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DEVELOPMENT OF PROBLEM-SOLVING SKILLS TEST ON DYNAMIC FLUID MATERIAL AT SMA TARUNA PBD MEDAN

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ABSTRACT

This study focuses on the development of a physics problem-solving skills test instrument on dynamic fluid material for grade XI high school students. The purpose of this study is to determine how to develop a problem-solving-based test instrument on dynamic fluid material and to determine the feasibility of a problem-solving-based test instrument on dynamic fluid material. The type of research used in this study is R & D (Research and Development) development research using the ADDIE research model which has a research design through four stages, namely Analysis, Design, Development, Implementation and Evaluation. The trial sample in this study was 29 grade XI students of Taruna PBD Medan High School with the assumption that the entire class is homogeneous. The research instrument used is a problem-solving skills test consisting of 7 questions in the form of essays. The trial results were obtained from the problem-solving ability test instrument in the validation test conducted by 3 validators who had a very high value category which was included in the category of suitable for use with revision. Analysis of the problem-solving ability instrument administered to 29 students, with the results obtained in the validity and reliability trials, showed that all test instruments were valid and reliable. In the trial, the difficulty level of five questions was classified as moderate, one was classified as easy, and one was classified as difficult. Furthermore, in the discrimination test, the seventh question was categorized as excellent. Thus, the developed test instrument was suitable for use with five questions.

So it can be concluded that the development of instruments based on students' problem-solving abilities is suitable for measuring students' thinking abilities.

Keywords:*Test instrument, Problem Solving skills*

INTRODUCTION

Education is a process of interaction between educators and students to achieve predetermined educational goals. Education serves to help students develop their potential. Education can be achieved through learning. The learning process can be said to be successful when learning outcomes align with expected outcomes. Learning outcomes can be determined through evaluation. Evaluation is crucial because it provides useful feedback for both students and teachers. Conducting an evaluation requires assessment results, and measurements are necessary to obtain these results. Measurement requires a valid and reliable instrument (Sani, 2020). The 2013 Curriculum requires students to possess high-level thinking skills in order to organize their problem-solving abilities by evaluating, analyzing, and creating ideas, concepts, or concepts that can build intelligent individuals with high intellectual abilities (Solekhah, 2018). In Indonesia, learning is expected to develop thinking skills, and this also applies to physics learning in high school. In physics learning, students are expected to possess high-level thinking skills. The TIMSS

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(Trends in International Mathematics and Science Study) results ranked Indonesia 40th out of 42 countries in terms of achievement in higher-order thinking skills in physics learning (Daulay, 2020). The results of the PISA (Programmer of International Students Assessment) in 2019, Indonesia's reading score was ranked 72nd out of 77 countries, then its mathematics score was ranked 72nd out of 78 countries, and its science score was ranked 70th out of 78 countries (Aulia, 2021). Indonesia is a country with relatively low thinking skills. This is due to several factors, one of which is that students in Indonesia are still poorly trained in completing tests that require analysis and creativity. To overcome this, development in various aspects is needed.

Based on the initial observations of researchers at SMA PBD Medan, it was found that 79.4% of students said that students still had difficulty understanding practice questions when the language used in the example questions and the practice questions given by the teacher was different, 85.7% of students were unable to complete a physics practice question about its application in everyday life and 97% of students had difficulty solving a problem in a physics problem given by the teacher. This is also in line with the results of interviews with teachers who stated that students had difficulty understanding a question even though the example question had been given. For example, when the language used in the example question and practice question was changed. This was caused by the instruments used by teachers being limited and students having difficulty solving HOTS (Higher Order Thinking Skill) physics problems because teachers were not used to giving HOTS physics practice questions to students but still gave HOT physics questions. Based on the above problems, the researchers concluded that the test instruments used by teachers were still simple and limited. One of the causes of the above problems was that the questions tended to test more aspects of memory which did not train students' high-level thinking skills, Indonesia's analytical thinking ability was scientifically considered still low. This problem is also caused by students in Indonesia being less trained in solving HOTS questions (Damanik, 2020).

RESEARCH METHODS

This study used the R&D (Research and Development) development method, a type of research method used to produce a specific product or test its effectiveness (Purwanti, 2015). This research was conducted at SMA Taruna PBD Medan in the even semester of the 2022/2023 academic year. The population in this study was grade XI. The research design used in this study was the ADDIE model (analysis, design, development, implementation, evaluation).

The procedure for developing the ADDIE design test instrument is as follows:

1) Analysis Stage

   The purpose of the analysis phase is to gather the information needed to develop a product that can be used to solve a problem faced by the school. Activities in this phase include needs analysis, materials analysis, and student analysis.

   a. Needs analysis

      The thing that was done in this research was to collect information and data regarding the basic problems needed at SMA Taruna PBD Medan, especially regarding the need for test instruments based on problem-solving skills in physics.

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b. Material analysis
This material analysis is conducted by comparing the concepts of a topic with other relevant material. This results in conclusions about the material that will be tested on students.
c. Student Analysis
In this activity, what is done is to consider the thinking abilities and experiences of each student.

2) Design stage
At this stage, the things that are done are determining the basic competencies that can be used to create problem-solving skills questions, designing the form of the test instrument and compiling the test grid.
a. Determining Basic Competencies and Question Indicators
In this case, the researcher first analyzed the existing basic competencies in the learning syllabus for class XI SMA Taruna PBD Medan which were in accordance with problem-solving skills in the Dynamic Fluid material.
b. Designing the Instrument Shape
The form of the question instrument to be developed is an essay question. The essay question is based on indicators in the problem-solving stages according to Polya's Theory (Polya, 1945).
c. Creating a test grid
The form of the problem-solving test grid that is made is a table form where the contents of the table that will be made are 6, namely basic competencies, question indicators, main material, sub-material, and instrument form as well as determining the question number for each sub-material.

3) Development Stage
At this stage, what is done is to create an instrument and carry out expert validation.
a. Making instruments
In this study, the number of problem-solving skills questions on fluid dynamics material was 7 essay questions.
b. Expert Validation
The question instrument that has been prepared will then be validated by validators, namely two physics expert lecturers from Medan State University and one physics teacher from Taruna PBD Medan High School.

4) Implementation Stage
This stage is the testing stage after the correct product has been produced.
a. Small group trials
This small-group trial involved 10 11th-grade students from Taruna PBD Medan High School. After the trial, the test instrument will be further revised to improve the instrument.
b. Large group trials
A large-group trial was conducted after the test instrument had been revised. This large-group trial involved 34 11th-grade students at Taruna PBD Medan High School.

5) Evaluation Stage

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The aim at this stage is to assess and conclude whether the problem-solving ability test instrument that has been developed is suitable for use or not.

The instruments in this study were a test instrument, an expert validation sheet, and a student response questionnaire. The data analysis techniques used in this study were expert validation of the test instrument, test validity, reliability, difficulty level, discriminatory power, and analysis of student responses to the questions.

ANALYSIS

The results of the analysis showed that when students were given questions that were different from the example questions, students would have difficulty in working on them and students rarely got questions that challenged their thinking skills, especially thinking skills in solving a problem and the physics material for class XI of SMA Taruna PBD Medan used in the problem-solving skills test was dynamic fluid material.

DESIGN

The result of the Design stage is a test instrument design in the form of an instrument grid designed according to the basic competencies of fluid dynamics material. The basic competency used in the problem-solving skills instrument is Basic Competency 3.1 Applying the principles of fluid dynamics in technology. This basic competency is then adjusted to the problem-solving skills indicators in fluid dynamics material. The form of the instrument used in this study is an essay format with 7 questions.

DEVELOPMENT

The development phase is the next step. At this stage, the skills test instrument is created based on the test instrument outline. After the test instrument is created, it is validated by a validator. The validator assesses the test instrument's content, construction, and language.

IMPLEMENTATION

The implementation phase included small-group trials and large-group trials. The validator's assessment results were then piloted on 10 students to determine the readability of the problem-solving skills questions. The validation results from the small-group trials are shown in Table 1.

Table 1. Small Group Test Validation Results

Question Number	rCount	rTable	conclusion
1	0.137525395	0.632	invalid
2	0.044881761	0.632	invalid
3	0.298995598	0.632	invalid
4	0.720414134	0.632	Valid
5	0.737343408	0.632	Valid
6	0.810090464	0.632	Valid
7	0.928783442	0.632	Valid

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Based on the validation results in table 1, questions 1, 2 and 3 still need to be revised before conducting large group trials.
After revisions were made, the large-group trial phase was piloted on 29 11th-grade students at SMA Taruna PBD Medan. The validity results from the large-group trial phase are as follows.

Table 2. Large Group Test Validation Results

Question No.	Rhitung	Rtable	Status
1	0.696588743	0.3674	Valid
2	0.372929104	0.3674	Valid
3	0.696588743	0.3674	Valid
4	0.779318489	0.3674	Valid
5	0.857377556	0.3674	Valid
6	0.710538505	0.3674	Valid
7	0.780949048	0.3674	Valid

The reliability results obtained from the problem-solving skills test instrument were 0.8079, indicating that the developed test instrument is reliable. A reliable test instrument produces consistent results when used over time.

Table 3. Reliability Results of Large Group Test

set value	Cronbach's alpha value	Conclusion	set value
0.795711121	0.795711121	Reliable	0.795711121

A test instrument is considered good if it is neither too difficult nor too easy. A higher difficulty index indicates easier questions, while a lower difficulty index indicates more difficult questions. The results of the analysis of the difficulty level of questions in the large-group test can be seen in Table 4.

Table 4. Results of the difficulty level of the large group test

Question Number	difficulty index	information
1	0.651724138	Currently
2	0.562068966	Currently
3	0.748275862	Easy
4	0.520689655	Currently

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5	0.386206897	Currently
6	0.5	Currently
7	0.279310345	Difficult

The results of the discriminatory power analysis conducted on the large group COA test showed that all 7 problem-solving skill items met the very good criteria. The results of the discriminatory power data analysis on the large group test can be seen in Table 5.

Table 5. Results of the Differential Power of the Large Group Test

Question Number	Differential Power	Criteria
1	3.833333333	Very well
2	0.99047619	Very well
3	3.185714286	Very well
4	3.247619048	Very well
5	2.742857143	Very well
6	3.095238095	Very well
7	5.880952381	Very well

EVALUATION

The next stage is the evaluation stage, which determines the quality of the problem-solving skills test instrument that has been developed. This stage aims to determine which instrument is suitable for use. Based on the data analysis, five questions were deemed suitable for use.

CONCLUSION

The developed test instrument is suitable for use with five questions. The process of developing the problem-solving skills test instrument in physics subjects at SMA Trauna PBD Medan goes through 5 stages, namely the first stage is the analysis stage (needs analysis, student analysis, material analysis), the second stage is the Design stage (determining basic competencies and question indicators, designing the instrument form, making test grids), the third stage is the Development stage (making instruments, conducting expert validation), the fourth stage is the Implementation stage (small group trials, large group trials), and the fifth stage is the Evaluation stage. To develop and optimize problem-solving skills, it is recommended to teachers that students be more accustomed to working on questions that hone students' skills in solving problems in physics material.

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