the items to ensure that all items fit the Rasch model, using the Fit item test. The goal is to determine if the test items accurately measure what they are intended to measure, which is referred to as a validity test[18,19]. This is evaluated based on measurement criteria, which include:

- Mark *Outfits Means Squere (MNSQ)* Which accepted $0.5 < MNSQ < 1.5$
- Mark *Outfits Z-Standard (ZSTD)* Which accepted $-2.0 < ZSTD < +2.0$
- Mark *Point measures Correlation (Pt Meacorr)* $0.4 < Pt Mea Corr < 0.8$

If all three of these criteria cannot fulfilled, it is necessary to conduct research more carry on. Results analysis served on Table 3.

Table 3. Items Statistics: Misfit Order

No Item	Item Code	Measure	OUTFIT MNSQ	OUTFIT ZSTD	PTMEACORR
1	Item1_ppg	-1.34	0.94	-0.3	0.54
2	Item2_ppg	0.72	1.21	1.4	0.53
3	Item3_ppg	-0.21	0.63	-2.1	0.64
4	Item4_ppg	0.27	1.22	1.3	0.44
5	Item5_ppg	1.11	1.04	0.3	0.49
6	Item6_ppg	-1.51	0.67	-0.8	0.45
7	Item7_ppg	0.15	0.78	-1.4	0.59
8	Item8_ppg	-0.51	1.34	1.7	0.37
9	Item9_ppg	-1.31	0.83	-0.4	0.47
10	Item10_ppg	-0.41	0.65	-1.7	0.60

Based on the Item Statistics, it is observed that the items meet the MNSQ Outfit criteria, and there are no negative PT MEA Corr values. This indicates that there are no deviating items and that the items are appropriate and valid. Although there are some items that do not meet the Wrong One criteria, they do not significantly decrease the quality of the items. For instance, item8_dpg does not fulfill the Pt Mea Corr criteria. However, it is still considered valid because there are no negative Pt Mea Corr values.

Comparing the Size of Pre-Posttest Items between Experimental and Control Classes

The Pattern of Size Change in Pre-Posttest Items as an Indicator of Significant Changes in Learning Treatment: A Comparative Analysis between Experimental and Control

Classes. Table 4 presents the measurement results of the pre-posttest based on the Rasch model's item entry test.

Table 4. Average Size of Ability in Pre-Posttest for Students in the Experimental and Control Classes

Item	Experiment			Control		
	Pretest	Posttest	Difference	Pretest	Posttest	Difference
Item1	2.14	0.35	-1.79	1.21	0.46	-0.75
Item2	1.45	0.17	-1.28	0.46	-0.10	-0.56
Item3	0.70	-4.56	-5.26	1.02	-1.07	-2.09
Item4	0.88	-0.41	-1.29	0.28	-0.31	-0.59
Item5	1.45	-0.01	-1.46	2.41	-0.31	-2.72
Item6	-1.14	-4.56	-3.42	-0.31	-1.42	-1.11
Item7	1.06	-2.38	-3.44	1.02	-0.54	-1.56
Item8	0.53	-1.46	-1.99	0.83	-1.42	-2.25
Item9	-0.63	-3.23	-2.6	-0.79	-1.07	-0.28
Item10	0.53	-4.56	-5.09	0.46	-0.79	-1.25
Mean	0.00	-1.07	-1.11	0.00	0.00	0.00

Based on Table 4, it is known that the size of the items consistently changed in the experimental and control classes. The average size difference of the pre-posttest items for students in the experimental class (-1.1 logits) was smaller compared to the average size difference of the pre-posttest items for students in the control class (0.00 logits). Additionally, it was found that the size difference of each pre-posttest item for students in both the experimental and control classes was negative. One item had a larger difference, indicating a decrease in item size with a logit value of -2.25 in the control class, while in the experimental class, it was -1.99.

In the changes in item size, there are both negative and positive size differences in the pre-posttest. If there is a negative pre-posttest change, it indicates that the posttest condition is significantly easier compared to the pretest. Conversely, if there is a positive pre-posttest change, it suggests that the item has become significantly more difficult compared to the pretest condition[20].

Size of Pre-Posttest Ability for Experimental and Control Students

Student ability changes are determined by comparing the size (logit value of items) of pre-posttest using the stacking Rasch model technique [21]. Person entry data is obtained as the mean from the experimental and control classes, as presented in Table 5.

Table 5. Mean size of pre-posttest items in the experimental class and control class.

Class	Number of Items	Mean (Average measure of problem-solving ability)		Pre and post test difference
		Pretest	Posttest	
Experiment	10	-0.24	1.55	1.79
Control	10	0.04	1.43	1.43

Based on the average student abilities in the experimental and control classes, there is a significant

difference. The mean size of the pre-posttest items in the experimental class (1.79 logits) is larger compared to the mean size difference of the pre-posttest items in the control class (1.43 logits). The difference in the mean size of the pre-posttest item differences between the experimental and control classes indicates that students who were taught using a project-based learning model with fotonovela media have a positive impact on students' ability to solve global warming problems.

The nature of changes in students' pre-posttest abilities: positive changes and negative changes

The comparison of size in the Pre-posttest for students, which includes negative (-) and positive (+) changes, can be illustrated using scatter plots.

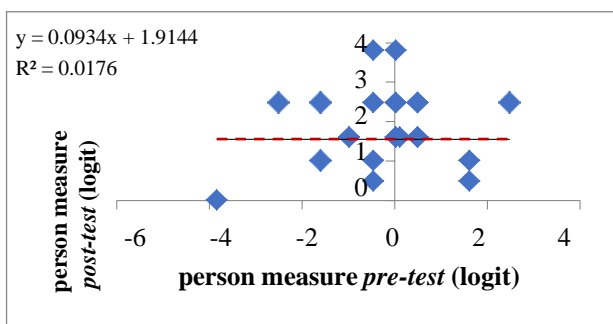


Fig. 2. Graphics Sccter Plot Size Ability Student Pre-Posttest Class

First, a total of 46% of students are above the boundary line, meaning that they experience a change in the size of the pre-posttest ability, which is + (positive), or the ability to change for the better after being taught with the PjBL learning model with photonovel media. For example, serial numbers 24 (-0.47, 3.8), 20 (0.01, 3.8), 22 (-2.5, 2.48)

Second, around 54% of students are below the change line, meaning that these students experience a change in the pre-posttest ability measure - (negative). In the post-test condition, the measure of students' ability is smaller than in the pre-test condition. For example, the size of students' pre-test ability with serial numbers 8 (-3.84, 0.01), 1 (-0.47, 0.49), 3 (1.6, 0.49).

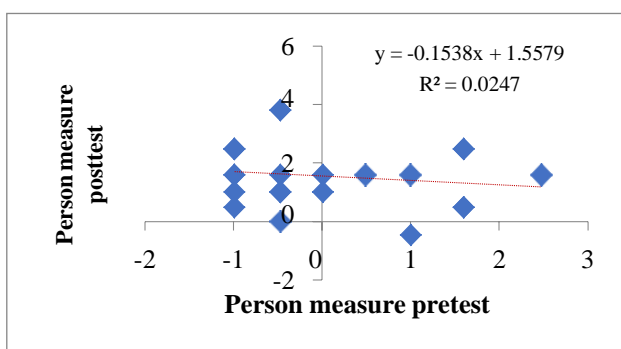


Fig. 3. Chart Sccter Plot Size Ability Student Pre-Posttest Class Control

Based on Fig. 3 shows the size of the pre-posttest abilities of students in the control class. First, 42% of students are above the change threshold line, indicating a positive change in pre-posttest abilities. Second, 58% of students experienced a negative change in pre-posttest abilities. The highest positive change values were observed in students with the following sequence numbers: 1 (-0.47, 3.8), 3 (-0.99, 2.48), and 21 (1.6, 2.48). The lowest negative change values were observed in students with the following sequence numbers: 18 (1, -0.47), 4 (1.6, 0.49), and 22 (-0.47, 0.01).

When comparing the scatter plot graphs of the size changes in pre-posttest abilities for students in the experimental and control classes, it is found that the vertical axis range (person measure: post-test) for the experimental class (4.0 logit) is higher than that of the control class (4.5 logits). This means that the change in the size of pre-posttest abilities for students in the experimental class is better than that of the control class.

Statistical Hypothesis

The ideal data for the Wilcoxon test is typically ordinal or interval scale. The Wilcoxon test is part of non-parametric statistics. Therefore the normal distribution of the research data is not required for this test.

Basis of Decision Making for Wilcoxon Test:

If the value of Asymp. sig. < 0.05, then the hypothesis is accepted.

If the value of Asymp. sig. > 0.05, then the hypothesis is rejected.

Based on the output of the "Test Statistic," it is known that the Asymp. Sig. (2-tailed) for the experimental class is 0.000 and for the control class is 0.001, which is smaller than 0.05. Therefore, it can be concluded that the "hypothesis is accepted". This means that there is a difference in students' problem-solving abilities between the pretest and post-test. Thus, it can be concluded that "there is an influence of project-based learning with fotonovela media on students' ability to solve global warming problems".

4 Conclusion

Based on the research findings, it can be concluded that H0 is rejected. This rejection signifies that there is an influence of students who are taught using project-based learning with fotonovela media on their problem-solving abilities. This is indicated by a significance value of 0.000 < 0.05

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