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Assessment of Creative Thinking in Cultural Context in Junior High School Students

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ABSTRACT

An instrument is one of the tools used to measure a certain object. In this study, the researcher developed a creative thinking instrument with items developed including fluency, flexibility, and originality indicators. By using the stages of reliability test through Cronbach's alpha and validity through exploratory factor analysis (EFA), it is hoped that this research will be able to provide a new view of the items developed to be used in measuring creative thinking. The results of this study show that the items developed in the assessment are 0.800 and based on the results of the validity test, it is interpreted that there are 3 components contained in the creative thinking assessment that are developed, namely fluency, flexibility, and originality. The most dominant component in the development of this assessment is fluency because it has the highest eigenvalue compared to other components, which is 3,914 or 39,139%. However, the results of the KMO test in this study are still categorized as sufficient and show 0.583. So, it is necessary to expand the sample to improve the results of the KMO test so that the items in the assessment are categorized better.

Keywords: assessment; creative thinking; cultural context

INTRODUCTION

Creative thinking is important in learning mathematics (Gr'egoire, 2016). Creative thinking involves not only the ability to generate new ideas, but also the ability to look at problems from various perspectives (Manurung et al., 2020). (Hadar & Tirosh, 2019) revealed that creative thinking is essential in solving problems and generating new ideas. This is because creative thinking can help in solving complex problems in real life and are urgently needed by students (Sa'dijah et al., 2019). In Indonesia, creative thinking is one of the competencies that plays an important role in improving the quality of education in Indonesia (Abidah et al., 2022). However, the reality revealed states that the creative thinking possessed by students in Indonesia is quite low (Amelia & Rejiastuti, n.d.). This was revealed in a study conducted by (Hasanah, 2021) which showed that students' creative thinking skills are still relatively low and do not meet the Minimum Completeness Criteria (KKM). If you refer to the 2022 PISA results, it shows an absolute decrease in the average score of math. This can be interpreted as a student's mathematical ability, one of which is creative thinking, which is considered to be declining. This reality makes the ability to think creatively has not become a priority in learning at school. As a result, students are less accustomed to thinking fluently, flexibly, and originally in dealing with various situations.

Theoretically, creative thinking encompasses various key aspects, namely fluency, flexibility, and originality. Fluency refers to the ability to generate multiple ideas in one

general concept. Flexibility is the ability to move from one approach to another in solving problems. While originality is the ability to come up with unique and unusual ideas. When these aspects complement each other and become the main indicator in assessing a person's creative thinking ability. In the context of education, developments when this aspect allows students to think broadly are not fixated on one direction, and produce innovative solutions (Aries et al., 2024). Therefore, an assessment instrument that measures creative thinking must be able to represent all of these aspects.

Assessment instruments have an important role in identifying, mapping, and supporting the development of students' creative thinking (Siahaan et al., 2022). Unfortunately, creative thinking assessment instruments are currently limited and not widely used in schools. Some of the assessments available have not explicitly measured all aspects of creative thinking such as fluency, flexibility, and originality. Some of the instruments available have also not been rigorously tested for their validity and reliability. In fact, validity and reliability are two important aspects to ensure that the instrument actually measures what it is supposed to measure. Without valid and reliable instruments, the results of creative thinking assessments can be misleading. Therefore, research is needed that focuses on developing creative thinking instruments that are not only comprehensive but also valid and reliable.

To answer these needs, this research develops creative thinking assessment instruments that are open and integrated with the cultural context. Open instruments were chosen because they allow students to explore and express creative ideas freely without the limitations of right or wrong answers (Yudhi, 2017). These types of questions provide a wider space for students to demonstrate their creative thinking aspects. In addition, the integration of cultural context is intended to build more relevant and meaningful question instruments for students. This is because problems that are close to student life and culture have the potential to give rise to students' creative thinking (Aminah, 2024). Cultural contexts can also foster creativity by allowing students to find varied solutions to challenging situations (Anwar et al., 2024). Referring to (Sa'dijah et al., 2024) also revealed that mathematics learning that is integrated with culture is able to show students' creative thinking. Thus, the assessments that are prepared tend to be more authentic and contextual. Through cultural values, this instrument is expected to encourage students to think creatively naturally.

The development process of this instrument involves construct validation to ensure that each question item truly represents a concept of creative thinking. One of the approaches used is exploration factor analysis. EFA was chosen because it is able to explore the structure of factors from a series of question items without referring to a predetermined structure (Retnawati, 2016). In the context of this research, the EFA aims to identify aspects of creative thinking that emerge from empirical data. The EFA helps group question items based on the similarity of the student's answer patterns. With this stage, the researcher can evaluate whether the constructs of fluency, flexibility, and originality are truly measurable in the developed instrument. In addition, the EFA can also indicate which items are inappropriate or need to be revised. The use of an EFA is an important first step before conducting a more confirmatory analysis.

In addition to validity, reliability is also an important indicator in the development of assessment instruments. Reliability indicates the extent to which the instrument provides consistent and stable results when used in similar situations (Saputri & Larasati, 2023). Without good reliability, the results of the assessment cannot be used as a basis for decision-making. In this study, the reliability of the instrument was tested using Cronbach's Alpha to ensure that each item in one dimension measures the same and consistently. The high level of reliability indicates that the instrument can be used repeatedly. This reliability test is important to detect question items that may be ambiguous or irrelevant. Thus, reliable instruments support the creation of accurate creative thinking assessments.

This research aims to develop and test the validity and reliability of creative thinking assessment instruments in the form of open ended and integrated cultural contexts. This instrument is designed to measure three main aspects of creative thinking, namely fluency, flexibility, and originality. Through a culture-based approach, it is hoped that the assessment will be more meaningful and contextual for students. The main contribution of this research is to provide valid, reliable, comprehensive and culturally relevant measurement tools. The results of the development of this research are expected to be used properly and be able to have a real impact in improving the quality of education that favors the creative potential of students.

RESEARCH METHODS

This type of research uses research and development (R&D) methods with various approaches to achieve its goals. The approach used in this study includes reliability, experiment/construct validity using exploratory factor analysis (EFA). In this section, the population and research procedures, research instruments, and data collection will also be explained.

Participants

The research subjects used in this study are 28 students of Malang City Junior High School class IX. Selected participants were given 60 minutes to work on 10 items of assessment questions developed. The selection criteria for subjects are determined based on their initial ability in the creative thinking process.

Instrument Development

The instrument in this study was used to measure the research variables. The instrument is well designed so that it can be used as a measuring instrument that is worthy of development. The development of the instruments used in this study is 10 items of creative thinking questions that contain components of creative thinking, namely fluency, flexibility, and originality. The fluency aspect is used to find out the ideas or answers put forward by students completely and correctly. Students demonstrate fluency in problem-solving when they can acquire multiple solutions. The flexibility aspect is used to know the various varied or different solutions that students produce correctly. The items used to illustrate this flexibility encourage to identify different strategies in the same portrait of the idea. Meanwhile, the originality aspect is used to identify the originality of ideas that students emerge from using their own language or are assessed as new ideas. Originality in problem-

solving refers to the student's ability to build a problem that is different from others. The instrument developed in this study is presented in appendix 1.

Data Collection

In the development of this instrument, the data collection stage focuses on the validity of the experiment. This means that the instrument is directly tested on real respondents, then statistically analyzed to determine the validity of the construct. The researcher conducted a one-to-one trial to get feedback, suggestions and inputs, and confirmed that the items in this instrument are relevant and clear based on the measured construct. After revision, the instrument was tested to 30 students of the first secondary school with a time of 60 minutes individually.

Before conducting the test, the subject was given an explanation of the research conducted by the researcher. Researchers also provide information related to the purpose of the research, the voluntary nature of their involvement in the research, and also the confidentiality of their data. Next, the subject is asked to write his answer on the sheet that has been provided.

Data Analysis

In conducting data analysis, the researcher used a reability analysis approach and validity testing using Explanatory Factor Analysis (EFA). The stages will be described as follows:

Reliability Testing

In the first test stage, the researcher conducted a reliability test using Croncbach's alpha. The basis for decision-making in this test states that if Croncbach's alpha value $>$ 0,60 is declared reliable or consistent. In this study, the reliability test result is 0.800, so this value is considered reliable or very good for exploratory studies. Reliability values are based on criteria $<$ 0,40 (very low), $0{,}40 - 0{,}59$ (low), $0{,}60 - 0{,}74$ (good) and $0{,}75 - 1{,}00$ (very good). (Cicchetti, Bronen, Spencer, Haut, Berg, Oliver & Tyrer, 2006).

Factor Analysis

These statistical tests are used to measure the validity of assessments and to ensure that the items contained provide accurate results.

1. The feasibility test of the data in this study used Kaiser Mayer Olkin (KMO) and Bartlett's Test of Sphericity. KMO is used to measure the adequacy of a sample for factor analysis. KMO decision-making with the provisions if (bad), (enough), (good), and (very good). Bartlett's Test of Sphericity was used to test whether the correlation matrix was significant for factor analysis. With the provision, if the significance value then the data can be used for EFA.$KMO < 0.5$ $0.5 < KMO \leq 0.70$ $0.70 < KMO \leq 0.90$ $KMO > 0.9$ < 0.05
2. The communality test is carried out to show the value of the variable being studied whether it can explain the factor or not. The smaller the percentage of communalities, the weaker the relationship between the variables and the factors formed. The larger the percentage, the stronger the relationship between the variable and the factors formed. The variable is considered to be able to explain the factor if the extraction value >0.50. (Hariyadi, 2017)

3. Factor extraction is carried out by selecting factors based on factors that have more variance than one original variable (Eigenvalue>1). At this stage, the factor should account for most of the variance in the data with a cumulative variance of >60%.
4. (Permadi, n.d.)Factor rotation is carried out to make it easier to interpret factors. Factor rotation is carried out to facilitate interpretation in determining the variables that are listed or included in a factor, where if there are several variables that have a high correlation with more than one factor or if part of the factor loading of the variable is below the smallest value that has been determined (Permadi, 2023)
5. The interpretation of the factors is done based on the rotated component matrix. Items with a high loading of >0.4 on a factor are considered bound to that factor.

RESULTS AND DISCUSSION

Reliability Test Results

The reliability test is a statistical test used to measure the level of consistency of a measuring instrument. In this case, it is an assessment. Reliability indicates the extent to which the assessment can be used reliably. The reliability test in this study uses Cronbach's alpha, which is a coefficient that describes the correlation between items.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.800	.790	10

Figure 1. Reliability Test Result

The results of this test showed that Cronbach's alpha was 0.800. So that this value is considered reliable or very good for exploratory studi This shows that the assessment of creative thinking is able to measure reliably. In line with research conducted by (Manurung et al., 2020) which revealed that the acquisition of reliability test results will have a good value if it shows a high or low value of Cronbach's alpha can be influenced by the number or few items used in the reliability test > 0.6(Tavakol & Dennick, 2011). The high value of Cronbach's alpha found in this study is due to the fact that the items used are not few and each item has a strong relationship. In line with the findings expressed by (Bland et al., 1997) who highlighted that the low value of Cronbach's alpha is due to the weak association of items, so it needs to be eliminated or replaced. With the results of Cronbach's alpha obtained in this study, it can be concluded that the items developed can be used because they are reliable.

KMO and Bartlett's Test Results

The Kaiser Meyer Olkin Test (KMO) and Bartlett's Test are among the tests used to determine the accuracy and correlation between factors. The KMO value is used to measure the adequacy of the sample for factor analysis. Meanwhile, a significant correlation for factor analysis can be seen based on the results of Bartlett's test.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.583
Bartlett's Test of Sphericity	Approx. Chi-Square	156.595
	df	45
	Sig.	.000

Figure 2. KMO and Bartlett's Test Result

The results of data processing using SPSS showed that the KMO test was 0.583 and the Bartlett's test was 0.00. This shows that the KMO results are considered sufficient based on the decision that $0{,}50 < KMO \leq 0{,}70$ it is said to be sufficient. While the significance value of Bartlett's test shows less than 0.05. It can be concluded that the data is feasible for exploratory factor analysis (EFA). This is in line with research conducted by ($0.00 <$ 0.05)(Rais, 2020) which revealed that the analysis of exploratory factor can be continued on the condition of the KMO value. In his book The > 0.5sequential Kaiser-Meyer-Olkin procedure as an alternative for determining the number of factors in common-factor analysis written by (Hill, n.d.) also explain the procedure that is in line with the findings of the study that the KMO test can be carried out even with sufficient values. These test results need to be an important note to improve test results so that they are of good value with several solutions, such as sample expansion.

Communality Test Results

The Communalities test is one of the tests used to find out whether the value of the variable being studied is able to explain the factor or not. The variable is considered to be able to explain the factor if the extraction value is greater than 0.50, on the other hand, if the extraction value obtained is less than 0.50, it is stated that the variable is unable to explain the factor. The results of the communality test in this study are shown in the following figure.

Communalities

	Initial	Extraction
S1	1.000	.570
S2	1.000	.796
S3	1.000	.678
S4	1.000	.685
S5	1.000	.935
S6	1.000	.897
S7	1.000	.716
S8	1.000	.458
S9	1.000	.806
S10	1.000	.707

Extraction Method: Principal Component Analysis.

Figure 3. Communality Test Result

Based on the results of the test using SPSS, the average extraction value in all tables shows that there are items with low values such as S8. Other items are considered good enough because they have a communality value of >0.5 and are considered adequate. The value of communality with the achievement of values is considered to have been well interpreted by the dimensions that will be formed > 0.5. > 0.5(Kusuma, 2023). Item S8 with low communality results or interpreted that the item is not properly interpreted by the dimension to be formed. < 0.5.

Variance Explained Results

The Total Variance Explained Test is one of the tests used to show how many factors are formed by combining several criteria to get the most appropriate number of factors. The results of the total variance explained test in this study are as follows:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.914	39.139	39.139	3.914	39.139	39.139	3.246	32.460	32.460
2	1.912	19.123	58.262	1.912	19.123	58.262	2.173	21.733	54.193
3	1.422	14.223	72.484	1.422	14.223	72.484	1.829	18.291	72.484
4	.946	9.464	81.948						
5	.649	6.489	88.438						
6	.550	5.503	93.940						
7	.276	2.758	96.698						
8	.156	1.558	98.256						
9	.116	1.155	99.412						
10	.059	.588	100.000						

Extraction Method: Principal Component Analysis.

Figure 4. Variance Explained Results

The formation of components determines the number of components formed based on an *eigenvalue* greater than 1 (Kusuma, 2023). Based on the statistical tests carried out, there are 3 components formed in the 10 items developed. The three components have an Eigenvalue greater than 1 with the details of the first component of 3,914 or 39,139%, the second component of 1,912 or 19,123%, and the third component of 1,422 or 14,223%. We can interpret the results that the first component (fluency) is the most dominant component and has the largest contribution to the total variance. The second component (flexibility) contributes quite a bit and is almost the same percentage as the third component. The third component contributes the least to the total variance. The three components explain quite well 77.484% of the total variance. In this study, there were 22,516% variables that were not interpreted properly. However, with the total percentage of the three components, the resulting variance is considered > 60%,*satisfactory* (Panday, 2019)

Rotated Component Matrix Results

The Rotated Component Matrix test is one of the tests that aims to ensure that a variable is included in which component and whether the indicators included in the research are valid. The Rotated Component Matrix test was carried out by looking at the largest correlation value between variables and the factors formed. Based on the results of the analysis, it is known that the Rotated Component Matrix test hasl is as follows:

Rotated Component Matrix[a]

	Component		
	1	2	3
S1	.722	.215	-.058
S2	.824	.309	-.145
S3	.820	-.016	.074
S4	.802	-.093	.184
S5	.126	.954	.098
S6	.075	.940	.084
S7	.056	.463	.706
S8	.172	.041	-.653
S9	.602	.099	.659
S10	.561	.054	.624

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Figure 5. Rotated Component Matrix Result

The value of the loading component on each component shows that the higher the value of the loading component of a variable, the closer the relationship between the variable and the component in question. Based on the figure above, the results of the rotated component matrix test are as follows:

1. Component 1 is a *fluency* component consisting of S1 of 0.722, S2 of 0.824, S3 of 0.820, and S4 of 0.802. In the 10 question items developed, it was interpreted that there were 4 items that were classified as being able to measure fluency.
2. Component 2 is *a flexibility* component consisting of S5 of 0.954 and S6 of 0.940. In the 10 question items developed, it was interpreted that there were 2 items that were classified as being able to measure flexibility.
3. Component 3 is the *originality* component consisting of S7 of 0.706, S8 of 0.653, S9 of 0.659, and S10 of 0.624. In the 10 question items developed, it was interpreted that there were 4 items that were classified as being able to measure originality.

The results of the EFA confirm that there are three factors that are assessed by the instrument developed in accordance with the design, namely *fluency, flexibility, and originality*. By being dominated by items that are classified as being able to measure *fluency* and *flexibility*.

CONCLUSION

Based on the results of the analysis that has been carried out, it can be concluded that there are 3 components contained in the creative thinking assessment that is developed, namely fluency, flexibility, and originality. The most dominant component in the development of this assessment is fluency because it has the highest eigenvalue compared to other components, which is 3,914 or 39,139%. However, when viewed from the adequacy

of the sample, it is only considered sufficient for factor analysis because the KMO test result is 0.583. Therefore, it is necessary to increase the number of samples to be able to increase the adequacy of the samples and conduct more accurate analysis. Further research can also use the ui *confirmatory factor analysis* (CFA) procedure to identify variables or items that have a significant influence on the latent variable or component. Thus, it can be known how well the measured variables can represent the factors that were formed before.

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APPENDIX I (Creative Thinking Assessment Instrument)

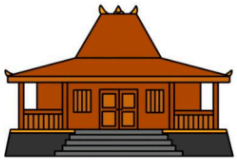
1. Rama is going to a traditional market and sees one of the traditional snacks called Jipang.

Rama wants to buy Jipang as a souvenir for his family. However, he wants the Jipang to be packaged in individual boxes (per piece) to look neat. Determine the number of possible nets that can be formed into a box containing Jipang. Provide at least 3 possibilities!

2. Indonesia is one of the countries with a diversity of both traditional and modern foods. One example is the Kue Balok (Block Cake) from Bandung.

Given that the size of the Kue Balok is 6 cm in length, 3 cm in width, and 2 cm in height, determine the possible dimensions (length, width, and height) of the Kue Balok box if each box contains a maximum of 6 pieces. Provide at least 2 possibilities!

3. Based on the box used for packaging the Kue Balok (Question no 2), determine how many possible carton surface areas are needed to form one box. Provide at least 2 possibilities!
4. Joglo traditional house is one of the cultural heritages that is still preserved today. This building is typical of Java and is known for its supporting pillars called soko guru.



If Mr. Rahmat plans to build a Joglo house and use mahogany wood with a volume of 384 cm^3, find the possible dimensions (length, width, and height) of the soko guru pillar. Provide at least 2 possibilities!

5. Based on question number 4 related to the soko guru, determine how many possible surface areas the solid figure could have!
6. The ancient Mayan pyramid is one of the world's most iconic archaeological structures. One of its functions is as a place of worship located at the top of the pyramid. This place is commonly called a temple or altar, where religious leaders perform rituals and offerings, and it is shaped like a rectangular prism.

Given that the altar has a length of 9 m, width of 4 m, and height of 6 m, draw at least 2 other solid figures with flat faces that have the same volume as the altar and show their dimensions!

7. Based on question no 6, if the volume of the altar is known to be 480 m^3, find several possible dimensions (length, width, and height) of the altar!
8. A die (dice) is one of the objects used in board games like snakes and ladders or other children's games. Each face of the die has a different number of dots. Determine several possible nets that can form a complete die along with its dots. Provide at least 2 possibilities!
9. Brown Sugar Cube is one of the innovations in the food sector introduced by palm sugar artisans. Currently, the demand for Brown Sugar Cube is soaring because of its minimalist and practical shape.

For its packaging, the seller uses a box made in the shape of a cube. If the box volume is 512 cm^3, determine the possible number of Brown Sugar Cubes that can fit inside the box!

10. Traditional cakes are increasingly popular due to their more modern packaging. One example is the cookie box. These cookies are popular among teenagers and adults because of their delicious taste and minimalist appearance..

The cookies are usually flat and round with a diameter of 5 cm and a height of 0.5 cm. Determine the possible number of cookies that can fit in a box if the box is cube-shaped!

indrani prisma

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