REACT digital and manual worksheet for enhancing physics problem solving skill

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Abstract. This study aims to find out the comparison of students' problem-solving abilities in harmonic vibration material between students who use REACT- digital and manual worksheets. The method used is quasi-experiment with the research sample taken from two classes totalling 60 students of Islamic schools. The results showed that there were no differences in problem-solving abilities between students who learned using REACT-digital and worksheets and those using REACT- manual worksheets, this happens because during the learning process the teacher uses the same supporting tools, namely student worksheet based on REACT. The implication of this study is problem solving ability can be obtained by learning using REACT digital and manual worksheets.

1. Introduction

Good learning is one that can foster thinking skills that are useful for solving problems in everyday life. This is consistent with the statement that the ability to solve problems is one of the competencies that must be possessed by students in the development of the 21st century [1].

The process of learning physics in general was still focused on teacher’s center, teacher as who plays a dominant role in each learning activity and most students have difficulty understanding the questions and benefits of physics in everyday life. Therefore, the ability to understand a problem that is one aspect of problem solving that must be trained and improved [2].

The problem-solving ability is very important for students both in the learning process of physics and in everyday life. Problem solving ability is a person's ability to find solutions through a process that involves acquiring and organizing information[3]. The problem-solving indicators used in this study are indicators of problem solving according to Docktor which consists of five indicators namely useful concept descriptions, physics approaches, specific physics applications, appropriate mathematical use, and logical progressions [4].

The use of relevant learning media can optimize the sustainability of teaching and learning activities. In connection with that, the teacher needs to make variations in the use of media and learning tools so that the learning which is a process of communication between teachers and students can run effectively so that the message to be conveyed can be received in full, both from the teacher himself and from the students. Learning media that are in accordance with the above problems are using worksheets [5]. Worksheets used in the learning process are teaching materials that can help students learn to understand
physics material and associate material with everyday life. Therefore, a worksheet is needed based on a strategy that is in accordance with the learning process so that the learning objectives are expected to be achieved.

Student activity sheets (worksheets) are sheets that contain assignments that must be done by students which contain steps to do a task [6]. Worksheets are printed teaching materials in the form of sheets of paper containing material, summaries and instructions for carrying out learning tasks that refer to basic competencies that must be achieved [7]. Based on this understanding it can be interpreted that the worksheet is a printed teaching material that contains material and tasks that must be done by students that refers to the competencies that must be achieved.

Based on the results of observations and giving questionnaires conducted in schools as much as 85% consider that the test is difficult because it is burdened by the formulation of questions without ever contradicting the context of everyday life. 90% state that teachers are more dominant in providing subject matter in providing formulas and ways to solve problems given, this causes the ability of students to solve problems that have not been approved.

In addition, based on the results of the analysis of the initial student worksheet used in the school, this student worksheet only contained questions and reviews of teaching materials for each topic. Student worksheet does not encourage students to carry out scientific processes, find concepts and apply concepts that already exist in life, this makes students not active in the learning process.

Based on the facts above, it is necessary to use alternative learning and appropriate student worksheet so that learning objectives can be accepted, one of them is by REACT learning strategy. REACT learning strategy (Relating, Experiencing, Applying, Cooperating, Transferring) is one part of the contextual learning strategy, this strategy can help the teacher to associate material taught with real conditions and encourage students to know their use in everyday life [8].

REACT strategy is a contextual learning strategy developed by Michael L. Crawford which refers to the notion of constructivism because learning with this strategy requires students to engage in various activities that are continuous, thinking and explaining their reasoning, knowing the various relationships between themes and concepts [9].

2. Experimental method

The research method used was quasi-experimental method with Non-equivalent Multiple Group Design Pre-test – Post-test design [10]. This research conducted on two groups of students consisting of experimental group 1 and experimental group 2. In this design, the researchers measured the problem-solving ability of the experimental group 1 and experimental group 2, then treated REACT-based digital work sheet for experimental group 1 and using REACT-based manual work sheet for the experimental group 2. After the two groups were given treatment, the next step was to re-measure (post-test) problem-solving ability to the two groups.

Digital worksheets and manuals used in learning are worksheets compiled based on the five steps contained in the REACT learning strategy. The problem-solving ability test instrument before being used is first tested for validity, reliability, difficulty level of the questions and different power. The data analysis test in this study is intended to test the proposed hypothesis, whether accepted or rejected. The pretest and post test data of experimental class 1 and experimental class 2 were normally distributed and homogeneous, so the t test was used. However, if the data is not normal and not homogeneous or normal but not homogeneous, and vice versa, the data analysis is done by the Mann-Whitney test and the results of the problem-solving ability test in both classes are analyzed by normalized gain to determine the improvement in both classes. For the enhancing problem-solving skill, we used normalized gain equation. Normalized gain interpretation categories used in this study can be seen in table 2 below [11].

Table 1. Interpretation normalized gain.

| Value (\(<g>\)) | Criterion |
|-----------------|-----------|
| \(<0.3\)        | Low-g     |
| \(0.3 \leq (<g>) \leq 0.7\) | Medium-g |
| \(>0.7\)       | High-g    |
3. Result and discussion

REACT-based physics worksheets are based on five elements, namely R from relating (learning) is learning in the context of real-life experience or prior knowledge, E from experiencing is a learning strategy through exploration, discovery, and creation, A of applying is learning with placing concepts to use by giving realistic and relevant exercises, C from cooperating is learning in the context of sharing, responding and communicating with other students, and T of transferring is learning to use knowledge in a new context. One physics material that is close to everyday life and is often considered difficult by students, namely harmonic vibration material, namely there are still many students who have difficulty in determining parameters that affect the magnitude of the spring period and pendulum swing [12]. The design of REACT-based worksheets is presented in Figure 1.

![Figure 1. REACT worksheet design.](image)

The implementation of learning activities in the class that uses digital work sheets and classes that use REACT-based manual work sheets which are reviewed from the activities of teachers and students of all meetings has increased. The results of the analysis of teacher and student activities from the three meetings in the experimental class 1 and three meetings in the experimental class 2, found that at the initial meeting students were not accustomed to being active, working in groups and sharing the results discussed with their classmates. Therefore, teachers as educators must be able to make active and comfortable students in class and teachers must get used to learning by giving problems that can make students active and creative. This is in line with statement which states that teachers as educators must provide comfort in classroom learning, learning needs to be designed by giving problems that can make students active and creative, so students are accustomed to solving a problem and students are required to spend their abilities in solving problems with their friends in class [13].

This is in line with [14] namely the learning process by using the REACT strategy of students building their own knowledge through active involvement in the learning process, students become the center of activities so that teachers do not dominate the learning process [15]. Because of this, the more often students learn with the same conditions, the students will be more familiar with what they do, so that the implementation of learning is more conducive. In addition, to create conducive learning, teachers must be able to be more creative and innovative in creating and using instructional media, this is intended to increase the students' capture of the learning material delivered.

The results of data analysis on the value of pretest, posttest and Normalized gain problem solving abilities obtained by students in both classes in learning with harmonious vibration material can be seen in table 2.
Table 2. Normalized gain problem solving skill.

| Group             | Pretest | Posttest | Normalized gain |
|-------------------|---------|----------|-----------------|
| Experimental class 1 | 10.43   | 57.17    | 0.52            |
| Experimental class 2 | 10.17   | 56.43    | 0.51            |

Table 2 shows the results of the problem-solving ability test. In the table it can be seen that there is an increase in problem solving abilities of students both in classes that use digital and class work sheets that use REACT-based manual work sheets. The average value of the experimental class 1 pretest is 10.43 with a failing category then after learning has increased by 46.7 so that the average posttest obtained is 57.17 with an unfavorable category and the average gain obtained is 0.52 in the medium category. The average value of the pretest in the experimental class 2 is 10.17 with the failing category then an increase of 46.3 so that the average posttest obtained is 56.43 with the unfavorable category and the average gain obtained is 0.51 with medium category. Each indicator of problem-solving ability in the question is analyzed to find out the average value obtained from each indicator in each class. The results of the analysis of the problem-solving ability indicators can be seen in table 3.

Table 3. Problem solving skill’s average.

| Problem Solving skill Indicator       | Normalized gain |
|--------------------------------------|-----------------|
|                                      | Experimental 1  | Experimental 2 |
| Useful Description                   | 0.72            | 0.67            |
| Physics approach                     | 0.52            | 0.60            |
| Specific physics application         | 0.56            | 0.48            |
| Mathematical procedures              | 0.43            | 0.44            |
| Logical progression                  | 0.40            | 0.37            |
| **Average**                          | **0.52**        | **0.51**        |

Table 3 shows that each indicator of problem-solving ability has improved both in the experimental class 1 and in the experimental class 2. Indicator of problem-solving problem description that is useful in both classes experienced the highest increase. While the indicator of the ability to solve logical progression problems in both classes experienced the lowest increase.

Comparison of the improvement of students' problem-solving skills in harmonic vibration material in the class that uses digital work sheets and classes that use manual work sheets can be known by doing a hypothesis test. Hypothesis testing can be done if the data obtained has been tested for normality and homogeneity.

The results of the normality and homogeneity test stated that both classes were normally distributed and homogeneous both in the initial test and the final test, meaning that the initial ability of students in both classes was the same and after being given treatment, the data obtained remained normally distributed and homogeneous. Therefore, hypothesis testing is done using the t test. Hypothesis testing in this study using SPSS version 16.0 software that is using Independent Samples T-Test. Based on the significance level taken, the test criteria are obtained as follows: 1) $H_0$ is accepted and $H_a$ is rejected if the significance value $(t\text{-test}) > \alpha (0.05)$; 2) $H_0$ is rejected and $H_a$ is accepted if the significance value $(t\text{-test}) < \alpha (0.05)$.

Based on the results of the analysis of hypothesis testing on pretest data using SPSS version 16.0 software shows that $H_0$ is accepted and $H_a$ is rejected because the significance value $(0.876) > \alpha = 0.05$. So, it can be concluded that there is no difference in the students' initial abilities in both the experimental class 1 and the experimental class 2. In other words, the students' initial abilities in both classes are
equal. While the results of hypothesis testing on the posttest data indicate that the significance value 
$(0.807) > \alpha = 0.05$, so it can be concluded that $H_0$ is accepted and $H_a$ is rejected. This shows that there
is no difference in problem solving skills between students who learn to use digital work sheet with
students who use manual work sheet.

The findings in this study are in line with the research that has been carried out before, that the
indicator of problem solving that is superior is the indicator of finding problems and finding ideas, while
the indicators of logical progression are increasing low, this happens because even though students have
been able to find problems and find the right ideas, but have not been able to pour these ideas into the
correct solution and have not been able to find support that is relevant to the ideas that have been
obtained [13]. As well as [16,17] states that the aspect of the ability to solve logical progressions is an
aspect that requires students to examine whether the solution of the whole problem is clear, focused, and
logically organized. In this case, students are required to convey their ideas perfectly [18]. In addition,
the low increase in normalized gain in this aspect is also in accordance with the results of research
conducted by [19] which states that of the five steps in solving physics problems that must be done in
problem solving, the least good is logical progression [20].

4. Conclusion
The absence of differences occurs because the treatment in both classes is almost the same and the
increase in problem solving ability in harmonious vibration material in both classes is almost the same.
Based on the results of the Normalized gain analysis of the five indicators of problem solving abilities
studied, all indicators experienced an increase in the medium and high categories. The description of a
useful concept which is the first indicator in both classes has the highest increase. While the fifth
indicator, the logical progression, has the lowest increase. This happens because even though students
have been able to analyze problems on the questions that have been given, but students have not been
able to express their ideas perfectly to get the solution of the whole problem clearly and correctly.

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