DEVELOPMENT OF MATHEMATICAL CONNECTION TEST ON SOCIAL ARITHMETIC MATERIALS FOR JUNIOR HIGH SCHOOL STUDENTS

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***Abstract*:**
This study aims to find out the procedure and assess the quality of developing test instruments to measure students' mathematical connection abilities. Students seemed lacking in answering questions to develop their mathematical connection ability, therefore it was necessary to practice in measure students' mathematical connection abilities. it was a research and development research and development under a formative research model that was conducted through four steps. The data collection instruments in this study were validation sheets and test instruments. The test subjects in this study were 10 students. The results obtained from the content validity test were declared valid because the CVR and CVI values were 1 which refers to very appropriate categories. The reliability of the instrument was declared reliable, where the reliability value was 0.815 which referred to a high reliability or consistency interpretation. Meanwhile, in terms of difficulty level, the average total score was 0.36 in the intermediate category. In terms of discriminating power, the average total score was 0.40 which refers to the good category. Thus, the developed mathematical connection ability test instrument has been fulfilled to be of good quality. This research was conducted at Tanjungpinang 11 Public Middle School in addition to developing mathematical connection tests and also as reference material in making questions and being able to measure students' mathematical connection abilities at the school.

Keywords: Instrument test, mathematical connections

INTRODUCTION

Learning is the most important thing for a human in further development. Slameto et al. (2017)Learning is a process of changing overall attitude resulting from personal experience to interact with the environment. Mathematics is an important science that is difficult to separate from daily human activities. Therefore, it is necessary to learn mathematics to become a guide for the mindset. Schools must also teach mathematics to train students to get used to systematical problem-solving. Sujono (Rosyana & Sari, 2015) Mathematics must be taught in schools in preparing to become students who are careful, efficient, and can build their character. Judging from how essential mathematics is, students should be proficient in mathematics. In understanding mathematics, it consists of several

interrelated concepts is the notion of mathematical connection ability. But unfortunately what happens in the field is many students have a weak level of mathematical connection. Mathematical connection is the ability of students to be able to connect everyday events with mathematics, other subject matter with mathematics, and connect concepts with mathematics itself (Diana et al., 2020).

Menanti & Sinaga (2018) mathematical connection ability connect mathematical concepts both between mathematics subjects themselves and connect it with concepts in other fields. NCTM (2000) states that mathematical connection is the relationship between mathematics subjects, the relationship between mathematics and science outside of mathematics, and the mutual relationship between mathematics and the real world or everyday life. From these two statements, it can be concluded that the connection in mathematical connection is not only the ability to connect in mathematics but in other materials or sciences and also in life. In this study, researchers used several indicators of mathematical connections in making tests, namely: mathematical connections with other sciences, mathematical connections between concepts and mathematical connections with everyday life (Furqoni & Destania, 2020).

However, unfortunately, whathappens in the field is that many students need a more robust mathematical connection level. To be able to know the level of the mathematical connection, an indicator of the achievement of a mathematical connection is needed. NCTM (2000) stated several indicators of mathematical ideas, understanding how mathematical ideas relate to one another and construct one another so that they are fully consistent, and recognizing and applying mathematics in contexts outside mathematics.

This can trigger students' weak It must be admitted that the relationship between mathematics lessons and other sciences, the relationship between mathematics learning and human activities in education was lacking. This can trigger students' weak mathematical connections. Similar research has also been carried out by Zulfa et al. (2018), showed that the research results are still relatively low in students' mathematical connections, with a percentage of 33.33%. It often happens that at school students rarely practice questions to hone their mathematical connection skills (Widiyawati et al., 2020). Students often work on problems by not using the right processing procedure (Munawwarah et al., 2020). When the teacher distributes questions that relate mathematics to everyday life and connects the math material being studied with previous material students also feel that they are still unable to do it as a whole correctly (Tohir et al., 2020). In general, it can be seen how the level of students' mathematical connection ability at school. There needs to be an effort to be able to improve students' mathematical connection abilities. One of them is by giving students practice questions to hone students mathematical connection abilities (Sa'dijah et al., 2020).

The instrument is essential because it is a tool for collecting data during research. According to Purwanto (2018), the instrument is a useful measuring tool for data collection then the test instrument is a technique that uses question items that students work on us to find out how students can provide appropriate answers orally. Measurements are used to assist teachers in measuring the level of ability of students to achieve an educational goal. Angriani et al. (2018) also discussed the development of a test instrument to measure the level of

mathematical connections. Therefore, the researcher wants to develop a test instrument that measures students' mathematical connections. The test aimed at students is in the form of questions that measure students' mathematical connections. Based on this background, researchers reviewed the need to develop a test instrument to be able to measure students' abilities seen from their mathematical connection abilities.

Based on the results of interviews conducted at Tanjungpinang 11 Public Middle School, students rarely do math practice questions that can hone mathematical connections. Students take tests in the form of multiple-choice and essay questions. However, students tend to refrain from using work procedures and drawing conclusions that are not entirely correct. Social arithmetic material is a mathematics subject that links mathematics with social or everyday life. This social arithmetic subject matter isto improve and enhance students' mathematical connection abilities (Setyoningrum et al., 2020; Abidin & Tohir, 2019). Through this material, students are trained to develop students abilities in their mathematical connections.

One way for students to be able to develop students understanding of mathematics is by frequently practising students in working on questions in the form of essays using word problems. The advantage of giving questions in the form of essays is to provide opportunities for students to be able to develop their thinking and work on questions in their way, but they must remain systematic and transparent. Likewise, by using story-shaped questions, students can analyze the problem by strengthening their understanding using mathematical concepts. In solving word problems, students must also answer questions using systematic steps.

Conducting this research at SMP Negeri 11 Tanjungpinang is expected that teachers can use the products produced by researchers as a reference and add sources of questions so that these questions can be given to students as exercises to improve students' mathematical connection abilities. Previous research developed a mathematical connection test in each area (Rahmi & Subianto, 2020; Kenedi et al., 2019; Agustini et al., 2017), as well as this research. What he did in Tanjungpinang was not only to develop questions and as reference material, but this research was also able to measure students' mathematical connection abilities at the school.

RESEARCH METHODS

The development type of research was carried out using a formative research type model through 4 stages, the preliminary or preliminary stage and the self-evaluation stage, which are self-evaluation, prototyping, and field tests. First, the preliminary stage has two processes, the first is the preparation process, and the second is the design process (Sugiyono, 2017).

In the preparation process, the stages are determining the place of research, carrying out observation activities, determining the object of the research, and carrying out activities to analyze the curriculum and materials to be used. After that, the process of designing activities is carried out, namely designing grids and

mathematical connection ability, and then a formative evaluation process is carried out (Furqoni & Destania, 2020).
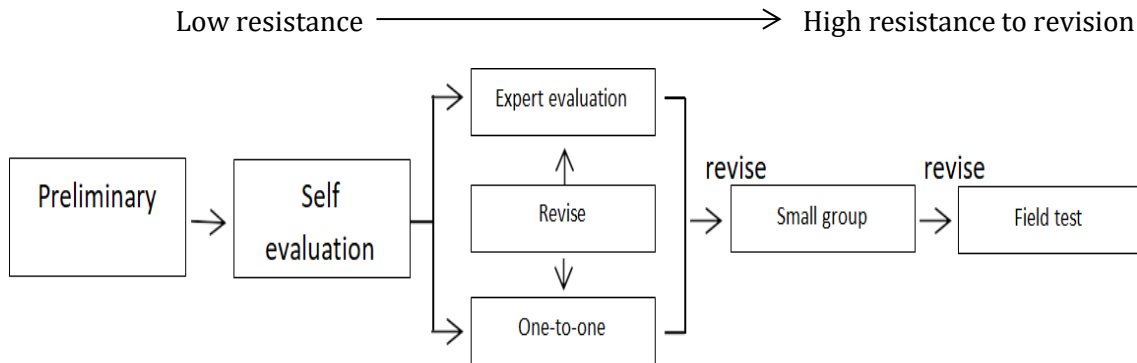

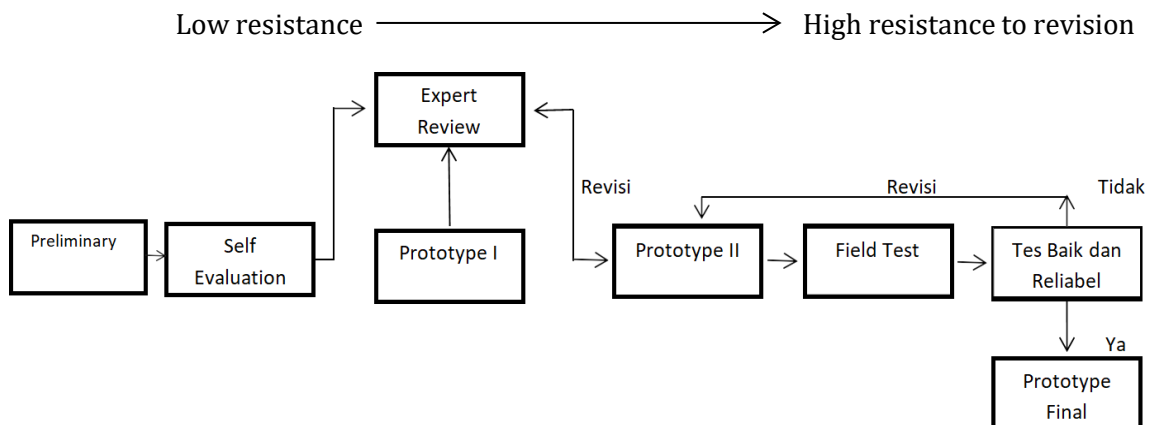**Figure 1**. Development of the Tessmer Type

Figure 2. Research Stage Design

The formative evaluation process needs to be carried out as a self-evaluation. The researcher evaluates and corrects the language rules and checks spelling and language rules before sending them to the validator. The results of this phase are called prototype I, where this phase is the product validation step carried out by the validator. The validator checks the questions created to see the material, construction, and language of the questions. The researcher will later carry out this.

The researcher did not carry out the one-to-one stage, where this phase required several students to be tested and provide comments and suggestions on the questions. This stage was not carried out because the researcher had held direct discussions with subject teachers. At that time, teaching and learning activities were still ongoing, where students would carry out semester exams. The results of the expert review will later become a consideration during implementation in revising prototype I. Then make a revision that will produce prototype II, where at the prototype II stage a field trial or field test will be carried out. This trial will be tested on research subjects, namely class VIII-V, as many as

ten students of SMP Negeri 11 Tanjungpinang. The data obtained is then used to measure reliability, discriminatory power, and difficulty level.

As for the grid, the mathematical connection indicators used in this study are as follows:

Table 1. Question grid

No.	Indicators of Competence Achievement	Mathematical Connection Indicator	Question Indicator	Cognitive Level
1.	Solving problems related to social arithmetic (sales, purchases, discounts, profits, losses, single interest, percentage, gross, net, tare)	Mathematical connection ability with other sciences	Complete word problems related to selling, buying prices, profits, losses, and percentages	C3
2.	Solve problems related to social arithmetic (sales, purchases, deductions, profits, losses, single interest, percentage, gross, net, tare)	Mathematical connection ability with other sciences	Solve word problems related to single interest, deductions, gross, net, and tare.	C3
3.	Solve problems related to social arithmetic (sales, purchases, deductions, profits, losses, single interest, percentage, gross, net, tare)	The ability to connect between topics/mathematical concepts in mathematics	Solve word problems related to single interest, deductions, gross, net, and tare.	C4
4.	Solve problems related to social arithmetic (sales, purchases, deductions, profits, losses, single interest, percentage, gross, net, tare)	Mathematical connection ability with other sciences	Solve word problems related to single interest, deductions, gross, net, and tare.	C5
5.	Solve problems related to social arithmetic (sales, purchases, deductions, profits, losses, single interest, percentage, gross, net, tare)	Mathematical connection ability with everyday life	Solve word problems related to selling, buying prices, profits, losses, and percentages.	C6

Table 2. Question Product

No.	Question Product
1.	Fatiya is a trader in her household. He sells various kitchen needs. At that time the stock of eggs at Fatiya's shop ran out and Fatiya went to the market to buy 10 egg boards for Rp. 60.000,-/board. 1 board contains 30 eggs. Fatiya resold the eggs and made a profit of IDR 500/item. So what is the total selling price of the eggs?
2.	That afternoon Faza came home from school and stopped at Toko Alam to buy math practice books for her classmates. On the bookshelf, it is written that for every purchase of a book at Toko Alam, you get a rebate of 5% of the price set by the publisher. If the amount of rebate received by Faza is Rp. 1.500,-. How much does a publisher charge for a book and how much does it cost to buy 50 books?
3.	Evi is a cake seller. On Sunday, he received orders for resolutions for the General Meeting of 80 pcs. Evi needs wheat flour with a net weight of 1 kg. He also went to the Sri Rezeki shop, he found wheat flour with a gross of 3 kg and 1 kg of tare. Then he went to Jaya's shop and found wheat flour with a gross of 2 kg and 1 kg of tare. Where should Evi buy flour?
4.	Mother wants to save Rp. 5,000,000 but you still want to compare the 2 banks with interest from each bank. Bank Matahari provides an interest of 5% per year while Bank Bulan provides an interest of 2% per 6 months. How much interest do you get if you save for 12 months and which bank will you choose?
5.	Riska will hold a family event at her house to celebrate her 15th birthday. He plans to do grilled fish with his family. He also went to the market to buy mackerel at an average price of Rp. 40.000,-/kg. Riska bought fish from a trader with a weight of 1 1/4 kg for Rp.40,000, -. Did the trader experience a loss/profit and how much loss/profit did the trader experience? Write it in percentage form!

RESULTS AND DISCUSSIONS

• Preliminary Stage
At this stage, there are two processes to go through, namely the first preparation process and the second the design process

Preparation Process
In the preparatory process, the researcher carried out a research location at Tanjungpinang 11 Public Middle School, using 10 students of class VIII-V as research objects. Using the 2013 curriculum using social arithmetic material.

Design Process
In this process, the design of the problem grid and mathematical connection questions is carried out.

• **Formative Evaluation Stage**

At this stage, the questions can be said to be good in terms of language rules, spelling and language rules.

• **Prototype I**

At this stage, it is still necessary to revise the use of construction and the use of question forms. The results of this revision will be used as reference material for implementing the revision.

• **Prototype II and Field Test**

The revision of prototype II is a matter that has been revised from the prototype I process and is continued by field trials or field tests. This trial will be tested on research subjects, namely class VIII-V students as many as 10 students of Tanjungpinang 11 Public Middle School by giving 5 test items. Then the data obtained later to measure reliability, discriminatory power, and level of difficulty. Data analysis techniques used analysis of content validity, reliability, level of difficulty, and discriminatory power. The details are as follows:

Content Validity

In Table 1 below are the results of content validity:

Table 1. Content Validity Before Revision

Question	Expert 1	Expert 2	CVR	CVI	Description
1	0	0	0	0.5	Invalid question
2	1	0	0	0.5	Invalid question
3	0	1	0	0.5	Invalid question
4	0	1	0	0.5	Invalid question
5	1	0	0	0.5	Invalid question
Total			**2.5**		

In Table 1, the validator stated that the item revision phase had to be carried out because the total CVR score was 2.5, namely the CVR value ≤ 0.99. The CVR calculation helps indicate. Whether an item is appropriate for use as a test preparation. This review was carried out based on the validator's recommendation, after which content Validity was carried out again to get good questions.

Table 2. Content Validity After Revision

Question	Expert 1	Expert 2	CVR	CVI	Description
1	1	1	1	1	Valid question
2	1	1	1	1	Valid question
3	1	1	1	1	Valid question
4	1	1	1	1	Valid question
5	1	1	1	1	Valid question
Total			**5**		

Meanwhile, the content validation in table 2 shows the results of questions that meet the requirements with a CVR score of 1. Then the CVR score is used to determine the CVI score. The average CVR is CVI. The CVI value for all questions is 1. From the CVR and CVI values obtained, it can be determined whether the content validity meets the criteria or not. This shows that the items are very suitable to be able to measure the ability of mathematical connections. Angriani et al. (2018) the results of the first content validity had to carry out the revision stage because there were 4 out of 15 items that received a CVR value of ≤ 0.99. Then the researcher carried out the revision stage and got a CVR score of 1; then, the CVR score would be used to be able to determine the CVI score, namely getting a value of 1. Thus, it can be concluded that to measure students' mathematical connections all items are very suitable.

RELIABILITY TEST

The field trial will produce a reliability test with 10 class VIII-V students of Tanjungpinang 11 Public Middle School who are asked to answer five questions within 30 minutes. The following is the reliability calculation in table 3:

Table 3. Reliability Test

		N	%
Cases	Valid	10	100.0
	Excluded	0	0.0
	Total	10	100.0

a. listwise deletion based on all variables in the procedure.

Table 4. Reliability Statistics

Cronbach's Alpha	N of Items
0.815	5

Table 4, showed that the development of this test gets a total score of 0.815 for reliability with a reliable or consistent interpretation. The results of the per-unit reliability test are shown in Table 4:

Table 5. Per-Unit Reliability Test

Unit-Total Statistics

Scale Mean ifItem Deleted		Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha If Item Deleted
Unit 1	7.00	11.111	0.651	0.765
Unit 2	7.60	12.933	0.438	0.827
Unit 3	7.40	11.156	0.628	0.773
Unit 4	8.10	12.767	0.686	0.768
Unit 5	7.90	10.989	0.674	0.758

Based on the results of the reliability analysis using SPSS version 26, it was 0.815 witha reliable or consistent interpretation. Therefore, research conducted by Adni et al. (2018) found that the questions made by researchers were reliable, with a score of 0.746.

Difficulty Level

The questions can be classified as good if the difficulty level of the questions is between 0.31 and 0.70. Based on this interval, the item items can be said to be neither difficultnor easy. Analysis of the level of difficulty of the questions in Table 6:

Table 6. Difficulty Level

Question	DifficultyLevel	Category
1	0.7	Easy
2	0.3	Currently
3	0.5	Currently
4	0.1	Hard
5	0.2	Hard
Average	**0.36**	**Currently**

Five questions from the results of the analysis of the questions tested, there was 1 item in the easy category, two questions in the medium category, and two questions in the difficult category. From this test, the average difficulty level is 0.36 in the moderate category. So, the quality of this test instrument has good quality. Research Adni et al. (2018) that the results of the difficulty level of the questions have four easy group items,10 group category items, and one complex group item with an average value of 0.542 with a reasonable interpretation.

DISCRIMINATING POWER

Test items can be considered good test items if they have a minimum discriminating power of 0.2 with sufficient interpretation. Discriminating power has the following results:

Table 7. Discriminating Power

Question	DiscriminatingPower	Category
1	0.6	Good
2	0.2	Enough
3	0.6	Good
4	0.2	Enough
5	0.4	Good
Total	**0.4**	**Good**

Based on the results of the analysis of the items on discriminating power, it was found that of the five questions tested, there were two questions in the fair group and three questions in the excellent group. Thus, it can be said that the development of test instruments that have been designed by researchers can be used for students' mathematical connections. Research Aida et al. (2017) that the results of the differentiating power of the item showed that the item has two items in the wrong group, five items in the fair group, six items in the amazing group, and two items in the good group, with an average reasonable interpretation of 0, 45. The results of this study are also the same as the research (Furqoni & Destania, 2020) where the research conducted stated that the questions developed obtained valid and practical results.

CONCLUSIONS AND RECOMMENDATIONS

This research activity produced a product in the form of questions to measure a mathematical connection of 5 items on social arithmetic material. It can be seen from the results of the two validators to see the completeness of the question requirements to measure mathematical connection abilities that these questions can be used as a test to measure students' mathematical connection abilities. On the results of the development of the first test made by the researcher, 5 items need to be revised. After revising from entering the validator, the test can be said to be valid and can be tested on students at the trial stage. The results of the content validity test were validated with CVR and CVI scores in category 1, referred to as very appropriate interpretations. Get a total score of 0.815 for reliability with reliable or consistent interpretation. Obtain an average total score of 0.36 with moderate interpretation for the level of difficulty of the data and an average total score of 0.4 for discriminating power with the good group. Examiners of the questions that have been developed have good quality.

Suggestions that can be delivered by researchers are how teachers often provide practice questions that trigger development in students' mathematical connections and students must also often practice developing their abilities.

Mathematical connections play an important role in the process of learning. It is hoped that further research will be able to develop at the one-to-one stage.

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