MATHEMATIC CREATIVE THINKING ABILITY INSTRUMENTS TO SOLVE CUBE AND RECTANGULAR PRISM VOLUME PROBLEMS FOR ELEMENTARY SCHOOL STUDENTS

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Abstract:

Mathematical creative thinking skills can help students solve mathematical problems with diverse, unique, and detailed solutions and strategies. The aim of this study is to produce instruments capable of obtaining information about students' mathematical creative thinking abilities. Research and Development are applied in this research. The population of this research was sixth-grade elementary school students in Jakarta and West Java. The participants were 33 students in East Jakarta and 15 students in Purwakarta. The sample is based on purposive sampling. The instrument developed was an essay test question. The results of expert validation indicate that the instrument is suitable for use with improvement. The item validity test shows the three items are considered accurate with the sig. < 0.05, and $r_{count} > r_{table}$ and is positive. The instrument is considered consistent for measuring mathematical creative thinking skills with Cronbach's Alpha > 0.7. The difficulty level of the three items is moderate and is in the range of 0.3-0.7. The discrimination power of the questions is very good with a discrimination power index > 0.30. Thus, the mathematical creative thinking skill instrument can be used for further research to understand the mathematical creative thinking ability of fifth-grade elementary school students.

Keywords: Mathematics creative thinking skills, Instruments, Cube and Rectangular Prism

INSTRUMEN KEMAMPUAN BERPIKIR KREATIF MATEMATIS UNTUK MEMECAHKAN MASALAH VOLUME KUBUS DAN BALOK SISWA SEKOLAH DASAR

Abstrak:

Kemampuan berpikir kreatif matematis dapat membantu siswa memecahkan masalah matematis dengan solusi dan strategi yang beragam, unik serta detail. Tujuan riset ini adalah untuk memproduksi instrumen yang mampu mendapatkan informasi tentang kemampuan berpikir kreatif matematis siswa. Research and Development diterapkan dalam riset ini. Populasi penelitian ini adalah siswa kelas enam SD di Jakarta dan Jawa Barat. Partisipan sebanyak 33 siswa di Jakarta Timur dan 15 siswa di Purwakarta. Sampel berdasarkan purposive sampling. Instrumen yang dikembangkan adalah soal tes esai. Hasil validasi ahli mengisyaratkan instrumen layak digunakan dengan perbaikan. Pengujian validitas item menunjukkan ketiga item dianggap akurat dengan sig. < 0,05, dan $r_{hitung} > r_{table}$ dan bernilai positif. Instrumen dianggap konsisten untuk mengukur kemampuan berpikir kreatif matematis dengan Cronbach's Alpha > 0,7. Tingkat kesukaran ketiga item tergolong sedang dan berada pada rentangan 0.3-0.7. Daya beda soal tergolong sangat baik dengan indeks daya beda > 0,30. Sehingga instrumen kemampuan berpikir kreatif matematis ini dapat dimanfaatkan untuk

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penelitian lebih lanjut untuk memahami kemampuan berpikir kreatif matematis siswa kelas lima sekolah dasar

Kata Kunci: Kemampuan Berpikir Kreatif Matematis, Instrument, Kubus dan Balok

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INTRODUCTION

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Mathematical creative thinking skills are one of the abilities that students in the 21st century must have and are classified as abilities that require deep thinking. This is because mathematical creative thinking skills are included in High-Order Thinking Skills (HOTS) (Pitrianti, 2017). The study says HOTS requires a higher thinking process than just restating the accessed facts (Kusumastuti, Fauziati, & Marmanto, 2019). Teachers must familiarize students with HOTS questions to find out students' mathematical creative thinking skills, if this is not what the teacher does, knowing mathematical creative thinking skills will not be observed, trained and students will find it difficult and anxious because they are not practiced to it. Research says students are worried about being asked to do higher-order thinking problems (Rahayu & Ulya, 2017).

Mathematical creative thinking skills are suggested to be taught since students are still in elementary school so that they are accustomed to thinking creatively so that they can solve all aspects of problems (Arifuddin, 2019). Students who have excellent mathematical creative thinking skills are easier to receive lessons (Rambe, Sinaga, & Yusnadi, 2018). Mathematical creative thinking skills will encourage students to increase their capacity to solve problems (Şener, Türk, & Taş, 2015). Students who can think mathematically creatively will be able to have ideas to solve problems systematically, critically, and communicate effectively (McGuinness, 1999). Thus, the capacity to think mathematically creatively is considered to be able to help students solve mathematical problems which are of course very much needed by elementary students in everyday life.

Reviewing the results of the 2018 PISA Indonesia ranking study there was a decrease compared to 2015. The study compared the math problem-solving skills, reading, and science performance of several children (Tohir, 2019). It is necessary to understand that the standard in measuring PISA is based on the HOTS-based learning level (Fitriyah, 2020). Meanwhile, mathematical creative thinking skills have been understood as part of the HOTS level (Ariyana, Pudjiastuti, Bestary, & Zamromi, 2018). Thus, it is important to teach and train mathematical creative thinking skills from an early age so that students can solve problems, read, and perform well in science. Also, HOTS questions have now been applied to the National Examination as an implementation of the 2013 Curriculum which requires students to have HOTS. (Oktiningrum & Wardhani, 2019).

Today's education is required can develop 21st-century competencies and HOTS. Reviewing the goals of National Education which functions to develop abilities and shape the character and civilization of a nation with dignity to educate the nation's life, develop the potential of students to believe and fear God Almighty, knowledgeable, competent, creative, democratic and responsible (Kemendikbud, 2003). This goal that students must have good mathematical creative thinking skills.

Furthermore, this study will reveal students' mathematical creative thinking skills in mathematics learning in elementary schools. Mathematics learning goals include: Understand mathematical concepts, explain the relationship of concepts and apply concepts of algorithms, are flexible, accurate, efficient, and precise in problem-solving; Using pattern and trait reasoning, performing mathematical manipulations and making generalizations, compiling evidence, or explaining mathematical ideas and statements. Solving problems includes the capability to understand problems, design mathematical models, solve models and interpret solutions; Communicate ideas with symbols, tables, diagrams, or the like to clarify the problem; Having an attitude of appreciating the usefulness of mathematics, namely curiosity, attention, and interest in learning mathematics, as well as being resilient and confident in solving problems (National Council of Teachers of Mathematics, 2000; National Research Council, 2001). Based on these goals, the capacity to think mathematically creative in solving problems is needed to achieve these goals.

The capacity to think creatively in mathematics is capacity to provide various answers to a problem, see the problem not only from one point of view, record problems in detail, reveal solutions in different ways than ever before, and explore various answers (Rosyanti, Rohaendi, & Zanthy, Sylviana, 2019). The study says that elementary students' creative thinking processes in solving mathematical problems are realized by generating ideas to identify known information, using different approaches to planning problem solving, and producing creative products that meet aspects of flexibility (Ishabu, Budayasa, & Siswono, 2019). Mathematical creative thinking skills as an orientation to mathematical instruction, including discovery and problem-solving tasks (Moma, 2016). The description of mathematical creative thinking skills shows that the capacity to think creative mathematically is the skill of students to find solutions to various problems in terms of answers, strategies, novelty, and describes in detail through logical processes and previously acquired knowledge.

The study reveals four criteria for mathematical creative thinking skills, namely fluency, flexibility, originality, and elaboration. Fluency is the capacity to easily generate many different ideas produced in a given time. Flexibility is the number of various strategies that go through during the exploration of ideas. Originality is the uniqueness of an idea in extraordinarily solving problems. Elaboration refers to the detailed and in-depth analysis of related ideas (Evans, 1994; Firdaus, As'ari, & Qohar, 2018; Wang, Wu, & Horng, 1999; Yani & Oikawa, 2019). Mathematical creative thinking skills involve the capability to find novelty. It involves flexibility, originality, fluency, elaboration, brainstorming, modification, delusional, associative thinking, attribute lists, and metaphorical thinking. The indicator used to measure the capacity to think creative mathematically in this study is fluency which is the capacity to produce more than one answer in solving mathematical problems, flexibility which is the capacity to produce answers that vary in solving mathematical problems, originality which is the capacity to produce unique answers in solving problems mathematically, the last is elaboration, namely the capacity to develop detailed answers in solving mathematical problems.

To understand students' mathematical creative thinking skills comprehensively, there must be a measuring instrument in the form of an instrument that can measure mathematical creative thinking skills appropriately and can be adapted by other teachers. The achievement of mathematical creative thinking skills can be measured by identifying it through open questions (Indah, Budiarto, & Lukito, 2018; Jaenudin, Kartono, Sukestiyarno, & Mariani, 2020). Studies suggest mathematical creative thinking skills can be measured by tests (Suwandari & Ibrahim, 2019). Thus, to measure the mathematical creative thinking skills of elementary school students using an open test type test instrument on the problem-solving material of volume cubes and rectangular prism.

The right instrument consists of a series of questions that gather information relevant to the research (Walton, 1997). A good test instrument is a test instrument that meets several requirements, namely valid, has high reliability, good minimum differentiation, and has a moderate level of difficulty. (Puspaningtias, Yunarti, & Yunarti, 2017). Supporting the statement, validity is defined as the extent to which the assessment accurately measures what it is intended to measure (Ramaligela, 2021). Furthermore, a reliable instrument provides a consistent characteristic measure despite fluctuations in its background (Putri, Wahyudy, Yuliyanto, & Nuraeni, 2020). Meanwhile, the difficulty level shows the balance between easy and difficult items, and there are more easy questions between the two or show a normal curve (Lu, 2015; Raharjo, Ramli, & Rinanto, 2019). The discrimination power is the assessment of the test questions to determine the ability of the test questions to discrimination students who are classified as capable and those classified as incapable (Ndiung & Jediut, 2020). Thus, a good test instrument is an instrument that has accuracy in measuring the variables under study (validity), is consistent in measuring under certain conditions (reliability), is not too easy and not too difficult (level of difficulty), and can distinguish between high-class students, medium, and low in response to instruments (discrimination power). Development of a test instrument with several criteria to see the success of the product (Mutmainna, Mania, & Sriyanti, 2018).

Thus, the goals of this research was to produce an instrument to measure students 'mathematical creative thinking skills on the volume of cubes and the rectangular prism of elementary school students that were accurate, consistent, had moderate difficulty, and was able to classify students' abilities well.

METHODS

The Research and Development method is applied to produce an instrument capable of measuring the mathematical creative thinking skills of fifth-grade elementary school students in problem-solving material volume cubes and rectangular prism. Sixth-grade students in Jakarta and West Java were the populations of this study. The sampling technique was purposive sampling. The participants were 48 students consisting of 33 students in East Jakarta, Jakarta, and 15 students in Purwakarta, West Java. The instrument developed was an open test related to solving the volume problem of cubes and rectangular prism. The blueprint of the mathematical creative thinking skills instrument is presented in table 1 below:

Table 1. Blueprint of Mathematical Creative Thinking Skills Instruments

Indicators Mathematical Creative Thinking Skills	Learning Indicators	Cognitive Level	Questions	Item
1. Fluency is the capability to generate more than one answer to an open problem about the volume of cubes and rectangular prism 2. Flexibility is the capacity to apply various strategies to problems related to the volume of cubes and rectangular prism 3. Originality is the ability to generate unique and unprecedented answers to open problems about the volume of cubes and rectangular prism 4. Elaboration, namely the ability to develop detailed answers to open problems about the volume of cubes and rectangular prism	4.5 Solving problems related to the volume of a space using units of volume (such as unit cubes) involving cubes and cube roots	Create	Draw as many pairs of rubics (A) as a cube and tissue holder (B) in the shape of a rectangular prism with the same volume but different surface areas, and find the edges!	1
		Analysis	The rectangular prism-shaped aquarium can accommodate 5 dm^3 of water. If the 2 cm small dice are stacked from the bottom of the aquarium to the surface, 10 dice are needed, so the height of the rectangular prism = the height of 10 piles of small cubes. What length and width might the aquarium have?	2
		Create	Determine the names and areas of objects around you in the form of a rectangular prism with a volume between 250 to 500 cm^3!	3

The scoring guide for mathematical creative thinking skills modifies the rubric developed by (Bosch, 1997) as follows:

Table 2. Guidelines for Scoring Mathematical Creative Thinking Skills

Indicators	Response to Problems	Score
Fluency is the ability to generate more than one answer to an open problem about the volume of cubes and rectangular prism	Does not produce solutions that are relevant to the problem	0
	Produce a solution that is relevant to the problem given but is less clear in its writing	1
	Produce a solution that is relevant to the given problem and is quite clear and complete in writing	2
	Produce more than one solution that is relevant to the problem but is less clear in its writing	3
	Produce more than one relevant solution in solving the problem and is quite clear and complete in writing	4
Flexibility is the capacity to apply various strategies to problems	Doesn't come up with a solution or come up with a solution in one or more ways but all are wrong	0
	Producing solutions in one way but there are inaccuracies in the calculation process and produce wrong solutions	1

related to the volume of cubes and rectangular prism	Produce solutions with one strategy with the calculation process and produce the correct solution	2
	Producing solutions for more than one strategy, but there are incorrect answers because there are inaccuracies in the calculation process	3
	Produce solutions for more than one strategy with the calculation process and produce the correct solution	4
Originality is the ability to generate unique and unprecedented answers to open problems about the volume of cubes and rectangular prism	Doesn't come up with solutions or come up with wrong solutions	0
	Come up with a solution with their strategy but difficult to understand.	1
	Produce solutions with their strategies, and the calculation process is directional but not precise	2
	Producing solutions with their strategies but there are inaccuracies in the calculation process resulting in wrong answers	3
	Produce solutions with their strategies through the calculation process and the results are correct.	4
Elaboration, namely the ability to develop detailed answers to open problems about the volume of cubes and rectangular prism	Doesn't come up with solutions or come up with wrong solutions	0
	There is an inaccuracy in developing the strategy without being detailed.	1
	There is inaccuracy in developing the strategy and it is accompanied by less detailed details	2
	Developing the strategy accurately and its completion steps but incomplete	3
	Developing the strategy accurately and complete	4

The development of instruments to measure mathematical creative thinking skills is carried out with logical and empirical validity. Logical validity is through the consideration of three experts in the field of mathematics education and elementary school education including mathematics lecturers and graduate masters of mathematics interest in the Elementary Education Program of the School of Postgraduate Studies of the Universitas Pendidikan Indonesia, as well as elementary school teachers who teach in high grades. The aspects that are evaluated in logical validity are the accuracy of the instrument items to be reviewed with the material, the accuracy of the contents used in the instrument, the sentence structure used does not offend certain individuals.

Empirical validity testing is carried out on subjects who are not examined in the research of students' mathematical creative thinking skills who are at least one level above the subject to be studied, i.e., students in sixth-grade elementary schools. The reason is that the subject has received the material to be tested on this instrumented test. Data analysis applied the help of SPSS 25, Office Excel 2019, and Anates 4.0 software developed by (To, 1996). The decision of the validity standards are observed based on the correlation coefficient (r_{xy}) and reliability is observed from the Cronbach's Alpha value. The instrument is said to be valid if the significance value < 0.05 = α and r count> r table and has a positive value (Mahendra, 2015). While the instrument is said to be consistent in measuring or reliable if the Cronbach's Alpha value is > 0.70 which is classified as acceptable, Cronbach's Alpha > 0.80 is classified as very good. (Wells, Russell, Haraoi, Bissonnette, & Ware, 2011). To find out the discrimination power, it can be seen with the discrimination index number (D) which shows the size of the discrimination power possessed by the item (Sukendro, Wiyatini, & Wiradona, 2020). And the difficulty level of the instrument items is known from the number (%) of students who correctly answered the questions in the question (Wulandari, Mulyani, & Utomo, 2013). The interpretation of the validity test used according to (Guilford, 1956) is as follows:

Table 3. Interpretation of Instrument Validity Test

Correlation Index Interval	Interpretation
$0{,}800 \le r \le 1{,}000$	Very high
$0{,}600 \le r < 0{,}800$	High
$0{,}400 \le r < 0{,}600$	Moderate
$0{,}200 \le r < 0{,}400$	Low
$r < 0{,}200$	Very low

The reliability interpretation according to (Guilford, 1956) is as follows:

Table 4. Interpretation of the Instrument Reliability Correlation Coefficient

r_{11} Value	Correlation	Interpretation
$0{,}90 \le r \le 1.00$	Very high	Very constant
$0{,}70 \le r < 0{,}90$	High	Constant
$0{,}40 \le r < 0{,}70$	Moderate	Sufficiently constant
$0{,}20 \le r < 0{,}40$	Low	Not constant
$r < 0{,}20$	Very low	Very not constant

The interpretation of the discrimination power used according to (To, 1996) is as follows:

Table 5. Interpretation of the Instrument's Discrimination Power

Classification	Interpretation
DP < 10%	Very bad, had to be thrown away
10% ≤ DP < 19%	Bad, better be thrown away
20% ≤ DP < 29%	Moderately good, need some revision
30% ≤ DP < 49%	Good
DP > 50 %	Very good

Interpretation of the difficulty level used according to (Susetyo, 2017) is as follows:

Table 6. Interpretation of Instrument Difficulty

Classification	Interpretation
TK < 15%	Very difficult
16% ≤ TK <30%	Difficult
31% ≤ TK < 70%	Moderate
71% ≤ TK < 85%	Easy
86% ≤ TK ≤ 100%	Very easy

RESULTS AND DISCUSSION

1. Test the Validity of the Mathematical Creative Thinking Skills Instrument

The three items of the mathematical creative thinking skills instrument have passed through a logical validity process and made improvements according to expert suggestions in their fields. Furthermore, to determine the accuracy of instrument items in measuring the ability to think creatively mathematically, an empirical validity test was carried out by comparing the r_{table} with r_{count} through the analysis of the Pearson product-moment correlation coefficient and the significance value with α. The summary of the results of the validity test of the mathematical creative thinking skill is presented in table 7 below:

Table 7. Results of the Validity Test of the Mathematical Creative Thinking Skill Instrument

Items	Correlation Value (r_{count})	r_{table}	Direction of Correlation	p-value	Criteria	Conclusion
1	0,897	0,285	positive, $r_{count} > r_{table}$	0,000	Very High	Valid
2	0,839	0,285	positive, $r_{count} > r_{table}$	0,000	Very High	Valid
3	0,838	0,285	positive, $r_{count} > r_{table}$	0,000	Very High	Valid

Based on table 7, shows that the three items have a p-value (sig. 2-tailed) $<0.05 = \alpha$ and $r_{count} > r_{table}$ and are positive. Thus, all three items are considered valid. Reviewing the correlation coefficient criteria according to (Guilford, 1956; Lodico, Spaulding, & Voegtle, 2006) the three items are classified as very high. This means that each item has a very strong relationship with its total score, if the item score is high, the total score will be high. Supporting these results, the instrument validity test uses the Pearson Product Moment correlation test by comparing the value of the r_{table} with r_{count}, where the instrument is considered valid if the value of $r_{count} > r_{table}$ (Nursalam, 2008; Sastroasmoro & Ismael, 2011). The validity test is carried out by considering the extent to which the question score of the developed indicators supports the total score or variables shown in the correlation coefficient with the instrument criteria considered valid if the significance is ≤ 0.05 (Creswell, 2009; Muhsin, Slamet, & Wahyudin, 2017). Based on this description, the three items are considered to be able to measure mathematical creative thinking skills appropriately.

2. Test the Reliability of the Mathematical Creative Thinking Skills Instrument

The results of testing the validity of the items of the mathematical creative thinking skill show that the three items have high validity criteria so that the three items can be considered to measure the mathematical creative thinking skill accurately. To find out whether the instrument can measure consistently when used repeatedly on similar subjects, at different times and places, the instrument reliability testing is taken. Because the instrument is in the form of an essay test, the reliability test is to compare the Cronbach's Alpha value with the correlation coefficient. Because Cronbach's Alpha is suitable for instruments in the form of essays (Pura, Wakhinuddin, & Maksum, 2014; Yusup, 2018). The results of the reliability test are listed in table 8 below:

Table 8. The summary of the reliability test of the mathematical creative thinking skill

Cronbach's Alpha	N of Items
0,810	3

Based on Cronbach's Alpha value, the instrument is classified as stable for measuring instruments in several situations such as similar subjects, different times, and places based on the correlation coefficient criteria (Guilford, 1956; Lodico et al., 2006) and Cronbach's Alpha> 0.7. In line with these results, Cronbach's Alpha ≥ 0.7 is considered acceptable (Xie et al., 2006). Instruments with a Cronbach's Alpha value> 0.7 are considered reliable and can be used for further research (Astutik & Priantono, 2020; Bolarinwa, 2015; Lima-Rodríguez, Lima-Serrano, & Domínguez-Sánchez, 2015; Tsang, Royse, & Terkawi, 2017; Wells et al., 2011). Thus, the mathematical creative thinking skill instrument can reveal student responses that are not much different when applied to similar students even though it is executed at different times and places.

3. Test of The Discrimination Power Mathematical Creative Thinking Skill Instruments

Furthermore, to determine the ability of valid instrument items to discrimination students from capable and incapable categories, a discrimination power test was conducted. The determination of the discrimination power of this test instrument is carried out with the discrimination index formula, namely by calculating the difference in the proportion of the upper class who answered correctly with the proportion of the lower class who answered correctly (Marsandi, Kusairi, & Suwono, 2016). The results of the discrimination power test are presented in table 9 below:

Table 9. Recapitulation of Discrimination Power Test of Mathematical Creative Thinking Ability Instruments

Items	Discrimination Power (%)	Criteria
1	71,15	Very good
2	53,85	Very good
3	61,54	Very good

Based on the table of the results of the discrimination power test, the three items have very good discrimination power criteria according to the developed discrimination power criteria (To, 1996). If the score for the discrimination power of each item is converted to a scale of 0-1, item 1 is 0.71, item 2 is 0.53, and item 3 is 0.61. Based on the discrimination power score, all items are classified as very good. In line with these criteria, the items collected must have a discrimination power index > 0.30 or higher (Iskandar & Rizal, 2018; Mansyur & Rasyid, 2007). The discrimination power desired is> 0.3 because the difference will be bad if the index is <0.3 (Kaloka & Sridadi, 2015). Based on the information, the three items can discriminate students who are classified as capable and incapable of responding to the instrument.

4. Test the Difficulty Level of The Mathematical Creative Thinking Skill Instrument

The next aspect of a good instrument is that it has a moderate level of instrument difficulty. The level of difficulty is used as an indicator to determine the differences in the skills of the test takers (Jumaeda, 2016). So that the difficulty level of a good instrument must have a comprehensive variety of variations, both the questions with easy and difficult criteria should have the same number, and questions with moderate criteria have a larger portion between the two criteria. In line with this assumption, a good level of difficulty in a test is 25% difficult, 50% moderate, and 25% easy (Widoyoko, 2014). Items with a moderate level of difficulty are considered good in measuring students' abilities. The complete level of difficulty is presented in table 10 below:

Table 10. The summary of the difficulty level of the mathematical creative thinking skill instrument

Items	Level of Difficulty (%)	Criteria
1	52,88	Moderate

2	51,92	Moderate
3	59,62	Moderate

Based on the table above, the three items difficulty index is classified as moderate based on the difficulty level criteria developed by (Susetyo, 2017). Thus, if the three items are converted in the range 0-1 then item 1 is 0.52, item 2 is 0.51, item 3 is 0.59. Other guidelines reveal that the level of the difficulty level of the test items (P) is good in the range of 0.3 to 0.7 as a description of the maximum ability of the test taker (Anderson & Krathwohl, 2001). A good level of difficulty is a moderate level of difficulty (Purwanto, 2014). Thus, the three items in the mathematical creative thinking ability instrument can be tested on students because they have question criteria that are neither too easy nor too difficult.

CONCLUSION

The instrument that was constructed to measure the ability to think mathematically as many as three items on the problem-solving material of the volume of cubes and rectangular prism can be implemented for further study on fifth-grade elementary school students in mathematics learning because it has excellent accuracy and stability to obtain creative thinking skills students' mathematics, and can distinguish the capacities of capable and incapable students, and all items have difficulties that are neither too easy nor too difficult. Thus, the resulting mathematical creative thinking skill instrument can be a solution for teachers to understand the level of mathematical creative thinking skills of fifth-grade elementary school students as the HOTS.

REFERENCES

Anderson, L. W., & Krathwohl, D. R. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Addison Wesley Longman, Inc.

Arifuddin, A. (2019). Students' Critical and Creative Thinking Skills on Mathematics Learning in Madrasah Ibtidaiyah. *AULADUNA: Jurnal Pendidikan Dasar Islam*, *6*(1), 38. https://doi.org/10.24252/auladuna.v6i1a5.2019

Ariyana, Y., Pudjiastuti, A., Bestary, R., & Zamromi. (2018). Buku Pegangan Pembelajaran Keterampilan Berpikir Tingkat Tinggi Berbasis Zonasi. *Direktorat Jendral Guru Dan Tenaga Kependidikan*, 1–87.

Astutik, M., & Priantono, S. (2020). Pengaruh Karakteristik Pekerjaan Terhadap Kinerja Karyawan dan Kepuasan Kerja Dengan Variabel Moderator Budaya Kerja Pada Badan Keswadayaan Masyarakat (BKM) di Kota Probolinggo. *Jurnal Manajemen*, *17*(1), 81–97. https://doi.org/10.25170/jm.v17i1.1296

Bolarinwa, O. A. (2015). Principles and Methods of Validity and Reliability Testing of Questionnaires Used in Social and Health Science Researches. *Niger Postgrad Med*, (22), 195–201.

Bosch, N. (1997). Rubric for Creative Thinking Skills Evaluation. Retrieved January 7, 2020, from www.adifferentplace.org/creativethinking.html

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (Third). California: Sage Publication, Inc.

Evans, J. R. (1994). *Creative Thinking in the Decision and Management Sciences*. Cincinnati: South-Western Publishing Co.

Firdaus, As'ari, A. R., & Qohar, A. (2018). Meningkatkan Kemampuan Berpikir Kreatif Matematis Siswa SMA Melalui Pembelajaran Open-Ended Pada Materi SPLDV. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *1*(2), 227–236. https://doi.org/10.20956/jmsk.v15i2.5719

Fitriyah, L. (2020). Pengaruh PISA (Program for International Student Assessment) Terhadap Pendidikan di Indonesia. *Academia Edu*. Retrieved from http://www.academia.edu/download/63216069/Pengaruh_PISA_Program_for_International_Student_Assessment_Terhadap_Pendidik20200506-33235-1muj4cv.pdf

Guilford, J. P. (1956). *Fundamental Statistics in Psychology and Education*. New York: McGraw-Hill.

Indah, N., Budiarto, M. T., & Lukito, A. (2018). The Open-Ended Problem Based Mathematics Learning to Increase Students Creativity on Fraction for Third Grade Elementary School. *Proceedings of the Mathematics, Informatics, Science, and Education International Conference (MISEIC 2018)*, *157*(Miseic), 77–80. https://doi.org/10.2991/miseic-18.2018.19

Ishabu, L. S., Budayasa, I. K., & Siswono, T. Y. E. (2019). Creative thinking process of female elementary school student with visual learning style in mathematical problem solving. *Journal of Physics: Conference Series*, *1265*(1). https://doi.org/10.1088/1742-6596/1265/1/012018

Iskandar, A., & Rizal, M. (2018). Analisis kualitas soal di perguruan tinggi berbasis aplikasi TAP. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *22*(1), 12–23. https://doi.org/10.21831/pep.v22i1.15609

Jaenudin, A., Kartono, Sukestiyarno, Y. L., & Mariani, S. (2020). The Identification of Students' Mathematical Creative Thinking Ability on Transformation Geometry. *Proceedings of the International Conference on Science and Education and Technology (ISET 2019)*, *443*(Iset 2019), 101–104. https://doi.org/10.2991/assehr.k.200620.020

Jumaeda, S. (2016). Komparasi Bentuk Tes Pilihan Ganda Dengan Tes Menjodohkan (Matching Test) Ditinjau Dari Tingkat Kesukaran Pada Mata Pelajaran Bahasa Arab Di Man Waimital Kabupaten Seram Bagian Barat. *Al-Iltizam: Jurnal Pendidikan Agama Islam*, *1*(1), 55–71. Retrieved from https://mail.iainambon.ac.id/ojs/ojs-2/index.php/ALT/article/download/186/144

Kaloka, P. T., & Sridadi. (2015). Evaluasi Butir Soal Ulangan Akhir Semester Gasal Kesehatan Pada Kelas Khusus Bakat Istimewa Olahraga (BIO) di SMA Negeri 4 Yogyakarta. *Jurnal Pendidikan Jasmani Indonesia*, *11*(2), 101–110. Retrieved from https://journal.uny.ac.id/index.php/jpji/article/viewFile/8186/6857

Kemendikbud. *Undang-undang No 20 Tahun 2003 Tentang Sistem Pendidikan Nasional*. , (2003).

Kusumastuti, I., Fauziati, E., & Marmanto, S. (2019). Challenged for Higher-Order Thinking Skill Implementation: Reports From EFL Classroom Teachers. *International Journal of Language Teaching and Education*, *3*(2), 108–117. https://doi.org/10.22437/ijolte.v3i2.7579

Lima-Rodríguez, J. S., Lima-Serrano, M., & Domínguez-Sánchez, I. (2015). Psychometric properties of an instrument to measure family disease management. *International Journal of Clinical and Health Psychology*, *15*(3), 253–264. https://doi.org/https://doi.org/10.1016/j.ijchp.2015.05.002

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2006). *Methods in Educational Research from Theory to Practice*. https://doi.org/10.1177/001312457500700301

Lu, Y. (2015). 10 Working Memory, Cognitive Resources and L2 Writing Performance. In *Working Memory in Second Language Acquisition and Processing* (Vol. 87). Bristol: Multilingual Matters.

Mahendra, I. (2015). Analisa Penerimaan Pengguna Sistem Informasi Koperasi pada Koperasi Karyawan Budi Setia Jakarta dengan Technology Acceptance Model. *Jurnal Pilar Nusa Mandiri*, *11*(1), 70–80. Retrieved from http://ejournal.nusamandiri.ac.id/index.php/pilar/article/view/415

Mansyur, & Rasyid, H. (2007). *Penilaian Hasil Helajar*. Bandung: Wacana.

Marsandi, Kusairi, S., & Suwono, H. (2016). The Development Of Formative Assessment On The Material Of The Senses Of Vision And Optical Devices. *Prosiding Seminar Nasional II 2016, 2*, 410–422. Retrieved from http://research-report.umm.ac.id/index.php/research-report/article/view/616/826

McGuinness, C. (1999). *From thinking skills to thinking classrooms: A review and evaluation of approaches for developing pupils' thinking*. Department for Education and Employment London.

Moma, L. (2016). Pengembangan Instrumen Kemampuan Berpikir Kreatif Matematis Untuk Siswa Smp. *Delta-Pi: Jurnal Matematika Dan Pendidikan Matematika*, *4*(1), 27–41. Retrieved from http://ejournal.unkhair.ac.id/index.php/deltapi/article/view/142

Muhsin, Slamet, A., & Wahyudin, A. (2017). Educational Mixed Marketing Strategies and Sustainable Competitive Advantages in Mediating The Influence of Marketing Orientation Over Marketing. *The Journal of Educational Development*, *5*(2), 153–171. Retrieved from https://journal.unnes.ac.id/sju/index.php/jed/article/view/14299

Mutmainna, D., Mania, S., & Sriyanti, A. (2018). Pengembangan Instrumen Tes Diagnostik Pilihan Ganda Dua Tingkat Untuk Mengidentifikasi Pemahaman Konsep Matematika. *MaPan*, *6*(1), 56–69. https://doi.org/10.24252/mapan.2018v6n1a6

National Council of Teachers of Mathematics. (2000). *Principles Standards for School Mathematics*. Retrieved from www.nctm.org

National Research Council. (2001). *Adding It Up* (J. Kilpatrick, J. Swafford, & B. Findell, Eds.). Retrieved from http://www.wakamono-up.jp/top/pdf/Third-party_evaluation_2013_points.pdf

Ndiung, S., & Jediut, M. (2020). Pengembangan instrumen tes hasil belajar matematika peserta didik sekolah dasar berorientasi pada berpikir tingkat tinggi. *Premiere Educandum : Jurnal Pendidikan Dasar Dan Pembelajaran*, *10*(1), 94. https://doi.org/10.25273/pe.v10i1.6274

Nursalam. (2008). *Konsep dan Penerapan Metodologi Penelitian Ilmu Keperawatan*. Jakarta: Salemba Medika.

Oktiningrum, W., & Wardhani, D. A. P. (2019). Kemampuan Pemecahan Masalah Matematis Siswa Sekolah Dasar Melalui Soal Higher Order Thinking Skills. *MaPan*, *7*(2), 281–290. https://doi.org/10.24252/mapan.2019v7n2a8

Pitrianti, S. (2017). The Implementation of Problem-Based Learning in Writing Discussion Text on Indonesian Language Learning. *IJAEDU- International E-Journal of Advances in Education*, *3*(9), 620–627. https://doi.org/10.18768/ijaedu.370432

Pura, A. F., Wakhinuddin, & Maksum, H. (2014). Hubungan Motivasi Belajar dengan Hasil Belajar Praktek Siswa Kelas X Program Keahlian Teknik Kendaraan Ringan pada Mata Pelajaran Teknik Las Otomotif Dasar di SMK Negeri 5 Padang. *Automotive Engineering Education Journals*, *2*(1). Retrieved from http://ejournal.unp.ac.id/students/index.php/poto/article/view/3152

Purwanto. (2014). *Evaluasi Hasil Belajar*. Yogyakarta: Pustaka Pelajar.

Puspaningtias, A. A., Yunarti, S., & Yunarti, T. (2017). Efektivitas Model Discovery Learning Ditinjau dari Pemahaman Konsep Matematis Siswa. *Jurnal Pendidikan Matematika Unila*, *5*(9), 1003–1014. Retrieved from http://jurnal.fkip.unila.ac.id/index.php/MTK/article/view/14204

Putri, H. E., Wahyudy, M. A., Yuliyanto, A., & Nuraeni, F. (2020). Development of Instruments to Measure Mathematical Anxiety of Elementary School Students. *International Journal of Learning, Teaching and Educational Research*, *19*(6), 282–302. https://doi.org/10.26803/ijlter.19.6.17

Raharjo, D., Ramli, M., & Rinanto, Y. (2019). Diagnostic test assessment on protist misconception. *Jurnal Pendidikan Biologi Indonesia*, *5*(2), 335–344. https://doi.org/10.22219/jpbi.v5i2.7685

Rahayu, & Ulya, H. (2017). Practicality of Ethnomathematic Learning Instruments on Fraction Materials for Elementary School Students. *International Conference on Mathematics, Science, and Education*, 90–95. Retrieved from https://journal.unnes.ac.id/sju/index.php/icmse/article/download/23715/11053

Ramaligela, S. M. (2021). Student's Perceptions of Assessment Legitimacy in TVET Sector in South Africa. In M. Makgato & G. Afeti (Eds.), *New Models for Technical and Vocational Education and Training* (pp. 162–181). https://doi.org/10.4018/978-1-7998-2607-1.ch009

Rambe, J. ., Sinaga, B., & Yusnadi. (2018). The Development of Learning Devices Based on Discovery Learning to Improve Mathematical Creative Thinking Ability of Students Class V at SD Negeri 060827 Medan Amplas. *Journal of Education and Practice*, *9*(9), 72-79–79.

Rosyanti, A., Rohaendi, A., & Zanthy, Sylviana, L. (2019). Analisis Kemampuan Berpikir Kreatif Dan Pemecahan Masalah Matematik Serta Kepercayaan Diri Siswa SMP Menggunakan Pendekatan Kontekstual. *Journal On Education*, *1*(3), 182–190. Retrieved from http://www.jonedu.org/index.php/joe/article/view/136

Sastroasmoro, S., & Ismael, S. (2011). *The Basics of Clinical Research Methodology*. Jakarta: Sagung Seto.

Şener, N., Türk, C., & Taş, E. (2015). Improving Science Attitude and Creative Thinking through Science Education Project: A Design, Implementation and Assessment. *Journal of Education and Training Studies*, *3*(4), 57–67. https://doi.org/10.11114/jets.v3i4.771

Sukendro, S. J., Wiyatini, T., & Wiradona, I. (2020). Evaluation of Online Learning during the Covid-19 Pandemic Through the Application of Computer-Based Examination (CBT) by Lecturers of the Department of Dental Nursing, Ministry of Health, Semarang Academic Year 2020/2021. *Jurnal Kesehatan Gigi*, *7*(2), 133–140. https://doi.org/https://doi.org/10.31983/jkg.v7i2.6546

Susetyo, B. (2017). *Statistika untuk Analisis Data Penelitian*. Bandung: Refika Aditama.

Suwandari, S., & Ibrahim, M. (2019). Application of Discovery Learning to Train the Creative Thinking Skills of Elementary School Student. *International Journal of Innovative Science and Research Technology*, *4*(12), 410–417. Retrieved from https://www.ijisrt.com/assets/upload/files/IJISRT19DEC462.pdf

To, K. (1996). *Mengenal Analisis Tes*. Bandung: Jurusan Psikologi Pendidikan dan Bimbingan FIP IKIP Bandung.

Tohir, M. (2019). *Hasil PISA Indonesia Tahun 2018 Turun Dibanding Tahun 2015*.

1–2. https://doi.org/10.31219/osf.io/pcjvx

Tsang, S., Royse, C. F., & Terkawi, A. S. (2017). Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. *Saudi Journal of Anaesthesia*, *11*(Suppl 1), S80–S89. https://doi.org/10.4103/sja.SJA_203_17

Walton, L. W. (1997). Telephone survey: answering the seven Rs to logistics research. *Journal of Business Logistics*, *18*(1), 217.

Wang, C., Wu, J., & Horng, R. (1999). Creative Thinking Ability, Cognitive Type and R&D Performance. *R&D Management*, *29*(3), 247–254. https://doi.org/10.1111/1467-9310.00134

Wells, G. A., Russell, A. S., Haraoi, B., Bissonnette, R., & Ware, C. F. (2011). Validity of Quality of Life Measurement Tools — From Generic to Disease-specific. *The Journal of Rheumatology*, *88*, 2–6. https://doi.org/10.3899/jrheum.110906

Widoyoko, S. E. P. (2014). *Penilaian Hasil Pembelajaran di Sekolah*. Yogyakarta: Pustaka Belajar.

Wulandari, D., Mulyani, S., & Utomo, S. B. (2013). Pembelajaran Kimia Berwawasan CET (Chemoedutainment) Dengan Eksperimen Menggunakan Laboratorium Virtuil Dan Riil Ditinjau Dari Gaya Belajar Terhadap Prestasi Belajar Siswa. *Jurnal Pendidikan Kimia*, *2*(1), 29–35. Retrieved from https://jurnal.fkip.uns.ac.id/index.php/kimia/article/view/492/350

Xie, F., Li, S. C., Roos, E. M., Fong, K. Y., Lo, N. N., Yeo, S. J., … Thumboo, J. (2006). Cross-cultural adaptation and validation of Singapore English and Chinese versions of the Knee injury and Osteoarthritis Outcome Score (KOOS) in Asians with knee osteoarthritis in Singapore. *Osteoarthritis and Cartilage*, *14*(11), 1098–1103. https://doi.org/10.1016/j.joca.2006.05.005

Yani, A. T., & Oikawa, S. (2019). Increasing Creative and Innovative Thinking Ability through The Strengthening of Character Education in Probability Theory Course. *JETL (Journal Of Education, Teaching and Learning)*, *4*(1), 163. https://doi.org/10.26737/jetl.v4i1.990

Yusup, F. (2018). Uji Validitas dan Reliabilitas Instrumen Penelitian Kuantitatif. *Jurnal Tarbiyah: Jurnal Ilmiah Kependidikan*, *7*(1), 17–23. https://doi.org/10.18592/tarbiyah.v7i1.2100

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