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Cultural-Based Assessment Instrument for Measuring Junior High School Students' Mathematical Creativity

Aulia Ikhsana[1], Lathiful Anwar[2,*], Sisworo[3]
[1,2,3]Universitas Negeri Malang, Indonesia
*Corresponding Author: lathiful.anwar.fmipa@um.ac.id

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ABSTRACT

Culture has an important role in facilitating students' mathematical creative thinking skills. The use of cultural context in mathematics learning helps students to understand mathematical concepts in a more relevant and real way. The results of the initial study conducted by the researcher indicated that there are still many students whose mathematical creative thinking skills are still low and teachers still have difficulties in developing appropriate assessments to measure creative thinking skills. This study aims to develop assessment instruments using the Jambi cultural context in measuring the mathematical creative thinking skills of junior high school students that are of high quality (valid, practical, and effective). This development research uses the Plomp development model. The development stages include the initial investigation stage, the development and prototyping stage and the assessment stage. The research subjects were 29 students of class IX.A and mathematics teachers. The results of the study were the quality of the product assessment was valid 3.6 with 'very valid' criteria, practical with an average teacher response questionnaire score of 3.25 and an average student response questionnaire score of 2.80 and effective with good differentiating power. The assessment developed is of high quality, namely valid, practical and effective. Thus, this assessment can be used by teachers directly or modified as needed to measure students' creative thinking skills.

Keywords: contextual; creative thinking; cultural; number patterns

INTRODUCTION

Mathematical creative thinking ability is a very important skill in preparing students to be able to face the challenges of the 21st century (Fitriyyah et al., 2024; Jatmiko et al., 2022; Maskur et al., 2020). This skill includes several aspects, namely: fluency, flexibility and originality (Silver, 1997). All of these aspects are interconnected in supporting mathematical understanding and assessing students' creativity. Creative thinking ability is the key to knowing whether students master the knowledge that has been previously acquired (Saidah & J, 2020). In addition, Faturohman & Afriansyah (2020) emphasised that if students can relate concepts to mathematics then they will have good mathematical understanding skills and tend to last long. This has an effect on students' creative thinking skills. The presence of students who are creative in mathematics will encourage students' ability to be creative in other fields (Kadir et al., 2022).

However, the development of creative thinking skills often faces various obstacles. Facts in the field show that students' creative thinking skills in Indonesia, especially in learning mathematics, are still not optimal (Irmayanti & Putra, 2023). This decline reflects the weak creative thinking skills of students, especially in solving non-routine problems (Jatmiko et al., 2022; Putra et al., 2018). In addition, it was found that most of the assessment

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questions given by teachers are procedural in nature and tend to test the memorisation aspect, which has an impact on the lack of development of good thinking skills in students (Badi'ah et al., 2024; Rosyidin, 2022; Septian & Monariska, 2021). Most of these questions are more inclined to measure memory skills so that they are not effective in training students' creative thinking skills. According to Galingging et al. (2024) found that most teachers find it difficult to design assessment instruments to evaluate mathematical creative thinking skills. This is a major obstacle in the effort to improve students' creativity in mathematics. One of the challenges in developing assessment instruments to measure creative thinking skills, especially in mathematics, is ensuring that all dimensions or indicators of creative thinking skills are represented (Amaliah et al., 2023). Many instruments only emphasise one or two indicators, such as fluency and flexibility, but have not given enough attention to novelty (Jagom, 2015). This imbalance results in assessment results that do not reflect creative thinking skills fully and optimally. In addition, previously developed assessments often do not involve local cultural contexts in their design (Elina et al., 2024; Subakti et al., 2021). In fact, the integration of local culture in mathematics learning is considered effective for increasing student engagement and the relevance of learning materials (Galingging et al., 2024).This approach not only fosters student creativity but also contributes to cultural preservation. In this way, students can understand the connection between the mathematical knowledge they learn and its application in everyday life (Kamid et al., 2021; Asmara et al., 2022). Cultural contexts can provide students with opportunities to relate mathematical concepts to everyday life, thus improving their understanding and application of the material taught (Monariska, 2017; Nurhayati et al., 2023; Wulandari & Puspadewi, 2016).

The development of assessment instruments to measure mathematical creative thinking skills is an urgent need to be developed in supporting adaptive and innovative learning to curriculum changes and developments. This instrument not only serves as an evaluation tool, but also a guide for teachers in designing more innovative learning that can trigger students' creative thinking skills in all aspects of creative thinking, namely fluency, flexibility and novelty (Arta, 2024). The development of assessment instruments using cultural contexts has a strategic role in supporting education on learning outcomes in the independent curriculum that emphasises the maximum development of student potential (Anggreaena et al., 2022). Assessment instruments designed with a local cultural context can be an effective tool to explore students' creative potential while preserving cultural values in education. In addition, this instrument is also expected to assist teachers in identifying and measuring students' level of creativity in mathematics, as well as creating a more meaningful learning experience and increasing students' involvement and motivation in learning mathematics, while strengthening their cultural identity. The cultural context of Jambi used in developing this assessment includes: a) Traditional Dances of Jambi Province, b) Celebration Days of Jambi Province, c) Typical Traditional Houses of Jambi, d) Traditional Food of Jambi, e) Cultural Heritage of Jambi, f) Traditional Cakes of Jambi, g) Traditional Games of Jambi and h) Traditional Musical Instruments of Jambi. By integrating Jambi cultural values in mathematics learning, it can enrich students' understanding and make mathematics learning more relevant and meaningful. This is because of the emergence of creative ideas developed through cultural innovation in the process of solving it. Based on

this description, the researcher needs to develop an assessment instrument using a cultural context to measure the mathematical creative thinking ability of junior high school students.

RESEARCH METHODS

This study uses a type of research in the form of Research and Development (RnD), which is designed to produce a product in the form of an assessment instrument. The research and development model used is the Plomp (2013) development model. Plomp divides it into 3 stages, namely: (1) preliminary research phase which includes needs and context analysis, literature analysis and development of conceptual and theoretical frameworks; (2) development or prototyping phase which includes the preparation of creative thinking ability assessment instruments and research instruments (teacher and student response questionnaires) and validating the developed products; and (3) assessment phase which includes product trial activities and analysis of the practicality and effectiveness of the developed assessment instruments. This research aims to develop and produce a product in the form of an assessment instrument that can be used to measure the mathematical creative thinking ability of junior high school students using the Jambi cultural context on number pattern material. The instrument was developed to fulfil three main criteria, namely validity, practicality and effectiveness.

This research was conducted in the odd semester of the 2024/2025 academic year at one of the junior high schools in Jambi City. The selection of trial subjects was based on the criterion that they had received learning on number pattern material, which is a topic relevant to the development of assessment instruments. This criterion was set to ensure that the research participants had a knowledge base that was relevant to the assessment instrument developed, so that the test results could provide a valid, practical and effective description of the measured mathematical creative thinking ability. Based on the recommendation of the mathematics teacher, one of the classes, namely class IX.A, was selected as the research subject which met the criteria and numbered 29 students.

The research and development instruments in this study include product validation instruments (creative thinking assessment instruments), teacher and student response sheets and creative thinking ability tests. The assessment instrument aims to measure creative thinking ability which consists of aspects of flue. First, in the aspect of fluency, students are encouraged to be able to create various relevant ideas/answers and the solutions are correct. Second, in the aspect of flexibility, students are encouraged to be able to create various appropriate solution strategies and the calculation process and results are correct. Third, in the aspect of originality, students are encouraged to be able to create new and different solutions from other students' answers and the results are correct. The researcher prepared a question design structure that was adjusted to the independent curriculum based on phase D learning outcomes in the algebra element, namely ‘Learners can recognise, predict and generalise patterns in the form of an arrangement of objects and numbers’, so the researcher used number pattern material as material on the assessment instrument. This material was chosen based on the results of the needs analysis and literature analysis. Number pattern material is one of the materials that can be used to train students' creative thinking skills (Handayani, 2023; Puspita & Sutirna, 2023).

Research data collection is carried out during the process of developing assessment instruments as well as in the assessment process. Any instruments used will be validated first by experts. The experts in this study consisted of 2 people, namely mathematics education lecturers and mathematics teachers. The results of validation by experts are made improvements to assessment products. After the validator determines that the instrument is valid and can be used, the researcher uses the instrument to collect the necessary data. The implementation of data collection for this research instrument lasted for 2 days. On the first day, the researcher gave the creative thinking ability test to the previously determined trial subjects.

Data analysis was carried out on the assessment instruments developed, namely validity analysis, practicality analysis and effectiveness analysis. The validity analysis includes product validation instruments obtained through instrument validation sheets that have been filled in by validators using a Likert scale with 4 validation categories, namely strongly agree (for score 4), agree (for score 3), moderately agree (for score 2), and disagree (for score 1) (Bidasari, 2017). Then, researchers determine the validity value using the formula, namely validity. After obtaining the validity, it is then represented based on the validity criteria. The product is said to be valid if it at least meets the criteria of being valid enough with an interval of $2{,}50 \leq x < 3{,}25$ (Siswanto et al., 2016). Practicality analysis was obtained through recapitulation of data from teacher and student response sheets tested using a likert scale (Bidasari, 2017). Furthermore, researchers determined the practicality score using the practicality level formula and represented the results based on the practicality criteria. The product is said to be practical if it at least meets the criteria of being practical enough with an interval of $2{,}50 \leq x < 3{,}25$ (Siswanto et al., 2016). Analysis of the effectiveness of the instrument can be shown by determining the difference test obtained from the top 27% of the total students who scored high and 27% of the total students who scored low (Arikunto, 2010). The differentiating power of the question aims to determine whether a question can distinguish high ability groups from low ability groups on the aspects measured (Yani et al., 2014). The product is said to be effective if it at least meets the criteria of good enough (Arikunto, 2010). To see the quality of the assessment instrument, researchers also conducted statistical tests in the form of assessment validity tests, assessment reliability tests, assessment interrater reliability tests and assessment difficulty tests. A test is called valid if the test can precisely measure what is to be measured (Khaerudin, 2015). In testing the validity of the items, the researcher did by correlating the score of each item with the total score obtained by students using the product-moment correlation formula. After obtaining the item validity coefficient, a representation is made based on the correlation criteria. The item is said to be valid if $r_{xy} > r_{tabel}$. To measure the reliability of the test, researchers used Cronbach's Alpha formula with a significance of 5%. The reliability test results obtained were compared to r-count and r-table, if the r-count value is greater than r-table, it means that the research instrument is reliable or has consistency in the assessment results. Whereas for avoid the subjectivity factor of the creative thinking ability test results, the researcher conducted an interrater reliability test using the cohen's kappa method involving external assessors.

RESULTS AND DISCUSSION

In this section, the research results are presented based on the stages of the development research stages, as follows:

The Preliminary Investigation Stage

At the needs analysis stage, a needs analysis was conducted and information was obtained that learning evaluation cannot be separated from the use of instruments (Ukobizaba et al., 2021). Assessment instruments have an important role in knowing the extent of students‘ ability to understand the material so as to provide an overview of students’ thinking skills (Nitko & Brookhart, 2007). Well-designed assessments allow students to display a variety of abilities, including creative thinking (Suherman & Vidákovich, 2022). Based on observations and teacher interviews at one junior high school in Jambi, it was found that the assessment of students' creative thinking skills in the school was still low. The low level of students' creative thinking skills is often caused by the lack of support from adequate assessment instruments (Gumilang et al., 2021; Ndolu & Lalang, 2023). This can be seen from the assessment that has been used by teachers is considered not optimal in providing meaningful learning experiences for students, especially in measuring students' creative thinking skills specifically.

At the literature analysis stage, At this stage, the researcher focused on reviewing the theory to determine the assessment instrument that suits the needs in measuring students' creative thinking ability. In answering the problem of the low level of students' creative thinking ability, the researcher chose a creative thinking test-based approach that refers to the indicators of creative thinking ability compiled by Silver (1997). According to Silver, the indicators of creative thinking ability include: fluency: the ability to generate many ideas or solutions; 2. flexibility: the ability to provide different solution strategies; and 3. novelty: the ability to produce solutions that are unique or different from other students. The three indicators are applied through open-ended questions. Open-ended questions encourage students to think openly with various solutions, giving rise to the creative thinking criteria of fluency, flexibility and novelty (Hanurrani, 2019; Yunadia et al., 2023). In addition, creativity can also be developed through cultural innovation. Integrating cultural values in mathematics learning can enrich students' understanding and make mathematics learning more relevant and meaningful (Anggraeni, 2023). This is due to the emergence of creative ideas developed through cultural innovation in the solution process (Wulandari & Puspadewi, 2016). Researchers identified the Learning Outcomes contained in the Merdeka Curriculum on the topic of number patterns at the junior high school level. Based on the learning outcomes in phase D (generally for grades VII, VIII and IX of SMP / MTs / Packet B) on algebraic elements that ‘Learners can recognise, predict and generalise patterns in the form of an arrangement of objects and numbers’. This topic was chosen because number pattern is one of the mathematics materials that require students to think creatively (Pebriana & Imami, 2024). Therefore, it is necessary to develop assessments using cultural contexts because it can have a positive impact in measuring students' creative thinking skills.

Development and Prototyping Stage

At this stage of development and prototyping, researchers compile assessment instruments and research instruments and validate assessment instrument products. In Preparing Assessment Instruments, Researchers compiled questions that were adjusted to the aspects of creative thinking. Each question has scoring guidelines designed to identify improvements in the quality of student responses to the questions given. The score given varies from 0-4, depending on the complexity of the problem and the outcome of the student's responses and answers (such as accuracy of calculations and so on) which is useful for measuring creative thinking abilities. Each problem allowed students to demonstrate creative thinking skills. The grids of the assessment instruments made are presented, namely: presented with contextual problems. The questions developed by the researcher were 10 items with the cultural context used. An example of one of the questions developed as a result of the prototype is shown in Figure 3 below:

Figure 1. Question Number 1 of the Creative Thinking Assessment Instrument

Question number 1 is given which is related to the concept of number patterns presented through the context of "Traditional Dance of Jambi Sekapur Sirih". Students are asked to determine various possible number patterns formed from the mass dance performance, as shown in Figure 1. The aspects and indicators of creative thinking skills used in this study are: Students are able to create various relevant ideas/answers and correct solutions (*Fluency*); Students are able to create various appropriate solution strategies and calculation processes and the results are correct (*Flexibility*); and Students are able to create answers/solution strategies that are different from other students' answers and the results are correct (Originality).

A development product is referred to as a quality product if the valid, practical, and effective criteria are all met (Arikunto, 2010; Plomp, 2013). The research instruments in this study include instrument user response questionnaires as well as discussions and scoring rubrics. The researcher compiled an assessment instrument validation sheet and a user response questionnaire validation sheet to measure the validity of the instrument. Validation was carried out by experts to ensure that the instrument was in accordance with the research objectives and was able to measure the variables studied appropriately (Sugiono et al., 2020). The practicality of the instrument is measured through the results of the user response questionnaire (which includes teachers and students) to find out whether the instrument is easy to understand, use, and apply by users, so that it does not cause obstacles in its implementation (Siswanto et al., 2016). The effectiveness of the instrument is measured from the test results of students' mathematical creative thinking skills after using the assessment instrument which is tested using the t-test. After the instrument has been prepared, the next

step is to validate it with experts. Product validation aims to ensure that the instruments used are feasible and suitable for measuring what should be measured (Sugiono et al., 2020). Validators were asked to assess the instrument to measure creative thinking skills. Feasibility can be seen from the statement points assessed from the two validators which include the formulation of question items using language that is easy to understand, the suitability of the question items for learning outcomes and the statement that the developed assessment can be used to identify creative thinking skills in the aspects of fluency, flexibility and novelty. Based on validation results the total score is 18 from the five statement points. So that the average score of the assessment instrument validation is 3.6. According to Siswanto et al. (2016) based on the validity criteria with a score of 3.6 is categorised as very valid, which means that the assessment developed is suitable for measuring the mathematical creative thinking ability of junior high school students.

Assessment Stage

At the assessment stage, the activities carried out were field trials of 29 students with the aim of proving the practicality and effectiveness of the assessment instruments that had been developed. An instrument is said to be practical if: It is easy to use by teachers and students, the results of the teacher and student response questionnaire show a minimum score in the "quite practical" category ($41\% \leq \text{score} < 61\%$) and the instrument can be implemented within a reasonable learning duration and in accordance with curriculum needs.

Table 1. Results of Teacher and Student Response Questionnaires

No.	Response	Total Score	Average Score	Description
1.	Teacher	26	3,25	Very Practical
2.	Students	568	2,80	Practical
	Total	594	3,025	Practical

Based on Table 1, the average score of the teacher response questionnaire is 3.25. According to Siswanto et al. (2016) based on the practicality criteria that the score of 3.25 is categorised as very practical, which means that the assessment developed is practically used by teachers in measuring the mathematical creative thinking ability of junior high school students. In giving a questionnaire assessment, the teacher gave a perfect response, especially in the aspects of fluency and flexibility. The average score of the student response questionnaire was 2.80. According to Siswanto et al. (2016) based on the practicality criteria that the score of 2.80 is categorised as practical. In providing an overall assessment, the lowest total score is on the construction assessment criteria, namely that the questions presented in the assessment force students to provide a variety of ideas/correct solution answers (fluency). Based on the results of the questionnaire responses given to teachers and students, the following conclusions were obtained: a) Good response to the two instruments given and b) The average score obtained from the teacher response questionnaire has very practical criteria and the average score obtained from the student response questionnaire meets the practicality criteria, namely practical. The product is said to be practical if the assessment results are obtained with a minimum criterion of ‘quite practical’, it can be said that the assessment instrument developed gets a positive response from users (Purnasari et al., 2021).

The results of the validity test items calculated using Pearson Correlation gave the results that it is found that question items 1, 2, 3, 4, 5, 6, 7, 8 and 10 are valid while question

item 9 is invalid, so improvements are needed to question item 9. Questions that are declared invalid must be revised or revised before being reused so that the questions can measure what will be measured (Kurniawan et al., 2022). The assessment is obtained that the assessment instrument to measure creative thinking ability has a reliability of 0.9372 with the criteria for the test reliability correlation coefficient on the score obtained is classified as very high and declared reliable, so it can be used more than once on the same group (Arikunto, 2010). the result of the level of agreement between raters in assessing each indicator on the instrument is 0.732. According to Widhiarso (2010) based on the interpretation of the kappa value with a score of 0.732 is categorised as good so that between the assessment of the researcher and other assessors have a good level of agreement in assessing the results of the creative thinking test. It can be concluded that of the 10 items tested, there is 1 item that has good differentiating power criteria, namely item number 3, 4 items have fairly good differentiating power criteria, namely item numbers 1,2,7 and 10, finally there are 5 items with poor differentiating power criteria, namely item numbers 4,5,6,8 and 9. Based on the results of the difficulty index analysis, no items were found in the very difficult (0%), difficult (0%) and very easy (0%) categories, which means that there is no balance between the difficulty levels of each item used.

CONCLUSION

The process of developing an assessment instrument to measure junior high school students' creative mathematical thinking abilities using the Plomp model. Based on the results of the quality analysis of the assessment product, it was declared valid, practical and effective. In addition, the results of the analysis of the creative thinking ability test provide valid, reliable quality, have differentiating power and difficulty level. The researcher provides several suggestions, namely: (1) That it is necessary for researchers who want to conduct further research to be able to consider the sample size of the research because the sample size has an influence on the results of the test; (2) Each test item should contain all aspects of what is to be measured, namely aspects of creative thinking ability in order to analyse students' abilities; (3) this development framework and assessment approach can be used as a reference for preparing similar instruments in other mathematics materials that can be adjusted according to needs; and (4) Based on the results of the statistical test analysis of the validity of invalid tests, questions must be revised or revised before being reused so that the questions can measure what will be measured (Kurniawan et al., 2022). On the results of the analysis of poor differentiating power if you want to reuse it should be revised first or discarded (Arikunto, 2010; Riyani et al., 2017; Sudijono, 2011). Meanwhile, the results of the level of difficulty analysis should have a balance between the level of difficulty of each item used. The level of difficulty of a good question is one that has a balanced distribution, namely 25% easy questions, 50% medium questions and 25% difficult questions (Widoyoko, 2014).

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