Development of science learning devices contextual problem based learning (CPBL) based in improving problem solving skills for 4th grade elementary school

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Abstract: Problem solving skill are very much needed in the life of the 21st century. However, it is indicated that problem solving skills with the learning model so far have not significantly improved. This study aims to improve problem-solving skills for grade 4 elementary school by using natural science learning tools based on contextual problem based learning (CPBL) on theme 2 sub-theme 3 on alternative energy that is valid, practic and effective. Design research was quantitative descriptive and carried out by grade IV students of SD Muhammadiyah 6 Genteng, Banyuwangi Regency involving 70 students. Research of development using a 4-D development model research design consisting of 4 stages: define, design, develop and dissemination. Processing in this study used the SPSS 17 program. After conducting research on the experimental class and control class, the data obtained from student learning outcomes in the form of pre-test and post-test data. The data will be processed using SPSS 17 to determine whether there is an effect of developing CPBL-based science learning tools on problem solving skills in class IVSD. The influence test using the independent t-test first checked the assumptions of normality and homogeneity of the pre-test and post-test data. The normality test in this study used the Shapiro-Wilk test, while the homogeneity test used the Levene test, it was found that the Sig. in the Shapiro-Wilk column for the experimental class is 0.135, because 0.135> 0.05, the pre-test data for the experimental class is normally distributed. Furthermore, the Sig value is obtained in the Shapiro-Wilk column for the control class is 0.214, which the pre-test for the control class is also normally distributed because 0.214> 0.05. The assumption for the normality of both data is fulfilled. The analysis was carried out using a mix method, namely combining statistical data with descriptive data in the form of lesson plans, worksheets, Learning Result Test, and problem solving abilities. The results showed that all indicators were
categorized as good and very good. It can be concluded that the problem solving indicators of alternative energy source materials show significant results.

1. Introduction

Education continues to develop according to the times. In 2013 the government perfected the curriculum from KTSP to Curriculum 2013. It aims to prepare Indonesian people to have the ability to live as individual and citizens who are faithful, productive, creative, innovative, and affective and able to contribute to the life of society, nation, state, and society. world civilization. Learning in the 2013 Curriculum demands the activeness of students in the learning process and is student-centered" [1]. In particular, Natural Sciences (IPA) uses an empirical approach to seek natural explanations of the observed cosmic phenomena [6].

Problem solving as an effort to find a way out of a difficulty, that cannot be achieved immediately [12]. Problem solving there are is four steps that must be taken, namely: (1) understanding the problem, (2) planning the solution, (3) solving the problem according to the second step plan, and (4) checking back the results obtained (looking back) [2].

Table 1. Indicators of Problem Solving according to Polya

| Indicators                          | Characteristics                                                                 |
|------------------------------------|-------------------------------------------------------------------------------|
| Understanding of the problem       | Students are able to understand what is known and asked in the questions given |
| Strategic Planning                 | Students are able to determine formulas / methods / methods that can be used to solve the given questions |
| Strategy Implementation            | Students are able to understand what is known and asked in the questions given |
| Check back                         | Students re-correct the answers that have been given in solving the questions to ensure the answer |

One of the learning models that can be used is Contextual Problem Based Learning (CPBL) [9]. Is a learning model that directs students to a problem or as a stimulus that encourages students to use their knowledge to analyze problems, followed by a student center information search process through discussions in small groups to get solutions to a given problem. Learning process is directed so that students are able to solve problems systematic and logical. Through CPBL activities, it is expected that logical, critical, and creative thinking characters can develop, even become habits in students [3].

Table 2. Learning Stage Contextual Problem Based Learning (CPBL).

| Phase                             | Teacher Behavior                                                                 |
|-----------------------------------|---------------------------------------------------------------------------------|
| The orientation of students on the problem | Teacher explains the learning objectives, explains the logistics needed, proposes phenomena or links material in real life to raise problems, |
| Organizing the students to learn  | Motivate students to be involved in solving selected problems. Teacher helps to define and operate learning tasks related to these problems |
| Guid individual or class investigations | Teacher encourages to collect appropriate information, carry out experiments to get explanations and get explanations of problem solving |
Develop and present work  Teacher helps students plan and prepare appropriate work such as reports, videos and models and helps them to share assignments with their friends.

Analyze and evaluate problem solving  Teacher helps to reflect and evaluate their investigations.

Teachers are required to arrange learning tools that are in accordance with the abilities or potentials of students. A good learning tool is a learning device which when applied is able to make students active in learning activities and able to understand the material being taught [4]. Learning devices are all the tools and materials used by the teacher to carry out the learning process. These learning tools can be in the form of a syllabus, lesson plans, student worksheets, and Learning Outcomes Test, learning media and student textbooks [11]. The results of observations at SD Muhammadiyah 6 Genteng, Banyuwangi Regency, especially in grade 4, show that learning outcomes of students were already good, but in learning there were no activities to increase the skills of students in problem solving. So that students’ ability to solve problems is still lacking. Students only carry out activities doing simple tasks that do not emphasize critical thinking activities to solve a problem and apply it in life.

The result of interview we conducted with the fourth grade teacher of SD Muhammadiyah 6 Genteng shows that the learning carried out is still not optimal, especially in learning Theme 2, sub-theme 3, learning 3 about alternative energy and limited in preparing learning devices, especially in galvani cell experiments on potatoes which can produce electrical energy according to real life everyday. Based on the background and problem formulation above, the research has the following objectives: (1)To analyze the level of validity of the Contextual Problem Based Learning (CPBL) learning tool in improving the problem solving skills of Grade 4 SD, (2) Shows the results of the practical application of Contextual Problem Based Learning (CPBL) learning tools in improving the problem solving skills of Grade 4 SD, (3) Knowing the effectiveness level of Contextual Problem Based Learning (CPBL) learning tools in improving problem solving skills in Grade 4 SD.

2. Method
Type of research and development (Research and Development) [10]. Research and Development method activity that is used to produce certain products and test the effectiveness of these products [5]. This study were analyzed using a mix method, namely a combination of quantitative statistical analysis and qualitative descriptive. The products developed and the feasibility test in this study are the Lesson Plan (RPP), Worksheets (LKS), and Learning Outcomes Test (THB) based on Contextual Problem Based Learning (CPBL).
2.1 Population
This research was conducted at SD Muhammadiyah 6 Genteng Banyuwangi in the odd semester of the 2020-2021 school year, the research subjects were grade 4 students with a sampling technique using purposive sampling. Class 4A (Shafa) as a control class by applying conventional learning models consisting of 15 male students and 20 female students. Class B (Marwah) as an experimental class by applying Contextual Problem Based Learning (CPBL) learning which consists of 35 students. Class of students at SD Muhammadiyah 6 Genteng is 70 students.

**Figure 1.** The design four-D model of research and development in contextual problem based learning
Table 3. Class 4 SD Muhammadiyah 6 Genteng Banyuwangi

| Class                      | Gender | amount |
|----------------------------|--------|--------|
| Class 4-A Students (Control Class) | L 15   | P 20   | 35    |
| Class 4-B Students (Experiment class) | 17     | 18     | 35    |

(Source; Dapodik data)

2.2 Instruments

Instruments used in this research are; pre-test and post-test, validation sheets, questionnaire sheets and interview. Test used for pre and post-test in form of an essay with a of 15 questions. The validation sheet was used to improve the results, with five categories: very valid (score 5), valid (score 4), quite valid (score 3), less valid (score 2), and invalid (score 1), as well as the observation sheet. student activity. The research began by determining two classes of students in grade 4 elementary school, one class as the experiment class totaling 35 students the other class as the control class totaling 35 students. After the class divisions are formed, the next step is to develop a pre-test and post-test.

Table 4. Pre and Post-test Pattern Design

| Class                  | pre-test | treatment | post-test |
|------------------------|----------|-----------|-----------|
| Experiment Class, N = 35 | O₁       | X         | O₂        |
| Control Class, N = 35  | O₂       | -         | O₂        |

Information :
O₁ : Observation / pre-test given to the experiment class and the control class
X    : Treatment in the form of application of Contextual Problem Based Learning
O₂ : Observation / final test (post test) given after treatment.

2.3 Assignments

This research encourages students be able to improve problem solving skills and also improve their learning outcome. Some of the problem solving skills assigned to students are as follows:

1) Alternative energy sources are not traditional energy sources, Are fossil fuels such as coal, petroleum, and natural gas. Alternative energy sources can be said to be a substitute energy source that will run out at a later date. Alternative energy sources that are being developed today utilize energy sources that are available in nature and will not run out. From this explanation, mention the various alternative energy sources available in nature or the area around us!

Answer:

a: Sun
b: Wind Power
c: Hydropower
d: Geothermal
e: Sea water waves
f: Bio fuel
g: Galvani Cell

2) Biofuels or biofuels are a renewable energy source that has known benefits compared to fossil fuels. Biofuels include: jatropha, sugar cane, sugar palm. Apart from distance, there are other materials that can be used to make biofuels. Together with your group, find out about the use of fuels that can be used as biofuel, with your
group you can find this information by reading books in the library or via the internet. Write down the infoemasi you got on a sheet of lined folio paper!

Answer:
- a: Sugarcane
- b: Sugar palm
- c: Coconut
- d: Sunflowers
- e: Candle nut
- f: Sago
- g: Corn
- h: sweet potato
- i: Cassava

3) Potatoes are a plant that has many functions, one of which can be used as an alternative energy source. Apart from potatoes there are also other fruits, namely apples and oranges. To prove it, practice the following potato branching:

Tools And Components
- 1. Potatoes
- 2. LED light
- 3. Cables
- 4. Crocodile Clamp
- 5. Copper plates / coins
- 6. Zinc plates / nails

Work Procedures
1. Poke copper and zinc plates into the potato at a distance of a few millis / centimeters (don't put them together).
2. Clip the wires to each of the plates and connect them to the lamp.
3. Look at the lights that occur
4. If the light is not visible, try reversing
5. If it doesn't work, then please add the potatoes so that the electric current generated increases
6. For more than one potato, connect: - Lempeng tembaga kentang satu ke lempeng tembaga kentang dua
   - Potato zinc plate one to potato copper plate two
   - Potato zinc plate two to copper potato plate three
   - And so on, until the last zinc plate connect to the lamp (-)

Question
1. What are the functions of the copper coin, nail and crocodile clamp in the above experiment?
2. Why can potatoes produce electrical energy?

Answer:
1. As positive and negative poles and connect the electric current cable to the two poles
2. Because potatoes contain an electrolyte solution where potato sap is included in an acidic solution which can conduct electric current. Electrolytic solutions are solutions that are ionically bonded and polar covalently. Can break down into ions that can move freely and conduct an electric current.

2.4 Data Collection and Analysis
Collection used pre and post-test in experiment class and the control class. In addition, researchers, observation and interview with research subjects. The results of the pre and post-test were used for quantitative analysis. Meanwhile, observation and interview were used qualitative analysis. Were analyzed statistic inferential. Qualitative were analyzed
The inferential statistic analysis are in the form of frequency, average, and standard deviation. The different test the researcher used the independent sample t-test between the experiment and control class.

Testing the effect of implementing the results tools based on Contextual Problem Based Learning (CPBL) in grade 4 students of SD Muhammadiyah 6 Genteng, using a difference test of 2 (two) groups of T test, both for the pretest and postest control classes with the pretest and postest experimental classes. The test is carried out after the data group has confirmed the normality and homogeneity of the data. The testing process for the differences between the two groups was carried out using SPSS 17 software.

### 3. Results

This research is a type of development research using a 4-D development model design consisting of the following stages, namely: the definition stage, the design stage, the develop stage and the dissemination stage. There are two types of used in this study, namely qualitative and quantitative. The qualitative comes from validator comments and suggestions, both input and students, while the validation results score, teacher and student observation sheet scores, learning outcome test scores, and student response questionnaires are used to measure quantitative data. Qualitative and quantitative data analysis is used to assess whether the learning tools that have met the requirements are valid, practical and effective.

| Validation Results of the Average Score of CPBL-Based Learning Instruments |
|---------------------------------|
| Validasi                        | Skor |
| lesson plan                     | 3.39 |
| student worksheet               | 3.73 |
| Teacher activity observation sheet | 3.83 |
| Student Activity Observation Sheet | 3.83 |
| learning outcomes test          | 3.91 |
| Student Response Questionnaire Sheet | 3.72 |

We show the results of the distribution of student problem solving skill based on the results control class and experiment class as in Figures 2 and 3 below:

**Table 5. Validation Results of the Average Score of CPBL-Based Learning Instruments**
Figure 3. Distribution of experimental class problem solving skills

The results pre-test analysis shown in picture 2-3, it shows the two classes have same variants. The problem solving skill of students in control class demonstrated; Very good 25%, Good 53%, Fairly good 12%, less good 8% and not good 0%. Whereas in the experimental class the students' problem solving skills showed; very good 20%, good 54%, quite good 18%, not good 8% and not good 0%.

Study aims to determine effect contextual problem based learning (CPBL) in problem solving skills the field of science. Data processing in this study used the SPSS 17 program. After conducting research on the experiment class and control class, it obtained on student learning outcomes in the form of pre and post-test. It will be processed using SPSS 17 to find out whether there is any influence from CPBL on problem solving skills in the field of science.

Before the effect test was carried out use the independent t-test, first assumptions of normality and homogeneity of the pre and post-test were checked. Normality test used the Shapiro-Wilk test, while the homogeneity test used the Levene test. Based on the first table, it’s found the Sig. in the Shapiro-Wilk column for experiment class is 0.135, because 0.135> 0.05, the pre-test for experiment class is normally distributed. Furthermore, still based on the first Table, value is obtained in the Shapiro-Wilk column for the control class is 0.214, which means the pre-test for the control class is also normally distributed because 0.214> 0.05. The assumption for the normality of both data is fulfilled.

Table 6. Normality pre-test for two classes

| Tests of Normality | Kolmogorov-Smirnova | Shapiro-Wilk |
|--------------------|---------------------|--------------|
|                    | Statistic | df | Sig.  | Statistic | df | Sig.  |
| Eksperiment class  | .107      | 35 | .200* | .952       | 35 | .135 |
| Control class      | .124      | 35 | .193  | .959       | 35 | .214 |

a. Lilliefors Significance Correction
* This is a lower bound of the true significance.

Furthermore, the homogeneity of the two data will be tested. The homogeneity test used is the Levene test. Based on Table 2 below, the Sig value is obtained. in the Levene Test column it is 0.606, because 0.606> 0.05 means that the pre-test data for both classes
are homogeneous. Because the assumptions of normality and homogeneity have been fulfilled, it can be continued with hypothesis testing. Hypothesis test pre-test data:

\[ H_0: \text{there is no difference between the two classes} \]
\[ H_1: \text{there is a difference between the two classes} \]

In Table second it can also be seen the Sig. (2-tailed) value obtained is 0.944, in other words the two classes have the same ability because 0.944 > 0.05. Because 0.944 > 0.05, \( H_0 \) accepted so that there is not significant difference between the two classes.

**Table 7.** Homogeneity and independent t-test

| Levene’s t-test for Equality of Means | 95% Confidence Interval of the Difference |
|--------------------------------------|------------------------------------------|
| Test for Equality of Variances       |                                           |
|                                      | F   | Sig. | t   | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
|                                      |     |      |     |    |                |                 |                       |       |       |
| Lea learning out scores              | .26 | .60  | .07 | 68 | .944           | -.05714         | .80634                 | -     | 1.5   |
| Equal variance                       |     |      |     |    |                |                 |                       | 1.66  | 518   |
| Equal variance                       |     |      |     |    |                |                 |                       | 616   |       |
| Out assumed                          |     |      |     |    |                |                 |                       |       |       |
| Equal variance                       | .07 | 67.541 | .944 | -.05714 | .80634 | - | 1.5 |
| Not assumed                          |     |      |     |    |                |                 |                       | 1.66  | 520   |
|                                      |     |      |     |    |                |                 |                       | 636   | 8     |

Furthermore, normality will be tested from the two classes. Based on Table 3 below, the Sig. in the Shapiro-Wilk column it is 0.572 for the experimental class, which means that the for the experiment class is normally distributed because 0.572 > 0.05. Furthermore, still based on Table 3, the Sig value is obtained in the Shapiro-Wilk column for the control class is 0.022, which mean that the for the control class is also normally distributed because 0.022 > 0.05. The assumption for the normality of both data is fulfilled.

**Table 8.** Normality post test for both classes

| Kolmogorov-Smirnov\(^a\) | Shapiro-Wilk |
|---------------------------|--------------|
|                           | Statistic    | df | Sig. | Statistic | df | Sig. |
| Kelas eksperimen          | .136         | 35 | .101 | .974     | 35 | .572 |
| Kelas kontrol             | .151         | 35 | .041 | .926     | 35 | .022 |

\(^a\) Lilliefors Significance Correction

The next step will be to test the homogeneity of the two data. The homogeneity test used is the Levene test. Based on Table 4 below, the Sig value is obtained in the Levene Test column it is 0.202, because 0.202 > 0.05 means that the post test data of the two classes are homogeneous. Because the assumptions of normality and homogeneity have
been fulfilled, it can be continued with hypothesis testing. Post test data hypothesis testing:

\[ H_0: \text{there is no difference between the two classes} \]
\[ H_1: \text{there is a difference between the two classes} \]

In Table 4 it can also be seen that the Sig. (2-tailed) value obtained is 0.00, in other words, the two classes have a significant difference because 0.00 < 0.05. Because 0.00 < 0.05, \( H_0 \) is rejected and \( H_1 \) is accepted so that there is a significant difference between the two classes. From this it can be concluded that CPBL affects problem solving skills because it can improve student learning outcomes.

**Table 9. Homogeneity and independent t-test**

| Levene's Test | \( t \)-test for Equality of Means for Equality of Variances |
|--------------|---------------------------------------------------------------|
| \( F \) | \( \text{Sig.} \) | \( t \) | df | \( \text{Sig.} \) (2-tailed) | \( \text{Mea} \) n | \( \text{Std. Error} \) | \( \text{Dif} \) ference | \( \text{Dif} \) ference |
| Levariances | 1.663 | .202 | 4.24 | 68 | .000 | 4.60 | 1.08 | 2.43 | 6.7 |
| Equal assumed | 9 | | | | 000 | 255 | 981 | 601 |
| Equal variances | 4.24 | 63. | .000 | 4.60 | 1.08 | 2.43 | 6.7 |
| Not assumed | 9 | | | | 600 | 255 | 710 | 629 |

Next we show the results of the distribution problem solving skill based on the post-test results of the control class and the experimental class;
Figure 4. Development Results of Problem Solving Skills in Control Class

Based on the results post-test analysis shown in picture 4-5, it shows that there are significant differences after different treatments are carried out. The students’ problem solving skills in the control class using conventional science worksheets showed results; very good 8%, good 48%, Fairly good 38%, Less good 8% and not good as much as 0%. Meanwhile, the students’ problem solving skills in experimental class after learning by using the Science Worksheets based Contextual Peoblem Based Learning showed the results; very good 48%, good 32%, Fairly good 25%, less good 5% and not good 0%.

Observations of 35 students in the experimental class who carry out learning using science worksheets based on contextual problem-based learning showed that the highest score in the learning process was on the very active criteria with a percentage of 50%. The second criterion is the active category of students with a percentage of 43%, then the group of students is active enough by 5%, 2% less active and 0% inactive. [8].
Figure 6. Distribution of student activity observation results in implementing Contextual Problem Based Learning based learning

For the results of the process of developing science worksheets based on Contextual Problem Based Learning theme 2, sub-theme 3 about alternative energy in elementary schools to improve student problem solving skills in terms of validity aspects based on expert validation data we can see in table 19 below

Table 10. Validity aspects of science worksheets based on contextual problem based learning

| No | Validity Aspect Criteria | Percentage (%) |
|----|--------------------------|----------------|
| 1. | Format for the preparation of science worksheets | 94% |
| 2. | Language in writing science worksheets | 88% |
| 3. | The substance of the IPA worksheets | 92% |
| Average | | 91.2% |
| Criteria | | Very valid |

4. Discussion

The development research uses a 4-D development model research design which consists of four stages, namely: the define stage, the design stage, the develop stage, and the dissemination stage. There are two types of data used in this study, namely qualitative data and quantitative data. The qualitative data comes from comments and suggestions from validators, practitioners and students, while the validation results scores, teacher and student observation sheet scores, learning outcomes test scores, and student response questionnaires are used to measure quantitative data. Qualitative and quantitative data analysis is used to assess whether the learning tools that have been developed meet the valid, practical and effective requirements

Table 11. Validation results of the average score of CPBL-based learning

| Validation       | Score |
|------------------|-------|
| lesson plan      | 3.39  |
| student worksheet| 3.73  |
This research produces learning tools developed that meet the criteria of validity, practicality, and effectiveness. This is indicated by the results of the validation of the devices carried out by 4 validators, namely the overall average score of the validation of the Learning Implementation Plan (RPP) 3.89; the overall average score of student worksheet validation (LKS) is 3.73; the overall average score of the validation of the Teacher's Activity Observation Sheet 3.83; the overall average score of the validation of the Student Activity Observation Sheet 3.83; the overall average score of the validation of the Learning Outcomes Test Sheet (THB) 3.91; The overall average score for the validation of the Student Response Questionnaire Sheet is 3.72. This means that the learning device developed meets valid criteria. Field trials conducted at SD Muhammadiyah 6 Genteng were used to determine criteria for practicality and effectiveness. Practicality is obtained from the overall average score of the results of the observation of teacher activity 2.54 which indicates good criteria. This means that the developed device meets practical criteria. The effectiveness is assessed from the test results of student learning who answered completely as many as 89.29%; The results of observations of student activity showed that 94.05% were very active and as many as 89.3% of students gave a positive response. Based on these activities it can be concluded that the device meets the criteria for being effective.

Learning using science worksheets based on contextual problem based learning has a significant effect to improving student problem solving [7]. The research result of problem solving skills in the control class showed the results; very good 8%, good 48%, good enough 38%, not good 6% and not good as much as 0%. Whereas for the experimental class after learning using science worksheets based on contextual problem-based learning showed the results; very good 48%, good 32%, quite good 25%, less good 5% and not good 0%. These result indicate that the problem solving skill of students in the experimental class are much higher than the problem solving skills of students in the control class. Learning using science worksheets based on contextual problem-based learning in the experimental class show that there are increased activity and problem-solving skills. The highest score in the learning process is in the very active criteria with a percentage of 50%, the second criterion is the active category with a percentage of 43%, and the moderately active category at 5%, 2% less active and 0% inactive. Based on this, it can be concluded that science worksheets based on contextual problem based learning are very effective in improving problem solving skills and student learning outcomes.

5. Conclusion

Based on results of the research and discussion has been described, it can be concluded; First, the process of developing science worksheets based on contextual problem based learning theme 2 sub-theme 3 about alternative energy in elementary schools to improve problem solving skills and student learning outcome has succeeded in presenting a very valid, very practical and very effective science worksheet product. This is evidenced by the responses given by teachers, students and expert validators. Second, the science worksheets based on contextual problem based learning are very effective in improving students' problem solving skill. This is evidenced by an increase in problem solving skills and student learning outcomes in the experimental class. Therefore, it is suggested for the next researcher to use science worksheets based on contextual problem based learning in an effort to improve problem solving skills in elementary schools.
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