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# Development of Mathematical Cognitive Test Instruments on Fraction Materials for Elementary School Students Based on Idea Exploration Ability

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## Abstrak

Eksplorasi ide sebagai bagian dari disposisi matematis memiliki peran penting bagi siswa. Dengan kemampuan eksplorasi ide, siswa akan mampu memecahkan soal matematika secara mandiri dan kreatif untuk mendukung keberhasilan pembelajaran matematika. Namun berdasarkan studi pendahuluan diketahui kemampuan eksplorasi ide siswa dalam menyelesaikan soal cerita materi pecahan masih rendah. Penelitian ini bertujuan mengembangkan instrument tes kognitif dengan membuktikan validitas dan reliabilitas konstruk instrumen tes eksplorasi ide materi pecahan di sekolah dasar. Metode penelitian ini adalah kuantitatif secara cross sectional dengan 307 siswa sebagai subjek penelitian. Analisis data menggunakan analisis faktor konfirmasi dengan software SPSS 26 dan Lisrel 8.80 untuk mengetahui nilai indeks daya beda dan nilai muatan faktor yang kemudian digunakan untuk menemukan nilai korelasi antar dimensi (AVE), validitas konstruk dan reliabilitas instrumen. Hasil penelitian menunjukan terdapat 12 butir soal valid secara konstruk dan reliabel. Penelitian ini memberikan implikasi dan rekomendasi dalam penggunaan instrument tes berbasis eksplorasi ide di sekolah dasar.
Kata Kunci: Eksplorasi ide; Instrumen Tes Eksplorasi Ide; Reliabilitas; Validitas Konstruk.

## Abstract

Exploration of ideas as part of a mathematical disposition is essential for students. With the ability to explore ideas, students can solve math problems independently and creatively to support the success of learning mathematics. However, based on a preliminary study shows that student's ability to explore ideas in solving word problems on fractions is still low. This study aims to develop by proving the construct validity and reliability of the exploratory test instrument for ideas on fractional material in elementary schools. The method in this study was quantitative with a cross-sectional method with 307 students as research subjects. Data analysis was carried out by confirming factor analysis using SPSS 26 and Lisrel 8.80 software to determine the value of the differential index and factor loading values which can then be used to find the inter-dimensional correlation (AVE) values, construct validity, and instrument reliability. Of the 35 items, 17 questions have high discriminatory power to be analyzed using Lisrel 8.80. The results showed that 12 items were stated to be constructively valid and reliable. This study provides implications and recommendations for using test instruments based on idea exploration in elementary schools.
Keywords: Construct Validity; Idea exploration; Idea Exploration Test Instrument; Reliability.

## I. INTRODUCTION

Mastery of mathematical material has a central role for students as a provision for life to become a productive society and can solve problems (Aprilia & Diana, 2023). This follows the formulated goals of learning mathematics by the National Council of Teachers of Mathematics NCTM (Maulyda, 2020). Seeing the vital role of mathematics in life, it is expected that learning mathematics not only emphasizes material but also pays attention to students' social, affective, mental, and psychological aspects (Amir & Risnawati, 2015; Hasanudin & Maryati, 2023). This is in accordance with the goals of learning mathematics, namely that students are expected to appreciate the usefulness of mathematics, curiosity, concern, and interest in learning mathematics (Indriyani, 2019).

Mathematics is a field of science that requires logic to think systematically. Studying mathematics can help students think critically, logically, analytically, and systematically so that it can positively impact their future development (Istiqomah & Saeful, 2007; Robiah & Nuraeni, 2023). To benefit from mathematics requires a logical mindset and analysis in solving mathematical problems (Fatimah, 2019; Puspita, Muzdalipah, & Nurhayati, 2023). In solving math problems or often called word problems, in addition to a logical mindset and analysis, it must also be accompanied by the ability to explore ideas. That way, students will have the initiative and creativity to increase independence in learning mathematics (Akhdiyat & Hidayat, 2018; Elyana, Astutiningtyas, & Susanto, 2023).

However, based on the results of a preliminary research study conducted in several elementary schools in Depok, Sleman. Through interviews, observation, and documentation activities in September 2022, several problems related to learning mathematics were found, such as low student motivation, lack of self-confidence, difficulties in completing arithmetic operations, and low ability to explore ideas. In this case, the researcher focuses on solving the problem of low exploration of ideas, considering that this ability is part of a mathematical disposition that also supports the success of learning mathematics (Siregar, Kairuddin, Mansyur, & Yusoff, 2023).

The ability to explore ideas as part of a mathematical disposition is a belief, desire, and tendency among students to act positively and think mathematically (Akbar et al., 2018). According to (Dewi, 2020), the ability to explore ideas is a process of finding creative ideas to improve the quality of learning. This definition aligns with (Puspitaningrum & Astutik, 2018), which defines the ability to explore ideas as the capacity to think of solutions in various ways to find the best ideas. The ability to explore ideas is a search or exploration activity that involves creative thoughts to find something (Hayuhantika & Rahayu, 2019; Herawati, Hidayati, & Iffah, 2023). The ability to explore ideas indicates mathematical communication skills, including perseverance, thoroughness, and creativity in reasoning from mathematical concepts to proof activities (Aswita et al., 2022; Dewi, 2020; Setyo et al., 2020). Exploration of mathematical ideas is carried out systematically, creatively, and selectively.

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Based on this description, it shows the importance of the ability to explore ideas in learning mathematics. The ability to explore ideas has several benefits, such as helping students to be able to learn mathematics independently and creatively can also help students to find the best solution to solve math problems (Mardhiyana et al., 2016; Aminah, Maat, & Sudarsono, 2023). So, objects that can support the formation of the ability to explore ideas need to be continuously developed.

Based on the results of interviews and observations that have been carried out in the preliminary study. Many learning outcomes instruments, both used by teachers for daily tests and schools for public tests, have not met the ideal requirements. The purpose of This ideal requirement is that the test instrument be standardized (Siregar & Halawa, 2021). Even though the instruments in the book do not precisely measure various student abilities or it can be said that they only measure cognitive abilities in general. Even the ability to explore ideas is part of the cognitive abilities that must be measured using instruments in accordance with the indicators of exploring ideas. Thus, this study aims to develop a test instrument for the ability to explore valid and reliable ideas according to the dimensions and indicators of the exploration of ideas.

Idea Exploration is the ability to explore ideas as an individual's capacity or ability to think of solutions to solving problems using various ways (Wei et al., 2022). As a basis for developing an idea exploration test instrument, the researcher first examines the dimensions, aspects, and indicators of the ability to explore ideas.

According to (Aswita et al., 2022), exploring ideas has several aspects: perseverance, thoroughness, creativity, and conceptual reasoning. Perseverance is one of the factors for student learning success through acceptance of experience, which is characterized by a scientific attitude in conducting investigations, discipline, and tenacity (Ilma et al., 2021; Miarsyah et al., 2019; Tamardiyah, 2017). Thorough is a habit of doing something according to the appropriate steps and cannot be wrong (Ja'far, 2014). Where accuracy can be said as thoroughness or accuracy, conceptual reasoning creativity is a new way or a different way to solve problems based on logic (Bramantyo, 2021). Students' creativity can be indicated through flexible activities, finding new ways, and imagining new answers (Rusdiana, 2012; Sitepu, 2019).

In addition to Aswita's opinion, Sadiq (in Dewi, 2020) states that exploring ideas includes: Representing, determining patterns, and conducting proofs. Representing is the ability to understand a problem contextually through an appropriate image or model (Lin & ChunTai, 2016), characterized by the ability to transform mathematical sentences into appropriate mathematical models. Finding patterns is simply organizing data to become information as a guide to reach a solution (Lahida & Jailani, 2015; Rahmayani, Susanto, & Suwito, 2023). While doing the mathematical proof is central to mathematics. When someone has a conjecture about something, one of the most appropriate ways to ensure that it is

true is to carry out a valid mathematical proof characterized by the ability to explain the results of reasoning in writing systematically (Almeida, 2003; Santosa, 2013; Suwanto et al., 2023).

Based on several aspects of exploring ideas from several experts, the researcher synthesizes aspects and indicators of exploring ideas. They are representational ability, accuracy, mathematical proof, and creative reasoning. They are, moreover, described in this table.

Table 1.
Aspects and Indicators of Idea Exploration

| Aspect | Indicator | Code |
|---|---|---|
| Representational ability | Turn word problems into mathematical models | A |
| Accuracy | Using the right steps | B |
| | Get the final result right | C |
| Mathematical Proof | Write down the results of reasoning systematically | D |
| Creativity reasoning concept | Use a new/different method | E |

Fractional material instruments based on exploring ideas are essential to do (Afriansyah, 2017). Seeing the state of the field, where many teachers still use instruments from student textbooks, it is also essential to develop student exploration of ideas. Through this developed instrument, students will practice thinking freely with guidelines consistent with mathematical concepts. Researchers use the CFA analysis technique to ensure that this instrument will be feasible.

Confirmatory Factor Analysis (CFA) is one of the main approaches in factor analysis. CFA can be used to test the dimensionality of a construct (OCB). This test is used to carry out model measurements (model measurement) to describe aspects and indicators in reflecting on the latent variable, namely OCB, by looking at the factor loading of each aspect that forms a construct. Confirmatory Factor Analysis (CFA) is also used to test the construct validity and construct reliability of the indicators (items) forming the latent construct (Latan, 2012 in Tentama & Subardjo, 2016).

As previously explained, this study aims to test the construct validity and reliability of the indicators (items) forming the latent construct with Confirmatory Factor Analysis (CFA). This test is carried out to obtain valid and reliable test instrument analysis data. In other words, this test is used to carry out model measurements to describe how well aspects and indicators can be used as measurements. Second-order confirmatory factor analysis (2nd Order CFA) is a measurement model of two levels. The first level of analysis is carried out from the aspect latent construct to its indicators, and the second analysis is carried out from the latent construct to the aspect construct (Latan, 2012 in Tentama & Subardjo, 2016). According to Hair, Black, Babin, & Anderson (2010 in Tentama, 2016), it is possible to test construct validity and reliability through CFA. There are several standards for determining factor loadings in CFA analysis. A factor loading weight of 0.50 or more is considered to have sufficiently strong validity to explain latent constructs (Ghozali I & Fuad, 2012; Hair et al., 2010). Sharma (1996) explains that the weakest acceptable factor loading is 0.40. This study uses the theory of Sharma, with a minimum factor loading value of 0.40.

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Convergent validity testing aims to analyze whether each item or item belongs to each dimension or aspect. This study is an exploration of ideas. As for determining convergent validity or Average Variance Extracted (AVE) using (Retnawati, 2016):

$$\omega = \frac{\left(\sum_{i=1}^{i} \lambda_i\right)^2}{\left(\sum_{i=1}^{i} \lambda_i\right)^2 + \left(\sum_{i=1}^{i} 1 - \lambda_i{}^2\right)}$$

Hair et al. (2019 in Sujati et al., 2020) recommend the extracted mean-variance (AVE) as a measure of convergent validity because AVE can explain the extent to which items are divided between constructs in structural equation modeling (SEM) where an AVE of 0.5 or more can be accepted as convergent validity.

Discriminant validity testing is a requirement in instrument development. This test aims to prove that a construct differs from others (Voorhees, Brady, Calantone, & Ramirez, 2015 in Sujati et al., 2020). The value of discriminant validity is obtained from a comparison of the cross-loading value with the AVE value that has been obtained √ $\omega$2.

In addition to testing the validity, reliability testing is also needed in developing an instrument. A reliable instrument is an instrument that can maintain the consistency of measurement results within a certain period or is used repeatedly but still provides relatively consistent results (Robert, 2006; Margono, 2015 in Sujati et al., 2020). Hair et al. (2010 in Tentama & Subardjo, 2016) state that constructs have good reliability if the Construct Reliability (CR) value is ≥ 0.70 and the variance extracted (VE) value is ≥ 0.50. The formula for determining construct reliability is as follows (Hair et al., 2010; Wijayanto, 2008):

$$CR = \frac{(\sum SLF)^2}{(\sum SLF)^2 + (\sum e)}$$

$$VE = \frac{(\sum SLF)^2}{(\sum SLF)^2 + (\sum e)}$$

## II. METHOD

The method used in this research is a quantitative approach with the cross-sectional method. Quantitative researchers use inductive reasoning to look for similar experiences, and results form new ideas, concepts, or theories (Lodico, 2010). The researcher chose this type of research because it followed the research objectives, namely that that is, researchers focus on testing the instrument's design to find the research product as a valid and reliable idea exploration test instrument.

The first step in this research is the needs analysis stage. Based on field findings, teachers need instruments to measure a variable in learning. In the second step of determining the focus of the problem, it was found that the teacher had difficulties determining indicators that measure the value of these variables, specifically on the idea exploration variable, the teacher's difficulties in determining measuring instruments and measuring scales to find out information about the level of students' idea exploration abilities. The next step is testing the test. The first test is to test the content validity (CVI) by several experts (mathematics and language), and then the results will be analyzed and corrected according to expert advice. The item is considered valid in content if it has a CVI

value ≥ 0.80. At the development stage, the researcher made 35 items representing each indicator.

The next step is a field empirical test with a specific sample size. There are several opinions about the sample size used. Schumacher & Lomax (2010 in Sujati et al., 2020) argues that to achieve proper calculations with CFA, a researcher needs 250 to 500 respondents, while Hoetler (1983 in Sujati et al., 2020) suggests 500 respondents. Comrey & Lee (1992 in Sujati et al., 2020) determined a sample size of 50 - very poor, 100 - poor, 200 - fair, 300 - good, 500 - very good, and 1000 - very good. In this study, researchers used the theory according to Comrey & Lee in the excellent category, namely, as many as 307 research subjects in the good category. After obtaining the empirical data, the researcher conducted a construct validity and reliability test, which will be described in the discussion section. There are two colors in the research design above, indicating an adaptation of steps from previous research. The yellow box is the result of adoption, and the black box is the adaptation of the procedure according to the researcher's needs.

The subjects in this study were fifth-grade elementary school students in Depok, Sleman, and Yogyakarta. There were seven schools used for data collection. There were 307 subjects in this study students who filled out the test of the idea exploration test instrument.

The name of the instrument being developed is the Idea Exploration Test Instrument. Thirty-five questions will be tested and represent five indicators of exploring ideas. Each indicator developed seven questions. Because there is one indicator that cannot be measured using an objective test, the researcher developed seven subjective questions to represent the "Using a new or different method" indicator. However, even so, data analysis was also carried out separately to avoid errors in the analysis. The following is a sample of sample items on the indicator of exploring the idea of "representing a problem by changing the mathematical model appropriately" developed in this study:

**A. An example of an indicator of A question**

Andi, Ani, and Doni are friends who often play together. One day they were going to play jump rope. Only Andi had a 3-meter-long rope, so he gave ¼ of the rope to Ani and ½ to Doni. The correct fraction to express the story is...

A. $3-\frac{1}{4}-\frac{1}{2}$ C. $3+\frac{1}{4}+\frac{1}{2}$

B. $3+\frac{1}{4}-\frac{1}{2}$ D. $3-\frac{1}{4}+\frac{1}{2}$

**B. An example of an indicator of B question**

Pak Doni memiliki halaman yang luasnya 2 1/4 km, 1/3 km akan ditanami sayur tomat dan sisanya akan dibuat untuk lahan cabai. Langkah penyelesaian yang tepat untuk mencari sisa lahan yang akan digunakan untuk menanam cabai adalah...

$A.\ 2\frac{1}{4}-\frac{1}{3}$

$\frac{10}{4}-\frac{1}{3}$

$\frac{30-4}{12}=\frac{26}{12}=2\ \frac{1}{6}$

$B.\ 2\frac{1}{5}-\frac{1}{5}$

$\frac{10}{5}-\frac{1}{5}$

$\frac{30-4}{12}=\frac{26}{12}=2\ \frac{1}{6}$

$C.\ 2\frac{1}{4}+\frac{1}{3}$

$\frac{10}{4}+\frac{1}{3}$

$D.\ 2\frac{1}{4}-\frac{1}{3}$

$\frac{12}{4}-\frac{1}{3}$

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$\frac{30+4}{12} = \frac{26}{12} = 2\ \frac{1}{6}$ $\frac{36-4}{12} = \frac{32}{12} = 2\ \frac{3}{4}$

**C. An example of an indicator of C question**

Hari ini Ani membeli terigu 1 kg, Ia telah menggunakan ¼ kg untuk membuat mie, dan ½ kg untuk membuat martabak. Sisa tepung terigu yang dimiliki Ani adalah… kg.

A. 4 C. $\frac{1}{2}$

B. $\frac{1}{4}$ D. $\frac{1}{3}$

**D. An example of an indicator of D question**

Pak Budi membeli ¼ ton batok kelapa kemarin. Hari ini ia membeli lagi ½ ton. Ternyata semua batok yang dibeli Pak Budi hari ini dan kemarin dibeli oleh 3 orang dengan jumlah pembelian yang sama. Cara yang sistematis untuk mencari berat batok yang dibeli masing-masing pembeli adalah...

A. $\left(\frac{1}{4}+\frac{1}{2}\right)x3 =$
$\frac{1+2}{4}x\ 3 =$
$\frac{3}{4}x3 = \frac{9}{4}$

C. $\left(\frac{1}{4}-\frac{1}{2}\right)x3 =$
$\frac{1-2}{4}x\ 3 =$
$\frac{-1}{4}x3 = \frac{3}{4}$

B. $\left(\frac{1}{4}+\frac{1}{2}\right):3 =$
$\frac{1+2}{4}:3 =$
$\frac{3}{4}:3 = \frac{3}{12} = \frac{1}{4}$

D. $\left(\frac{1}{4}+\frac{1}{2}\right):3 =$
$\frac{1+2}{4}:3 = \frac{3}{4}:3 = \frac{9}{4}$

**E. An example of an indicator of E question**

Wahyu memiliki toples berisi permen dengan berat 4 1/2 kg. Jika tanpa permen tersebut berat toplesnya adalah 3/4 dari berat sebelumnya. Buktikan menggunakan cara kamu sendiri apakah benar jika berat toplesnya saja adalah 3 3/8 kg!

Jawab: ……

Data analysis in this study was carried out quantitatively descriptive, including analysis of an instrument's validity and reliability. Confirmatory Factor Analysis (CFA) can be used to determine construct validity and instrument reliability. Thus, the results of calculations through the application of SPSS 26 and Lisrel 8.80 will be presented quantitatively and described by the researcher.

## III. RESULTS AND DISCUSSION

Based on the results of the field test, which 307 students attended, the data results were processed for analysis. There are several sub-sections in this part. The researcher will explain, starting from the instrument content validity test results, the different power tests of the items through SPSS 26, CFA analysis, convergent validity analysis, discriminant validity, and reliability.

### A. Content Validity

Content validity aims to realize good content validity and must be used with various qualitative and quantitative methods to assess all elements of the assessment instrument. In the early stages of developing the instrument, the purpose of content validation was to reduce the variation in the potential for instrument manufacturing errors and to increase the possibility of obtaining a construct validity index in follow-up studies. The item is considered valid in content if it has a CVI value ≥ 0.80. Experts carried out the content validity stage. In this study, they were mathematicians and linguists. Th(Tentama & ., 2018)e total score of R1 = 175, a total score of R2 = 199, and a total score of R3 =

181, with 30 items valid in content and five items receiving notes that can be used with revision. In this case, the researcher revises and submits a re-validation of the five questions.

**B. Problem Difference Power Index**

The differentiating power test is carried out to determine the intensity of a question in terms of difficulty. A discriminating power is needed, namely the ability between items to distinguish between students who master the material being tested and students who have not mastered the material being tested (Fatimah, 2019). An item is said to have good discriminating power if it has an item discrimination index range (D) of 0.40 – 0.70. In this stage, differential power analysis is also used to select item items with good discriminating power so that they can be analyzed using the lisrel 8.80. Distinguishing power analysis was carried out using SPSS 26, with the following results:

Table 2.
Results of Power Difference Analysis

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| A1 | 20,76 | 19,068 | 0,553 | 0,782 |
| A2 | 20,77 | 19,017 | 0,554 | 0,781 |
| A3 | 20,89 | 19,654 | 0,269 | 0,793 |
| A4 | 20,89 | 20,142 | 0,145 | 0,799 |
| A5 | 20,86 | 18,934 | 0,479 | 0,783 |
| A6 | 20,85 | 19,912 | 0,218 | 0,795 |
| A7 | 20,92 | 20,543 | 0,042 | 0,804 |
| B1 | 20,78 | 18,995 | 0,537 | 0,781 |
| B2 | 20,85 | 18,938 | 0,482 | 0,783 |
| B3 | 20,85 | 19,932 | 0,213 | 0,796 |
| B4 | 20,83 | 19,941 | 0,221 | 0,795 |
| B5 | 20,79 | 19,290 | 0,434 | 0,786 |
| B6 | 20,89 | 19,899 | 0,203 | 0,796 |
| B7 | 20,85 | 18,938 | 0,482 | 0,783 |
| C1 | 20,79 | 18,934 | 0,551 | 0,781 |
| C2 | 20,87 | 20,251 | 0,123 | 0,800 |
| C3 | 20,85 | 20,235 | 0,134 | 0,799 |
| C4 | 20,86 | 20,202 | 0,140 | 0,799 |
| C5 | 20,85 | 19,827 | 0,240 | 0,794 |
| C6 | 20,76 | 18,994 | 0,572 | 0,781 |
| C7 | 20,72 | 19,390 | 0,502 | 0,785 |
| D1 | 20,89 | 20,197 | 0,132 | 0,800 |
| D2 | 20,72 | 19,521 | 0,455 | 0,786 |
| D3 | 20,73 | 19,244 | 0,541 | 0,783 |
| D4 | 20,85 | 19,912 | 0,218 | 0,795 |
| D5 | 20,75 | 19,112 | 0,556 | 0,782 |
| D6 | 20,99 | 20,359 | 0,078 | 0,803 |
| D7 | 20,89 | 19,899 | 0,203 | 0,796 |
| E1 | 10,9381 | 30,660 | 0,237 | 0,698 |
| E2 | 11,0586 | 28,814 | 0,396 | 0,661 |
| E3 | 11,5016 | 28,238 | 0,351 | 0,672 |
| E4 | 11,5993 | 26,254 | 0,469 | 0,639 |
| E5 | 11,6906 | 27,142 | 0,457 | 0,644 |
| E6 | 11,7915 | 27,166 | 0,430 | 0,651 |
| E7 | 11,8241 | 26,315 | 0,467 | 0,640 |

Of the 35 items analyzed, the researcher only took 17 with good discriminatory power, namely > 0.40. This condition is the same as Retnawati (2016) states that the minimum value of the differential power is 0.40. Among these items were good are A1, A2, A5, B1, B2, B5, B7, C1, C6, C7, D2, D3, D5, E4, E5, E6 and E7.

**C. Confirmatory Factor Analysis (CFA)**

As was written in the previous section, CFA analysis is used to carry out model measurements to describe aspects and indicators in reflecting latent variables by looking at the factor loading of each aspect that forms a construct. Of the 35 item items that have been tested for discriminatory power, 17 items are in good criteria to be able to analyze CFA at lisrel 8.80, and the following is the result of the calculation:

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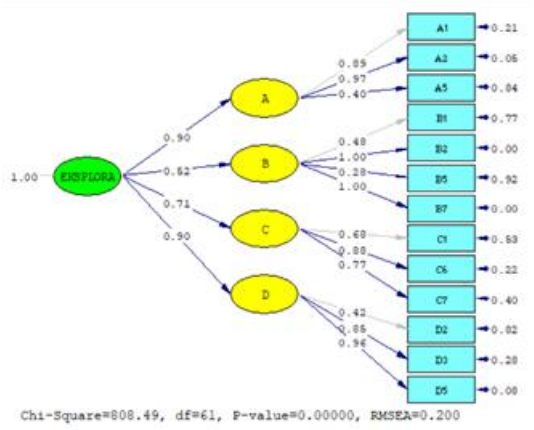


Figure 1. CFA Analysis of Indicator A, B, C, D.

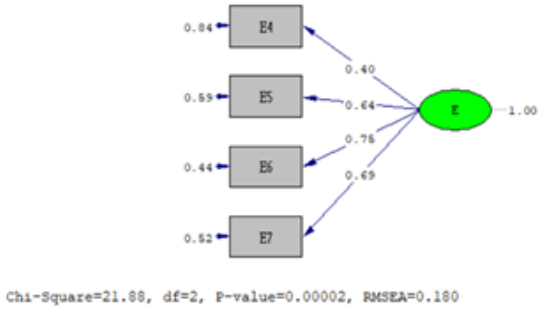


Figure 2. CFA Analysis of Indicator E.

There are two path diagrams: figure 2 shows CFA analysis from indicators A, B, C, and D, and Figure 3 shows CFA analysis from indicator E. CFA analysis is carried out separately because indicator E uses subjective questions while indicators A, B, C, D use objective matter in this study using the theory of Sharma (1996), with a minimum factor loading value of 0.40. So, the acceptable factor loading values are indicators A1, A2, A5, B1, B2, B7, C1, C6, C7, D2. D3, D5, E4, E5, E6 and E7. From the previous 17 item questions, after CFA analysis, there are 16 remaining item questions. The explanation of codes A, B, C, D, and E is in Table 1.

## D. Convergent Validity and Discriminant Validity

Convergent validity testing aims to analyze whether each item or item belongs to each dimension or aspect. This study is an exploration of ideas. In this case, using Retnawati's formula (2016). While testing discriminant validity aims to prove that a construct differs from others. The test results can be seen in Table 3.

Table 3.
Convergent Analysis Results and Discriminant Validity

| Aspect | Item | λ | Λ² | 1- λ² | ω | √ω² |
|---|---|---|---|---|---|---|
| A | A1 | 0,89 | 0,7921 | 0,2079 | 0,631 | 0,79436 |
| | A2 | 0,97 | 0,9409 | 0,0591 | | |
| | A5 | 0,4 | 0,16 | 0,84 | | |
| ∑ | | 2,26 | 1,893 | 1,107 | | |
| B | B1 | 0,48 | 0,2304 | 0,7696 | 0,74347 | 0,86225 |
| | B2 | 1 | 1 | 0 | | |
| | B7 | 1 | 1 | 0 | | |
| ∑ | | 2,48 | 2,2304 | 0,7696 | | |
| C | C1 | 0,68 | 0,4624 | 0,5376 | 0,6099 | 0,78096 |
| | C6 | 0,88 | 0,7744 | 0,2256 | | |
| | C7 | 0,77 | 0,5929 | 0,4071 | | |
| ∑ | | 2,33 | 1,8297 | 1,1703 | | |
| D | D2 | 0,42 | 0,1764 | 0,8236 | 0,60683 | 0,779 |
| | D3 | 0,85 | 0,7225 | 0,2775 | | |
| | D5 | 0,96 | 0,9216 | 0,0784 | | |
| ∑ | | 2,23 | 1,8205 | 1,1795 | | |
| E | E4 | 0,4 | 0,16 | 0,84 | 0,37737 | 0,6143 |
| | E5 | 0,64 | 0,4096 | 0,5904 | | |
| | E6 | 0,75 | 0,5625 | 0,4375 | | |
| | E7 | 0,69 | 0,4761 | 0,5239 | | |
| ∑ | | 2,48 | 1,1321 | 1,8679 | | |

Based on Table 3, we can see each aspect's AVE value and discriminant validity, according to Hair et al. (2019 in Sujati et al., 2020), where an AVE value of 0.5 or more can be accepted as convergent validity. Based on this theory, aspect E is invalid because the AVE value is 0.37737 or less than 0.5 of the five aspects. While other aspects, namely aspect A = 0.631, aspect B = 0.74347, aspect C = 0.6099, and aspect D = 0.60683, are categorized as convergently valid because they have an AVE value of more than 0.5.

Meanwhile, the discriminant validity analysis can meet the criteria if the square root of the AVE is greater than the correlation between constructs. Because aspect E did not meet the convergent validity criteria, it was not included in the discriminant validity analysis. The results can be shown in the table below:

Table 4.
Discriminant Validity

| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | **0,79436** | | | | |
| B | 0,607 | **0,86225** | | | |
| C | 0,456 | 0,428 | **0,78096** | | |
| D | 0,604 | 0,567 | 0,463 | **0,779** | |
| E | - | - | - | - | **0,6143** |

Based on Table 4, we can conclude that aspects A, B, C, and D meet discriminant validity criteria. These results follow the criteria we use: according to Hair et al. (2010) and Wijayanto (2008), the minimum value of AVE is 0.50.

### E. Reliability

An instrument is reliable if it meets the criteria for a CR coefficient > 0.70. This was disclosed by Hair et al. (2010), which stated that the construct has good reliability if the value of Construct Reliability (CR) ≥ 0.70 and the value of variance extracted (VE) ≥ 0.50. The following is the result of reliability analysis using CFA results:

Table 5.
Reliability Analysis

| Aspect | CR | VE |
|---|---|---|
| A | 0,8228 | 0,63248 |
| B | 0,88873 | 0,74337 |
| C | 0,8252 | 0,61406 |
| D | 0,80822 | 0,60673 |

Table 5 shows that the CR values of aspects A, B, C, and D are≥ 0.70, and the VE values of aspects A, B, C, and D are≥ 0.50. Thus, the idea of exploration test instrument items are said to be reliable or consistent.

## IV. CONCLUSION

Based on these results and discussion, it can be concluded that from the aspects given, there are four aspects that meet the criteria as constructively valid instruments, namely those that meet a CFA value > 0.40 and AVE > 0.50 are said to be constructively valid and CR ≥ 0.70 and the value of variance extracted (VE) ≥ 0.50 are said to be reliable. Where from the 35 items developed there are still 12 items remaining and can be used with valid and reliable criteria. So, it can be concluded that the 12 items in the idea exploration test instrument are feasible and can be used to measure students' idea exploration abilities. The results of this study are expected to have implications for the quality of the use of idea-based mathematical test instruments in elementary schools.

## REFERENCES

Afriansyah, E. A. (2017). Desain Lintasan Pembelajaran Pecahan melalui Pendekatan Realistic Mathematics Education. *Mosharafa: Jurnal Pendidikan Matematika*, *6*(3), 463-474.

Akbar, P., Hamid, A., Bernard, M., Sugandi, A. I., Disposition, M., & Matematik, D. (2018). Analisis Kemampuan Pemecahan Masalah dan Disposisi Matematik Siswa Kelas XI SMA Putra Juang dalam Materi Peluang. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 2*(1), 144–153. https://doi.org/10.31004/cendekia.v2i1.62

p-ISSN: 2086-4280
e-ISSN: 2527-8827

Akhdiyat, A. M., & Hidayat, W. (2018). Pengaruh kemandirian belajar matematik siswa terhadap kemampuan berpikir kreatif matematis siswa sma. *JPMI: Jurnal Pembelajaran Matematika Inovatif, 1*(6), 1045–1054. https://doi.org/10.22460/jpmi.v1i6.p1045-1054

Almeida, D. (2003). Engendering proof attitudes: Can the genesis of mathematical knowledge teach us anything?. *International Journal of Mathematical Education in Science and Technology, 34*(4). https://doi.org/10.1080/00207390310001085 74

Aminah, N., Maat, S. M., & Sudarsono, S. (2023). Computational Thinking of Prospective Mathematics Teacher Viewed from Entrepreneur Character. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(2), 267-278.

Amir, Z., & Risnawati. (2015). *Psikologi Pembelajaran Matematika (1st ed.)*. Aswaja Pressindo.

Aprilia, I. S., & Diana, H. A. (2023). Pembelajaran CORE Terhadap Kemampuan Berpikir Kritis Matematis Siswa Taruna Terpadu Bogor. *Plusminus: Jurnal Pendidikan Matematika*, *3*(1), 83-92.

Aswita, D., Nurmawati, Salamia, Sarah, S., Saputra, S., Kurniawan, E. S., Yoestara, M., Fazilla, S., Zulfikar, Putri, Z., Iqbal, M., & Ismail, N. M. (2022). *Pendidikan Literasi Memenuhi Kecakapan Abad 21*. K Media.

Bramantyo. (2021). *Teknik Berpikir Kreatif*. Uwais Inspirasi Indonesia.

Dewi, N. R. (2020). *Monograph Pengembangan Pembelajaran Prepospec Berbatuan TIK untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Mahasiswa*. Penerbit Lakeisha.

Elyana, D., Astutiningtyas, E. L., & Susanto, H. A. (2023). Kesalahan Siswa dalam Menyelesaikan Soal Garis Singgung Lingkaran. *Plusminus: Jurnal Pendidikan Matematika*, *3*(1), 93-106.

Fatimah, L. U. (2019). Analisis Kesukaran Soal, Daya Pembeda dan Fungsi Distraktor. *Jurnal Komunikasi Dan Pendidikan Islam, 8*(2). https://doi.org/10.36668/jal.v8i2.115

Ghozali I, & Fuad. (2012). *Structural equation modeling, teori,konsep dan aplikasi dengan program LISREL 8,8*. Universitas Diponegoro.

Hair, J. ., Black, W. ., Babin, B. ., & Anderson, R. . (2010). *Multivariate data analysis*. Prentice Hall.

Hasanudin, H., & Maryati, I. (2023). Kemampuan pemahaman konsep matematis peserta didik kelas v pada materi akar pangkat tiga. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, *2*(2), 193-204.

Hayuhantika, D., & Rahayu, D. S. (2019). Eksplorasi Ide - Ide Matematika pada Kesenian Reyog Tulungagung. *Jurnal Penelitian Dan Riset Matematika, 2*(1), 1–14. https://doi.org/10.33503/prismatika.v2i1.545

Herawati, T., Hidayati, W. S., & Iffah, J. D. N. (2023). Students' Higher Order Thinking Process in Solving Math Problems by Gender. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(2), 255-266.

Ilma, A. Z., Budiharti, R., & Ekawati, E. Y. (2021). Eksperimentasi Model Discovery Learning dan Problem Based Learning Didukung Modul LCDS Ditinjau dari Ketekunan Belajar Peserta Didik. 11, 17–24.

Indriyani, M. (2019). Peningkatan Kemampuan Disposisi Matematika Siswa Melalui Pendekatan Pembelajaran Model STAD (Student Team Achievement Division). *PEDIAMATIKA: Journal of Mathematical Science and Mathematics Education, 01*(01), 103–112.

Istiqomah, & Saeful, A. (2007). *Matematika SD : Ringkasan Teori Latihan Soal dan Pembahasan Evaluasi*. Agro Media Pustaka.

Ja'far, M. (2014). Pengembangan Perangkat Pembelajaran Berbasis Karakter Konsisten dan Teliti Menggunakan Pendekatan Realistic Mathemathic Education (RME) Pada Bab Kesebangunan dan Kekongruenan Bangun. JUKASI: *Jurnal Edukasi, 1*(3). https://doi.org/10.19184/jukasi.v1i1.3398

Lahida, Y., & Jailani. (2015). Analisis Proses Pemecahan Masalah Matematika Siswa Sekolah Menengah Pertama. *Jurnal Riset Pendidikan Matematika, 2*(1). https://doi.org/10.21831/jrpm.v2i1.7157

Lin, S.-W., & ChunTai, W. (2016). A Longitudinal Study for Types and Changes of Students' Mathematical Disposition. *Universal Journal of Educational Research, 4*(8), 1903–1911. https://doi.org/10.13189/ujer.2016.040821

Lodico, M. G. (2010). *Methods in Educational Research from Theory to Practice*. Jossey-Bass.

Mardhiyana, D., Octaningrum, E., & Sejati, W. (2016). Mengembangkan Kemampuan Berpikir Kreatif dan Rasa Ingin Tahu Melalui Model Pembelajaran Berbasis Masalah. *Prosiding Seminar Nasional Matematika*, 672–688.

Maulyda, M. A. (2020). *Paradigma Pembelajaran Matematika Berbasis NCTM* (Issue January).

Miarsyah, M., Sigit, D. V., Ichsan, I. Z., Fadrikal, R., & Suprapto, M. (2019). Lekersmulia: Improving indonesian students' environmental responsibility using multimedia in environmental learning. *International Journal of Scientific and Technology Research, 8*(12), 1639–1643.

Puspita, T., Muzdalipah, I., & Nurhayati, E. (2023). Kemampuan Penalaran Proporsional pada Materi Perbandingan. *Plusminus: Jurnal Pendidikan Matematika*, *3*(1), 107-116.

Puspitaningrum, H. Z., & Astutik, S. (2018). Lembar Kerja Siswa Berbasis Collaborative Creativity Untuk Melatihkan Kemampuan Berargumentasi Ilmiah Siswa SMA. *Prosiding Seminar Nasional Quantum #25*, 159–164.

Rahmayani, S. A., Susanto, S., & Suwito, A. (2023). Analysis of Middle School Students' Mathematical Representation Ability on Triangle Material Based on Learning Style. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(2), 279-290.

p-ISSN: 2086-4280
e-ISSN: 2527-8827

Retnawati, H. (2016). *Validitas reliabilitas dan karakteristik butir*. Parama Publishing.

Robiah, S., & Nuraeni, R. (2023). Pengaruh kepercayaan diri terhadap kemampuan komunikasi matematis siswa mts pada materi himpunan. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, *2*(2), 215-228.

Rusdiana. (2012). *Pendidikan Kewirausahaan*. Insan Komunika.

Santosa, C. A. H. (2013). Mengatasi Kesulitan Mahasiswa Ketika Melakukan Pembuktian Matematis Formal. *Jurnal Pengajaran MIPA, 18*(2). https://doi.org/10.18269/jpmipa.v18i2.36130

Setyo, A. A., Fathurahman, M., & Anwar, Z. (2020). Model Pembelajaran Problem Based Learning Berbantuan Software Geogebra untuk Kemampuan Komunikasi Matematis dan Self Confidence Siswa SMA. Yayasan Barcode.

Sharma, S. (1996). *Applied multivariate techniques. John Wiley & Sons*. Inc.

Siregar, B. H., Kairuddin, K., Mansyur, A., & Yusoff, N. S. M. (2023). Innovation in The Development of an Electronic Practicum Book of IT-Based Learning Media Oriented to The Team-Based Project. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(2), 243-254.

Siregar, H. T., & Halawa, T. S. (2021). Perbaikan Pembelajaran dengan Menggunakan BUPENA pada Percobaan Tema Bagian Tumbuh - Tumbuhan dan Fungsinya di Kelas IV SD Negeri 068007 Medan Tuntungan. *SEJ (School Education Journal), 11*(2), 2020–2021. https://doi.org/10.24114/sejpgsd.v11i2.27201

Sitepu, A. S. menda B. (2019). *Pengembangan Kreatifitas Siswa*. Guepedia Publisher.

Sujati, H., Sajidan, Akhyar, M., & Gunarhadi. (2020). Testing the construct validity and reliability of curiosity scale using confirmatory factor analysis. *Journal of Educational and Social Research, 10*(4), 229–237. https://doi.org/10.36941/JESR-2020-0080

Suwanto, F. R., Wijaya, A., Aprisal, A., Fauzi, A., & Tobondo, Y. V. (2023). Realistic Mathematics Textbook Toward the Students' Mathematical Generalization Skills. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(2), 291-300.

Tamardiyah, N. D. (2017). Minat Kedisiplinan dan Ketekunan Belajar Terhadap Motivasi Berprestasi dan Dampaknya pada Hasil Belajar Matematika SMP. *Jurnal Manajemen Pendidikan, 12*(1).

Tentama, F., & . S. (2018). Pengujian Validitas dan Reliabilitas Konstruk pada Organizational Citizenship Behavior. *Humanitas, 15*(1), 62. https://doi.org/10.26555/humanitas.v15i1.5282

Wei, Y., Zhang, Q., & Guo, J. (2022). Can Mathematical Modelling Be Taught and Learned in Primary Mathematics Classrooms: A Systematic Review of Empirical Studies. *Education Sciences, 12*(12).

https://doi.org/10.3390/educsci12120923

Wijayanto, S. H. (2008). *Structural Equation Modeling dengan LISREL 8.8*. Graha Ilmu.

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