Identifying the Drawbacks of the Problem-Solving Skills by Using a Three-Tier Diagnostic Test with Google Form Assistant

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ABSTRACT

The present scientific paper aimed to identify of problem-solving skills and students' responses to the use of google form as a media for a three-tier diagnostic test in the tenth-grade students at Senior High School (SMA) of Indonesia Islamic University (UII) of Yogyakarta. The weaknesses of problem-solving skills using three-tier diagnostic test questions assisted by google form on the materials of work and energy lessons. The questions employed had been valid and reliable. The research method used was descriptive qualitative. The subjects of this study were 26 tenth-grade students who were randomly selected. The results showed that the problem-solving skills of students were in the moderate category. Students utilized the google form to identify drawbacks in problem-solving skills employing a three-level diagnostic test, including the very high category.

Keywords: Problem-solving, Three-tier diagnostic test, Google form, Work and energy

1. INTRODUCTION

Education has an important role in the process of improving human resources [1]. The role can be seen from the condition that humans are changing over time. This also applies to the process of educational development which has to keep up with the times. The times have brought challenges to education. The challenges of education in the era of the industrial revolution 4.0 have to be able to prepare students to face the challenges of a dynamic world. Facing these challenges students should have self-competence to be able to compete. One of the competencies that should be possessed is problem-solving skills.

Problem-solving is included in the category of higher-order thinking skills [2]. When coping with the student's problems, it would think about the process and how to solve the problem [3]. One of the subjects in its implementation requiring problem-solving skills in physics. This is in line with the 2013 curriculum which required students to have problem-solving skills [4]. Therefore, it can be said that problem-solving skills are important to be owned and developed by students. The problem-solving skills possessed by students can influence the mind-set when solving problems in real life.

Assessment using a diagnostic test can measure the level of understanding and skills of students [5]. The diagnostic test can also provide information about misunderstandings and how students think. The results of the diagnostic test can be used as an evaluation of learning [6]. The existence of learning evaluation is expected to help overcome learning difficulties and improve students' thinking skills.

Furthermore, the form of questions employed in the diagnostic test is in the form of multiple-choice questions with a level of confidence or what is commonly called a three-tier diagnostic test. Also, the use of three-tier diagnostic tests is more effective than one-tier and two-tier diagnostic tests. Besides, the three-tier diagnostic test can provide an overview of students' understanding and misunderstanding of concepts [7], [8]. This is because in the three-tier diagnostic test there is a choice of the confidence level that can identify students' lack of understanding [9].

However, the use of three-tier diagnostic tests to identify students' problem-solving skills has not been widely used.

In the industrial revolution 4.0 era, the development in educational assessment has changed rapidly, especially in the fields of education and technology. One of the alterations that occurred in the assessment using the Paper and Pencil Test (PPT) began to be replaced by an assessment called the Computer Based Test (CBT) [10]. The use of CBT allows flexibility, paperless, saving time, and making it easier to assess [11]. Additionally, the CBT system in the assessment let it easier to find out the skills and to provide feedback to students after an assessment is conducted [12], [13]. The reasons lead to the benefits of CBT assessment more effective and efficient.

During the outbreak of Covid-19 globally, the majority of schools in Indonesia should implement an online system. The assessment of employing the CBT system during the Covid-19 pandemic was effective. One of the CBT media that can be used is the google form. This is due to the use of google form which is online and free [14].

The google form can contain a large number of questions so that it can be used for three-tier diagnostic tests. The test results using google form can be found quickly, making it easier to assess. Therefore, the use of google form as an assessment medium can attract the attention of students so that it can motivate them to learn independently [15], [16].

The current paper discussed the use of a three-tier diagnostic test to identify the problem-solving skills of students with google form assistant. It was recommended that the test be carried out online because it is more effective and efficient. Students can also take the test from home in which the pandemic that requires it to be at home so that social distancing sustains.

2. RESEARCH METHOD

The research was quantitative descriptive. The instrument employed was a test named a three-tier diagnostic test which was validated and reliable. The instrument consisted of 8 three-tier or three-tier multiple-choice questions of three-tier assisted by the google form application.

Then, the instrument was validated by experts. After obtaining the research results, it was calculated using the Aiken's V formula to determine its validity value. The following equations are used:

$$V = \frac{\sum s}{[n-(c-1)]} \tag{1}$$

Where $s = r - l_o$, l_o was the number of the lowest validity assessment (in this case 1), c seemed the highest validity rank (in this case 3), r was the number given by the validator, n showed the number of validators, and V was the Aiken's V score. Aiken's V score was then categorized based on Table 1.

Table 1. Product Criteria

Percentage (%)	Category
$80 \le x \le 100$	Very Good
$60 \le x < 80$	Good
$40 \le x < 60$	Moderate
$20 \le x < 40$	Low

The results obtained were then converted into percentages. The percentage of problem-solving skills using the equation:

$$\overline{X} = \frac{\sum X}{n} \times 100\% \tag{2}$$

In which $\overline{X}$ was the percentage score, ΣX was the score obtained, and n was the maximum score. The results of the percentage analysis of students' problem-solving skills were then categorized based on Table 2 [17].

Table 2. Assessment Categories

Percentage (%)	Category
$80 \le x \le 100$	Very Good
$60 \le x < 80$	Good
$40 \le x < 60$	Moderate
$20 \le x < 40$	Low
$0 \le x < 20$	Very Low

The student response questionnaire consisted of nine criteria. The percentage of total score in each item response data of students was gained by using the equation:

$$P = \frac{\sum X}{\sum X_i} \times 100\% \tag{3}$$

Where P was the percentage of the score, ΣX was the total score for each item, ΣX_i was the ideal score. The percentage of the total response data of students was calculated by using the equation:

$$P_{total} = \frac{\sum P}{n} \qquad (4)$$

Then, P_{total} was the percentage of total responses, $\sum P$ was the number of percentages of the score, and n was the number of items or statements. Percentage results were categorized based on Table 3 [18].

Table 3. The Percentage of Students' response result

Result Percentage Range (%)	Category
$80 \leq x \leq 100$	Very Good
$60 \leq x < 80$	Good
$40 \leq x < 60$	Moderate
$20 \leq x < 40$	Low
$0 \leq x < 20$	Very Low

3. RESULT AND DISCUSSION

3.1 Result

Figure 1 Google form

Figure 2 The form three-tier diagnostic test questions on google form

This study uses google form as a medium for giving questions as shown in Figure 1 and three-tier diagnostic test questions as shown in Figure 2. Data analysis on students' problem-solving skills on optical instrument can be seen in Table 4. The results of students' responses to google form media as a three-tier diagnostic test media are in Table 5.

3.2 Discussion

The identification of problem-solving skills in this research was conducted at SMA UII Yogyakarta in the tenth-grade students employing a three-tier diagnostic test with google form Assistant. The three-tier diagnostic test used has been validated and the results are valid. The reliability score of the three-tier diagnostic test was 0.64 in the high category [19].
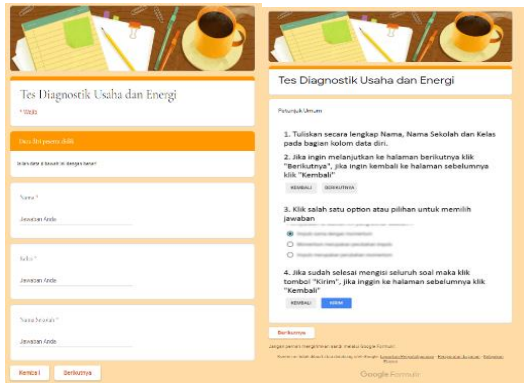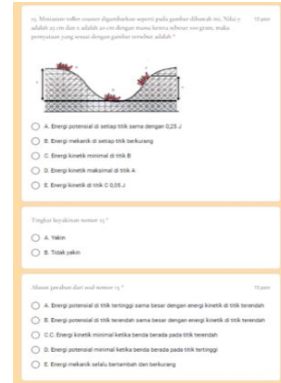
Table 4. The result of analysis of problem-solving skills

Aspects	Indicators	The percentage of Students' Answer	Categories
Identification	Distinguishing between irrelevant information and relevant information	52,88 %	Moderate
	Identifying the information falling into the issue interpretation	50,48 %	Moderate
Plan	Giving the logical reason from a suggestion offered	55,29 %	Moderate
	Initiate a variety of strategies that may be in progress	42,31 %	Moderate
Implementation	Solving multi-representation problems	39,42 %	Low
	Analyzing the information available for interpretation	49,04 %	Moderate

Evaluation	Re-examining the effectiveness of the problem-solving process	54,33 %	Moderate
	Criticizing the solution result in conclusions	54,33 %	Moderate

Table 5. Results of students' responses to google form

No	Categories	Score Percentages
1	The test display with google form is interesting	92,75%
2	The image in the test with google form seems to be clear	95,65%
3	The image in the test with google form is understandable	91,30%
4	The language used in the test with google form is easy to understand	84,78%
5	The material in the test using google form is following the work and energy instrument theme	95,65%
6	Test with google form is easily accessible	92,03%
7	The test with google form is practical to use	92,03%
8	The general instructions for using the test using google form are displayed	90,58%
9	The test with google form can help find out skills and weaknesses in the mastery of work and energy	92,75%
	Total	91,95%

As shown in Table 4, it shows the results of data analysis of problem-solving skills employing a three-tier diagnostic test assisted by google form on the materials of work and energy lessons. Each aspect of problem-solving skills consists of two indicators. The identification aspect of the first indicator obtained 52.88% in the moderate category. This indicates that students can distinguish objects that have large and small work with information in the form of data and images. The second indicator is 50.48% in the moderate category. This means that students can identify and interpret information related to kinetic energy experiments. The results of the identification aspect show that several students are able to define problems in the questions given.

The aspect of the plan on problem-solving skills, the first indicator was 55.29% with moderate category. It showed that students can provide reasons for solutions related to formulating the height of an object. The second indicator was 42.31% in the moderate category. This indicated that students can think of the right solution in terms of the difference in kinetic energy at a certain height. The results of the aspect of the plan showed that several students can plan strategies in solving problems faced.

In the implementation aspect of the problem-solving skills, the first indicator got a percentage of 39.42% with a low category. This showed the skills of students in multi-representation when applying existing data information to the solution equation

associated with kinetic energy and potential energy was still lacking. It was due to the fact that students were only limited to entering known values in the equation without analyzing the problems they faced [20].

The second indicator obtained 49.04% with a moderate category. It indicated that students can analyze and interpret the information provided to determine ball speed. The results in this aspect of implementation showed that some students have not been able to solve problems in a multi-representation manner, but can cope with and interpret the issues.

In the evaluation aspect of problem-solving skills, the first indicator was 54.33% included in the moderate category. It can define that students are able to re-check the conformity of the statement with the information provided. The second indicator obtained 54.33% with moderate category. This meant that students can conclude statements with the information provided. The results of the evaluation aspect showed that some students can examine and criticize the emerging problems.

Furthermore, the students' problem-solving skills on the materials of work and energy lessons were classified as moderate category with an overall average of 49.76%, so it can be concluded that the use of a three-tier diagnostic test was able to identify students' problem-solving skills. Assessment employing a three-tier diagnostic test can identify students' understanding [21]. The problem-solving

skills of students was quite influenced by several factors, including the learning methods used by the teacher, the facilities and learning resources utilized, as well as the motivation and readiness of students in the learning process. The display of the three-tier diagnostic test with google form media to identify weaknesses in student problem-solving skills can be seen as in Figure 1. Validation of google form media using Aiken's V score with a score of 1. This shows that the use of google form is very good for use as a medium of computer-based assessment.

The results of the student's questionnaire responses to the use of google form media can be seen in Table 5. The total score percentage shows that 91.95% is in the very high category, this means that students can work on three-tier diagnostic test questions easily using google form. This is because the use of google classroom is easy to access for students [22].

4. CONCLUSION

To sum up, the problem-solving skills of the tenth grade in Senior High School of Indonesia Islamic University (SMA UII) of Yogyakarta are in the category of moderate in the material of work and energy. The response of students to the use of google form to identify problem-solving skills using the three-tier diagnostic test was very high. Therefore, problem-solving skills can be identified using a three-tier diagnostic test assisted by google form.

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