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DEVELOPMENT OF A TEST INSTRUMENT TO MEASURE PROBLEM SOLVING ABILITY ON NUMBER OPERATION MATERIAL

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ABSTRACT

The main purpose of this research is to develop a problem-solving ability test on number operation material. The type of research used is Research and Development (R&D) research or development research with the Tessmer development model which consists of four stages, namely: preliminary stage, self evaluation stage, prototyping stage (expert review, one-to-one, and small group), field test stage which was carried out in class IV SDN 196 Polewali. The data collection instruments used were validation sheets, student response questionnaires, and test instruments. The data obtained were then analyzed using data analysis of validity, reliability, difficulty level, differentiability and problem-solving ability results. Based on the results of the validator's assessment, the test instrument developed meets the valid criteria. The reliability test results obtained are very high, the level of difficulty of the instrument is in the medium category and the distinguishing power of the test instrument is in the good category. The results of the analysis of students' problem-solving ability are in the good category. The implications of this research are to familiarize students with problem solving problems, enrich learning variations, as a consideration for further study of mathematics learning problems in schools.

Keywords: Test Instrument Development; Problem Solving; Number Operations

1. INTRODUCTION

Evaluation in learning is defined as a process of comparing a learning activity in the field with a plan that has been made to determine the extent to which learning objectives can be achieved (Magdalena, 2020). In conducting an evaluation, a test instrument is needed that meets the indicators of a good and valid test instrument and can measure what is to be measured. Instruments are tools that can be used to measure the level of competency achievement. Forms that are grouped according to the type of bill and test assessment techniques include: stuffing, true-false, matching, multiple choice and description. Non-test includes: questionnaire observation guide, interview guide and public (al-Tabany, 2013). A test is a tool or procedure in the form of a series of questions that function to measure skills, knowledge, talents or abilities that a person has (Diawati, 2018).

Mathematics comes from the root word mathema meaning knowledge, mathanen meaning thinking or learning. In the Big Indonesian Dictionary, mathematics is defined as the science of numbers, the relationship between numbers and operational procedures used in solving problems regarding numbers (Hamzah & Muhlisrairi, 2014). Polya in Hendriana and Soemarmo explained that problem solving is an effort to find a way out of a difficulty in order to achieve a goal that cannot be achieved immediately (Hendriana & Soemarmo, 2014). Problem solving in mathematics learning must be developed in the learning process and it is necessary to familiarize students to solve problems, both mathematical problems and problems in everyday life. Mathematical problem solving is an important skill that contributes to success in learners' lives and education. However, the ability is not simply acquired as it requires an understanding of mathematical content and practice of problem-solving skills (Yapatang & Polyiem, 2022).

Based on the latest PISA test in 2018 testing the academic performance of school children on average in each country, Indonesia ranks 73 out of 79 countries in math with a score of 379. When compared to the international average score of 489, Indonesia is quite far away (Magfirah, 2022).

Learning story problems can develop and train students' mathematical abilities in solving problems, as well as provide experience and an overview of the relationship between these problems and real life (Ifanali, 2014). One of the math materials that is often encountered in the form of story problems is number operations. Number operations are material that is very close to the lives of students. There are still many students who have difficulty and do not understand how to solve problems solving integer story problems related to everyday life because they must be solved with certain steps (Mulyani, Suarjana & Renda, 2018).

Based on the results of the analysis of questions in class IV SDN 196 Polewali Kab. Soppeng, the questions used in learning, especially in number operation material, are routine questions, namely questions that directly write the formulas for addition, subtraction, multiplication and division without any process to find the formula first, so that the questions used are considered less able to measure students' problem-solving skills, besides that students are also not used and trained. Whereas the learning objectives of mathematics set by the Ministry of National Education are in line with NCTM which stipulates five competencies in mathematics learning: mathematical problem solving, mathematical communication, mathematical reasoning, mathematical connections and mathematical representation (Maulyda, 2020). Therefore, the learning applied in schools should be able to direct students to foster and improve problem solving skills.

2. RESEARCH METHOD

The type of research used in this study is Research & Development (R&D) or development research. The development model used in this research is Teesmer's development model known as the formatife evaluation type development model. This research consists of 4 stages, namely the preliminary stage, the self-evalution stage, the prototyping stage (expert reviews, one-to-one and small group) and the field test stage. The test subjects used in this study were fourth grade students of SDN 196 Polewali, Soppeng Regency, South Sulawesi in the even semester of the 2022/2023 school year. Data collection techniques consisted of interviews, questionnaires, validation sheets and tests. Data collection instruments in the form of validation sheets, learner response questionnaires and test instruments. The data analysis technique consists of the validity of the problem-solving ability test instrument, the reliability of the test instrument, the level of difficulty of the test instrument, the distinguishing power of the test instrument and the data analysis of the problem-solving ability results.

3. RESULTS AND DISCUSSION

Test Instrument Development Procedure to Measure Problem Solving Ability

The development of test instruments to measure students' problem-solving skills through a series of development phases of Tessmer's formative research type starting from the preliminary stage, self evaluation, prototyping to the field test stage so as to produce a product. The preliminary stage begins with the collection of several references related to this research, namely about the development of test instruments to measure problem solving skills, then determining the place and subject of research. The test site in this study was SDN 196 Polewali with the subject of this research being grade IV students. This is in line with research conducted by (Putri Wulandari: 2021) which states that at the preliminary stage, the activities carried out are looking for references

related to the research to be carried out, determining the school and followed by setting a research schedule.

The next stage is the self-evaluation stage, at this stage the researcher conducts analysis activities consisting of curriculum analysis, learner analysis and material analysis. After material analysis activities are carried out, the next step is to design or design test instruments to measure problem solving skills, including: question grids, test questions, test answer keys and scoring guidelines which are then consulted with the supervisor and produce prototype I. This is in line with research conducted by (Sitri Cayani: 2021) which states that at the self-evaluation stage, there are two activities carried out at this stage, namely the analysis stage (curriculum analysis, students and materials) and the design stage.

The test instrument developed was then validated by the validator and then tested at the one-to-one stage which aims to determine the readability of the questions and the students' assessment of the problem-solving test instrument. The assessment results from validators and one-to-one were then used to revise prototype I and produce prototype II. Then prototype II was tested at the small group stage. The results of the small group were then used to revise prototype II and produce prototype III. The resulting prototype III was then used for the field test stage, namely the field trial where the test instruments that had been developed were tested on the research test subjects, namely fourth grade students of SDN 196 Polewali. The results of students' work were then analyzed to measure reliability, difficulty level, distinguishing power and measure the level of problem-solving ability of students. This is in line with research conducted by (Nurul Fuadah: 2017) which states that at the prototyping stage, after validation by the validator, the results of the validation are tested at the one-to-one stage then continued at the small group stage and the last is the field test stage.

Data Analysis of Development Results

Analysis of the Validity of Test Instruments by Experts

Validators or experts are asked to provide an assessment of all test instruments developed in prototype I which includes content, construct and language on the instrument. The validation process of test instruments to measure problem solving skills was carried out by 3 validators (experts) including two lecturers from the Faculty of Tarbiyah and Keguruan and one homeroom teacher. The results of the instrument validation analysis obtained are presented in the following table:

Aspects	Indicator	Item No.	S	V	Kat.
Contents	Suitability of question items with the material taught	1	14	1,16	Very Valid

	Suitability of question items with indicators of problem solving ability	2	11	0,91	Very valid
	The question items presented are appropriate to the ability level of the learners	3	11	0,91	Very valid
	Tested question items are conceptually correct	4	12	1	Very valid
Construct	The formulation of the question or question sentence uses question words and commands that require a decomposed answer.	5	11	0,91	Very valid
	There are clear instructions on how to do the questions and they are easy for test takers to understand.	6	14	1,16	Very valid
	The information on the question is presented clearly	7	12	1	Very valid
	The question formulation presented does not depend on the answer to the previous question item.	8	11	0,91	Very valid
Language	Accuracy of sentence structure	9	11	0,91	Very valid
	Sentence effectiveness	10	11	0,91	Very valid
	Standardization of terms	11	11	0,91	Very valid
	Questions do not have multiple meanings	12	12	1	Very valid
	Sentences used are easy to understand	13	13	1,08	Very valid
	Ability to motivate learners	14	12	1	Very valid
	Appropriateness to the learners' level of emotional development	15	11	0,91	Very valid
Average				1	Very valid

Table 1. Results of Expert Validation Analysis

The results of the validation test analysis by experts show that the test instrument is included in the highly valid category in terms of content, construct, and language with a validity coefficient of 1 which is at the vulnerable value of V > 0.8.

Reliability Test of Test Instrument

The reliability test is based on the results of a field test involving fourth grade students of SDN 196 Polewali. The number of students in the class was 11 people and all students became test subjects. The following are the results of the reliability test through the SPSS version 22 program.

Reliability Statistics

Cronbach's Alpha	N of Items
.989	35

Table 2. Reliability Test Results

Based on table 2 shows the reliability value of the problem-solving test instrument is 0.989 with a very high interpretation. This shows that the test instrument can be said to be reliable, so based on this analysis, there is no revision of the test instrument according to the reliability test. The results of the analysis and calculation of test reliability can be seen in the appendix So based on this analysis, there is no revision of the test instrument according to the reliability test. Test

Instrument Difficulty Level

The test items can be said to be good if the test items have a level of difficulty in the interval 0.16 - 0.85 this indicates that the items are not too easy and not too difficult. The level of difficulty of the test developed was obtained from the results of students' work at the field test stage. The following are the results of the analysis of the level of difficulty on the problem-solving ability test.

Question Item	Difficulty Level	Category
1	0,65	Medium
2	0,67	Medium
3	0,77	Easy
4	0,65	Medium
5	0,70	Medium
6	0,58	Medium
7	0,78	Easy
8	0,56	Medium
9	0,82	Easy
10	0,59	Medium
11	0,80	Easy
12	0,72	Easy
13	0,51	Medium
14	0,65	Medium
15	0,66	Medium
16	0,76	Easy
17	0,29	Difficult
18	0,30	Difficult
19	0,68	Medium
20	0,30	Difficult

21	0,65	Medium
22	0,58	Medium
23	0,61	Medium
Average	0,62	Medium

Table 3. Analysis of the Level of Difficulty of the Problem-Solving Ability Test Instrument

Based on table 3, it is known that questions number 3,4,7,9,10 and 14 have a level of difficulty in the "easy" category, which means that students generally answer correctly on these questions. While questions number 1,2,5,6,8,11,12,13,17,19,20 and 21 have a level of difficulty with the category "medium" which means that students answer, balanced. And questions number 15, 16 and 18 have a level of difficulty with the category "difficult" which means that few students are able to answer these questions. Based on the table above, there are no questions about the problem-solving ability test instrument that have unfavorable criteria (too easy and too difficult).

Distinguishing Power of the Test Instrument

The distinguishing power of the test instrument developed was obtained from the data on the results of students' work on the field test. Analysis of the distinguishing power of the test items can be seen in the appendix. The following are the results of the analysis of the distinguishing power of the problem-solving test instrument.

Question No.	Distinguishing Power	Category
1	0,38	Good
2	0,36	Good
3	0,34	Good
4	0,36	Good
5	0,4	Very good
6	0,42	Very good
7	0,24	Good
8	0,5	Very good
9	0,3	Good
10	0,34	Good
11	0,38	Good
12	0,38	Good
13	0,46	Very good
14	0,4	Very good
15	0,34	Good
16	0,34	Good
17	0,34	Good
18	0,36	Good
19	0,42	Very good
20	0,32	Good
21	0,3	Good
22	0,56	Very good

23	0,52	Very good
Average	0,38	Good

Table 4. Analysis of Distinguishing Power of Problem-Solving Ability Test Instrument

Based on table 4, it is known that question numbers 5, 6, 8, 13, 14, 19, 22 and 23 have differentiating power in the "very good" category, meaning that the question is very good at distinguishing high ability students from low ability students. While question numbers 1,2,3,4,7,9,10,11,12,15,16,17,18,20 and 21 have differentiating power in the "good" category, meaning that the question is good for distinguishing high ability students from low ability students. The average differentiating power on problem solving questions is 0.38 with a good category, meaning that the problem-solving questions can differentiate the abilities of students, namely students with high abilities and those with low abilities.

Data Analysis of Problem-Solving Ability Results

Test data to measure students' problem-solving ability can be seen based on the final score obtained by students when working on the problem-solving test. The test data is then analyzed into quantitative data to determine the level of problem-solving ability of students. The following are the results of the analysis of the students' problem-solving ability test.

Learner Score	Frequency	Percentage (%)	Category
80-100	2	18,18%	Very good
60-79	5	45,45%	Good
40-59	2	18,18%	Simply
20-39	2	18,18%	Less
0-19	0	0	Very Less
Number of Subjects	11	100	
Average Score	62		Good

Table 5. Analysis of Test Results of Problem-Solving Ability of Students

Based on table 5, it is known that of the 11 trial subjects there are 2 students who have problem solving skills in the very good category, as many as 5 students who have problem solving skills in the good category, as many as 2 students who have problem solving skills in the sufficient category, and as many as 2 students who have problem solving skills in the poor category. The average score of students' problem-solving ability test results is 62 with a good category.

4. CONCLUSION

The process of developing a problem-solving test instrument on the number operation material at SDN 196 Polewali Kab. Soppeng goes through four stages, namely; (a) preliminary stage or preparation stage, (b) self evaluation stage which consists of analysis stage (curriculum analysis, students and materials) and design, (c) prototyping stage which consists of expert review, one-to-one and small group stages, then the last stage is (d) field test stage.

The test instrument developed meets the validity criteria with an average value of 1, which means that based on the validity criteria with a vulnerable value of V > 0.8, the problem-solving test instrument is declared very valid, then the results of the one-to-one stage meet the readability of the question with a positive response from students is 83.33%, and at the small group stage, the positive response questionnaire results obtained are 77.08%. The test instrument has a reliability of 0.989 with very high interpension. The average difficulty level of the test instrument is 0.62 with a medium category that is in accordance with the criteria for difficulty levels ranging from 0.31 - 0.70. The average distinguishing power of the test instrument is 0.38 with a good category that is in the interval 0.30 - 0.39. Therefore, the development of test instruments to measure problem solving ability meets valid and reliable criteria and meets the criteria for difficulty level and distinguishing power. The results of the analysis of students' problem-solving ability obtained an average score of 62 with a good category. Of the 11 students who were used as test subjects, 2 students had a "very good" problem solving ability level, 5 students had a "good" problem ability level, 2 students had a "sufficient" problem solving ability level and 2 students had a "less" problem solving ability level.

This problem-solving ability test instrument can be used as material for consideration to examine more deeply the questions of learning mtematics in schools in an effort to measure students' problem-solving skills, and to find out more about the quality of the test instruments that have been developed, it is recommended that further researchers be able to test on a wider test subject.

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