



Development of an Ethnic-Math HOTS-Based Assessment Instrument to Measure Students' Numerical Literacy

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Abstract: This study aims to develop an Ethnic Math HOTS Assessment Instrument to measure the numerical literacy of the 8th-grade students in Manado. The research used the Research and Development method. This research and development included potential and problems, information gathering, product design, design validation, design revision, product trial, and product revision. Data analysis was used to collect qualitative and quantitative data from experts' assessments, material experts, and media experts. The result of testing expert eligibility assessment was 81%, the material expert was 80%, media experts was 88%, the small-scale trial was valid with r count > r table 0.361 and reliable with a reliability coefficient of 1.653, and practical test results where the attractiveness was 31%, the use process was 20%, the convenience was 20%, the time was 9%, and the evaluation was 20%, and the large-scale trial was also valid and reliable. These results can provide information about students' capacities in numerical literacy. The HOTS ethnic math assessment instrument can be used as an assessment tool in the learning process.

Keywords: ethnic math, hots, instrument, assessment

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INTRODUCTION

Mathematics is a science relevant to everyday life that has a role in developing students' HOTS (Retnawati, 2017; Rahmawati et al., 2022). For example, when shopping, planning vacations, planning events, etc., information is often expressed numerically or graphically. Some students need help understanding problems in reading and mathematical language, lack understanding of the contents of the prerequisite material, find it hard to develop solving techniques, and find it difficult to draw conclusions, especially in solving HOTS questions. The quality of learning needs to be measured by an assessment that is oriented towards higher-order thinking skills. It is recommended that learning and assessment based on HOTS higher thinking skills be carried out in a quality education process (Kemendikbudristek, 2020; Mahmud & Pratiwi, 2019; Nudiati, 2020).

Factors causing low HOTS include (1) there were errors in understanding HOTS questions seen from the results of the assessment instrument analysis, which were dominated by questions with a cognitive level of C1 as much as 14.28%, C2 was 62.85%, C3 was 20%, 2.85% for C4, while C5 and C6 were 0%. The results of instrument analysis prove that the C1 to C3 levels dominate with 97.13%, while the C4 to C6 levels are rarely used with a percentage of only 2.85% (Afrita & Darussyamsi, 2020; Nurmayanti & Basid, 2021; Sari et al., 2019). (2) 55% of teachers use no problems that exist in the environment around students, such as culture or various advantages that exist in certain areas that will support students' HOTS (Antara et al., 2020; Nurmayanti, & Basid 2021; Suratmi et al., 2020). Likewise, with numerical literacy, the factors that cause low numerical literacy include context-free learning, meaning that understanding is not related to everyday life (Fuadi et al., 2020; Siskawati et al., 2020). Numerical literacy is directly related to solving mathematical problems, not only solving routine problems but also finding solutions or answers to problems that arise in everyday life (Arifin, 2017; Hadi & Zaidah, 2021; Halimatus Sa'diyah, 2020; Pangesti, 2018). Therefore, the lack of habit of solving problems related to daily life and local culture makes students' numeracy literacy need to be improved.

Based on observations and limited interviews with junior high school mathematics teachers in Manado City, it was found that students' learning outcomes in mathematics still needed to be improved. Teachers have not been able to develop HOTS questions, which include levels C4, C5, and C6, only restricted to levels C1, C2, and C3. In addition, teachers generally use HOTS questions contained in learning books. However, these questions have been used frequently, so from the researcher's analysis, the questions can be categorized as something other than capable of measuring HOTS abilities. This research will be conducted at MTs Negeri 1 Plus Research, Private MTs Al Inayah, SMP Negeri 1 Manado. The selection was based on the results of the 2019 assessment that these schools obtained the best national exam scores in the city of Manado. However, in 2020 - 2021, obstacles occurred in dealing with the Minimum Competency Assessment implemented that year. Based on these facts, researchers want to explore HOTS-based test instruments for measuring numerical literacy (Han

et al., 2017; Hartatik, 2020). One form of HOTS question to measure literacy and numeracy is the Ethnic-Math HOTS Question (Antara et al., 2020; Dewi & Rahmawati, 2022; Rahmawati et al., 2022).

Ethnic-Math HOTS questions are cultural-based and local wisdom-based math HOTS questions that can be used as a solution to the problems discussed previously since cultural-based questions in the area are more interesting, easier to understand and answer for students (Benidiktus, 2018; Hanafi et al., 2022; Sudianto et al., 2021). Meanwhile, the diversity of local cultures in North Sulawesi can be used as a context for developing HOTS questions for students who can measure numerical literacy. Numerical literacy is assessed in the Minimum Competency Assessment (AKM), which the government has rolled out to replace the National Examination system (Purnamasari et al., 2023; Wenas, 2010). For example, statistical material (AKM Writing Team, 2022) in the context of maengket dance, walewangko traditional house, tinu'tuan, cake of lights etc. This study aims to portray the development and feasibility of an Ethnic-Math HOTS- based assessment instrument for measuring the Numerical Literacy of 8th-grade Students of SMP/MTs in Manado City.

METHODS

The researcher used the research and development method (Sugiono, 2019). The research and development (R&D) is a method used to produce certain products and test their effectiveness. This study uses the Borg & Gall research and development modified by Sugiyono. The research stages cover potency and problem, collecting information, product design, design validation, design revision, small-scale design trials, product revision, large-scale trials, and value interpretation (Mardapi, 2007; Hanafi et al., 2022; Pulungan et al., 2021). Development of Ethnic Math HOTS (High Order Thinking Skill) assessment instrument for 8th grade mathematics subject at MTs Negeri Manado, MTs Al Inayah, and SMP Negeri 1 Manado.

The data collection technique used in this research was a written test (Widyoko, 2012; Sudaryono, 2013). Tests were used to obtain data on the effectiveness or potential effect of the questions to measure higher-order thinking skills (Paramitha & Yunianta, 2017; Pratama & Sihotang, 2021). This test was in the form of an Essay (Kusaeri, 2012; Ali, 2012; Arikunto, 2012), which consists of 5 items. The data analysis technique in this development was to describe all opinions, suggestions, and responses of evaluators obtained from the comment sheet. At the trial stage, criticism, suggestions, input, and improvements were made (Mardapi, 2012). The results of this descriptive analysis (Ananda & Fadhil, 2018; Bungin, 2015; Simangunsong, 2018) were used to determine the level of accuracy, feasibility, and attractiveness of the product or development result in the form of an ethnic math HOTS (High Order Thinking Skill)-based assessment instrument on statistic material of 8th grade MTs/SMP. Data from the test was quantified using the Likert scale (Sudaryono, 2013) and then analyzed through the percentage of the average item score on each answer to each question in the test.

RESULT AND DISCUSSION

Description of the development of the Ethnic-Math HOTS-based assessment instrument to measure the numerical literacy of 8th grade SMP/MTs students in Manado City for the stages study include potency and problem, collecting information, product design, design validation, design revision, design trials on a small-scale, product revision, large-scale use trials, value interpretation (Mardapi, 2007). The potential in this research and development is the Ethnic Math HOTS (High Order Thinking Skill) Assessment Instrument in Mathematics class VIII MTs/SMP. The problem in this research and development is the need for a HOTS (High Order Thinking Skill) Assessment Instrument in Mathematics subjects that can train students' higher-order thinking skills. Potential and problems were obtained from the results of pre-research conducted at MTs Negeri 1 Manado, MTs Swasta Al Inayah and SMP Negeri 1 Manado. Information collection is carried out to overcome the potential and problems of the development carried out by researchers. Information collection can be in the form of supporting research related to the Ethnic Math HOTS (High Order Thinking Skill) Assessment Instrument in Mathematics subjects. After collecting data obtained through interviews with educators and then supported by information from books, journals, and the internet, the next stage is designing products using Ethnic Math HOTS (High Order Thinking Skill) assessment instruments. Based on the material taught, researchers began designing the Ethnic Math HOTS (High Order Thinking Skill) assessment instrument using Canva,

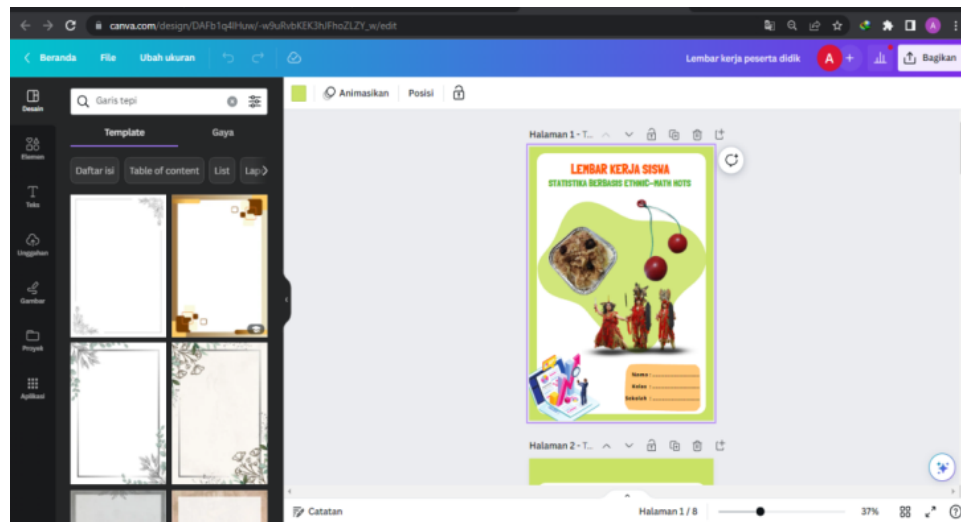


Figure 2. The front cover designed using Canva

This product was validated by six expert validators: 2 material experts, two media experts, and two assessment experts. Assessment validation on the Ethnic Math HOTS (High Order Thinking Skill) assessment instrument in mathematics subjects in measuring numerical literacy of Class VIII students consists of two expert validators, with aspects covering content feasibility, construction feasibility, and suitability of Hots level. Assessment validation aims to see the feasibility of the Ethnic Math HOTS assessment instrument developed in Mathematics Subjects in measuring the numerical literacy of Class VIII SMP/MTs students. Assessment validation results by Assessment expert validators are presented in the figure below:

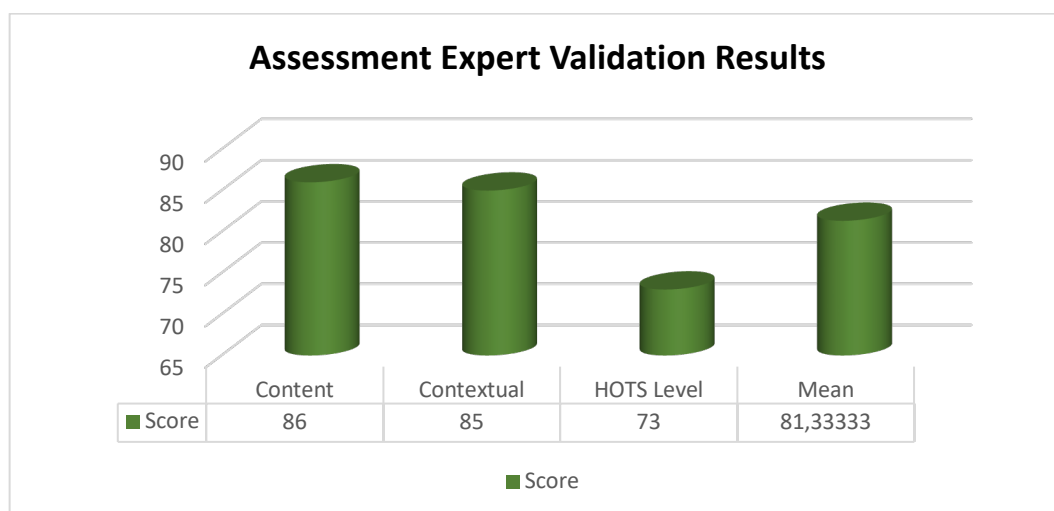


Figure 3. Diagram of Assessment Expert Validation Results

Based on Figure 3, it can be seen that the content feasibility aspect consisting of 5 assessment items obtained a total of 43 with a maximum score of 50 and a percentage of 86%, the contextual aspect consisting of 2 assessment items obtained a total of 17 with a maximum score of 20 and a percentage of 80%, and the suitability of the HOTS level consisting of 3 assessment items obtained a total of 22 with a maximum score of 30 and a percentage of 73%. Based on the percentage of the assessment score, an average score of 81% was obtained, with the category "Very Eligible" out of a total of 82 with a maximum score of 100. The assessment score from the largest of the three aspects of Assessment feasibility is the content feasibility aspect, with a score of 86%; the contextual feasibility aspect, with a score of 85%; and the suitability of the HOTS level, with a score of 73%. Material validation on the Ethnic Math HOTS (High Order Thinking Skill) Assessment Instrument in Mathematics Subjects Class VIII MTs / SMP consists of two expert validators, with aspects of assessment which include aspects of content feasibility, Contextual, HOTS level suitability, Presentation Feasibility, and Language Feasibility aspects. Material validation aims to see the feasibility of the ethnic math HOTS assessment instrument developed in mathematics subjects for Class VIII SMP/MTs students in measuring numeracy literacy. Figure 4 of the initial stage material validation results by the material expert validators is presented in the figure below:

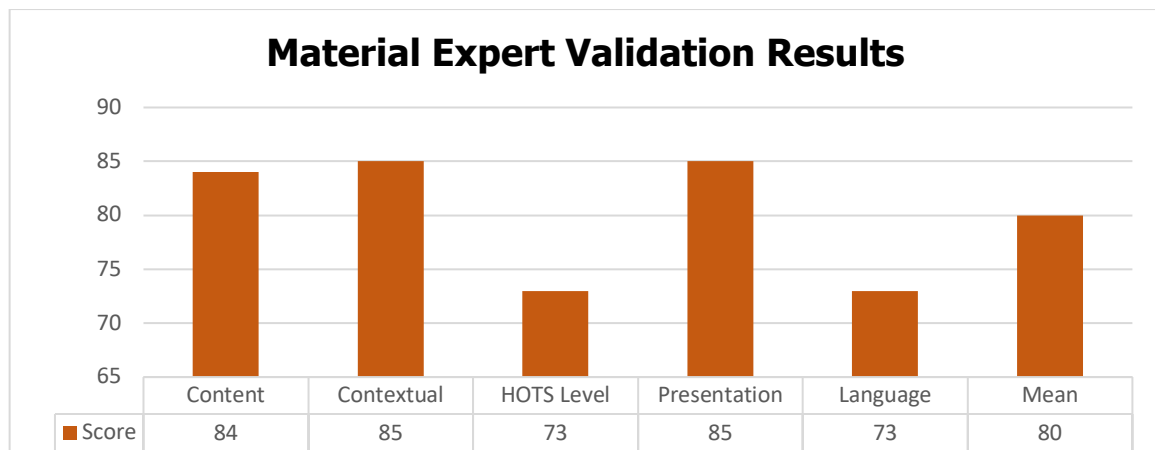


Figure 4. Diagram of Material Expert Validation Results

Based on Figure 4, it can be seen that the content feasibility aspect consisting of 5 assessment items obtained a total of 42 with a maximum score of 50 and a percentage of 84%, the contextual presentation aspect consisting of 2 assessment items obtained a total of 17 with a maximum score of 20 and a percentage of 85%, the suitability of the HOTS level consisting of 3 items with a total of 22 with a maximum score of 30 and a percentage of 73%, The presentation aspect consists of 2 assessment items obtained a total of 17 with a maximum score of 20 and a percentage of 83%, the language feasibility aspect consists of 3 assessment items obtained a total of 22 with a maximum score of 30 and a percentage of 73%. Based on the percentage of the assessment score, an average score of 80.13% was obtained, with the category "Very Eligible" out of 120 with a maximum score of 150. The assessment score from the largest of the five aspects of material feasibility is the contextual aspect with a score of 85%, the presentation aspect with a score of 85%, the content feasibility aspect with a score of 84%, the HOTS level suitability aspect with a percentage of 73% and the language feasibility aspect with a score of 73%.

Media validation of the Ethnic Math HOTS (High Order Thinking Skill) Assessment Instrument in Mathematics Class VIII SMP/MTs consists of 2 expert validators with assessment aspects, including cover design and content design. Media validation aims to see the feasibility of HOTS worksheets developed from the HOTS (High Order Thinking Skill) ethnic Math Assessment Instrument in Class VIII Mathematics Subjects of SMP/MTs. The results of media validation by the media expert validator are presented in Figure 5 below:

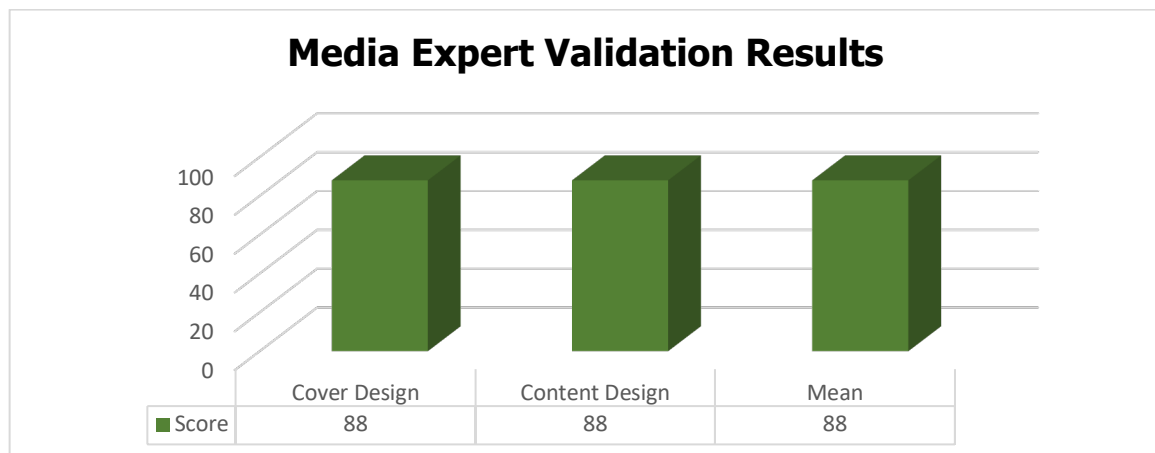


Figure 5. Diagram of Media Expert Validation Results

Based on Figure 5, it can be seen that the cover design consisting of 10 assessment items obtained a total of 88 with a maximum score of 100 and a percentage of 88%, the content design consisting of 10 assessment items obtained a total of 88 with a maximum score of 100 and a percentage of 88%, based on the percentage of the assessment score obtained an average score of 88%, with the category "Very Eligible" out of a total of 176 with a maximum score of 200. The Ethnic Math HOTS (High Order Thinking Skill) Assessment Instrument for grade VIII SMP/MTs math material which expert validators have validated, the next step is to improve the product design in the form of HOTS (High Order Thinking Skill) Ethnic Math Worksheets with Class VIII Statistics material SMP/MTs following the criticisms and suggestions given by expert validators. The validation results by the validator provided information to researchers regarding the weaknesses in the Ethnic Math HOTS (High Order

Thinking Skill) assessment instrument that was developed. The criticisms and suggestions given by the validator are presented in Table 1 as follows:

Table 1. Criticism and Suggestion Data of Experts

Validator	Criticism and Suggestion	Description
Assessment Expert	Include HOTS levels C4, C5, and C6 in the contain outline.	Fixed
Material Expert	The answer key must be clearly categorized	Fixed
Media Expert	Tidy up the writing procedures in the worksheets that are made.	Fixed

The effectiveness of the Ethnic Math HOTS (High Order Thinking Skill) Assessment Instrument developed is seen in the results of product trials conducted by researchers on students in three schools consisting of MTs Negeri 1 Manado, MTs Al Inayah, SMP Negeri 1 Manado. The small group trial consisted of 10 students from MTs Negeri 1 Manado, 10 students from SMP Negeri 1 Manado, and 10 students from MTs Al Inayah, so the total sample for the small group trial was 30. The small product trial aims to measure students' numerical literacy by using the Ethnic Math HOTS (High Order Thinking Skill) assessment instrument developed. The number of items used in the small-scale trial was five with 30 respondents, while the recap is in Table 2 as follows.

Table 2. Validation Analysis Recap

Items	r_{count}	r_{table}	Description	Status
1	0.7284	0.361	$r_{count} > r_{table}$	Valid
2	0.6084	0.361	$r_{count} > r_{table}$	Valid
3	0.6531	0.361	$r_{count} > r_{table}$	Valid
4	0.5464	0.361	$r_{count} > r_{table}$	Valid
5	0.516	0.361	$r_{count} > r_{table}$	Valid

Based on Table 2, the results of the small-scale trial, all questions on the items are declared valid where the test results r_{count} greater than r_{table} 0.361. Thus, it can be said to meet the data validity test. The test reliability test was carried out in the study using the Alpha Cronbach Formula technique. Based on the test results using the Cronbach Alpha technique, the reliability coefficient value was 1.653. The coefficient value is greater than the predetermined reference value of 0.7. The revision results are the final product of the Ethnic Math HOTS (High Order Thinking Skill) Assessment Instrument with Statistics material for class VIII SMP/MTs. The next step is to conduct a large-scale product test. Large group trials were conducted in 3 schools: 1) MTs Negeri 1 Plus Manado research, which consists of 17 students. 2) MTs Al Inayah, which consists of 17 students. 3) SMP Negeri 1 Manado consisting of 17 students. This large product trial aims to determine the response of a limited number of students to the developed Ethnic math HOTS (High Order Thinking Skill) assessment instrument. The number of items used in the large-scale trial was five items with 54 respondents, while the recap is in Table 3 as follows:

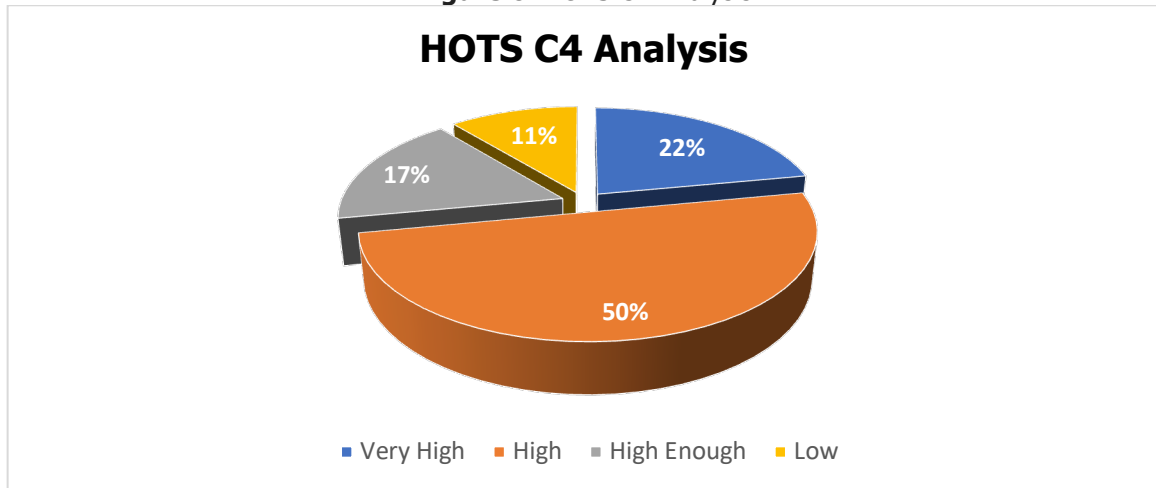
Table 3. Recap of Validation Analysis

Items	r_{count}	r_{table}	Description	Status
1	0.679	0.226	$r_{count} > r_{table}$	Valid
2	0.732	0.226	$r_{count} > r_{table}$	Valid
3	0.658	0.226	$r_{count} > r_{table}$	Valid
4	0.527	0.226	$r_{count} > r_{table}$	Valid
5	0.485	0.226	$r_{count} > r_{table}$	Valid

Based on Table 3, the results of the large-scale trial, all questions on the items are declared valid where the test results r_{count} greater than r_{table} 0.226. Thus, it can fulfill the data validity test. The test reliability test was carried out in the study using the Alpha Cronbach Formula technique. Based on the test results using the Cronbach Alpha technique, the reliability coefficient value was 1.640. The coefficient value is greater than the predetermined reference value of 0.7, meaning that the data is reliable. In the large-scale trial, the higher-order thinking skills questions provided students with information about their ability in numerical literacy.

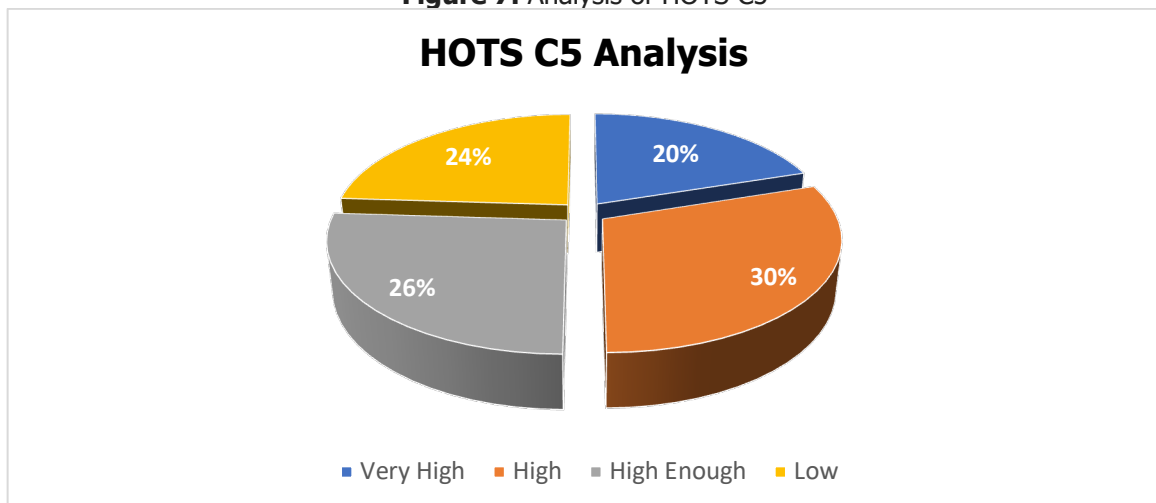
The results of the Analyzing HOTS Test (C4) on the large-scale trial obtained detailed results, namely the ability of students at the level of analysis of 22% of students in the very high category, 50% of students in the high category, 17% of students in the fairly high category, 11% of students in the low category, and 0% of students in the very low category, can be seen in Figure 6 below.

Figure 6. HOTS C4 Analysis



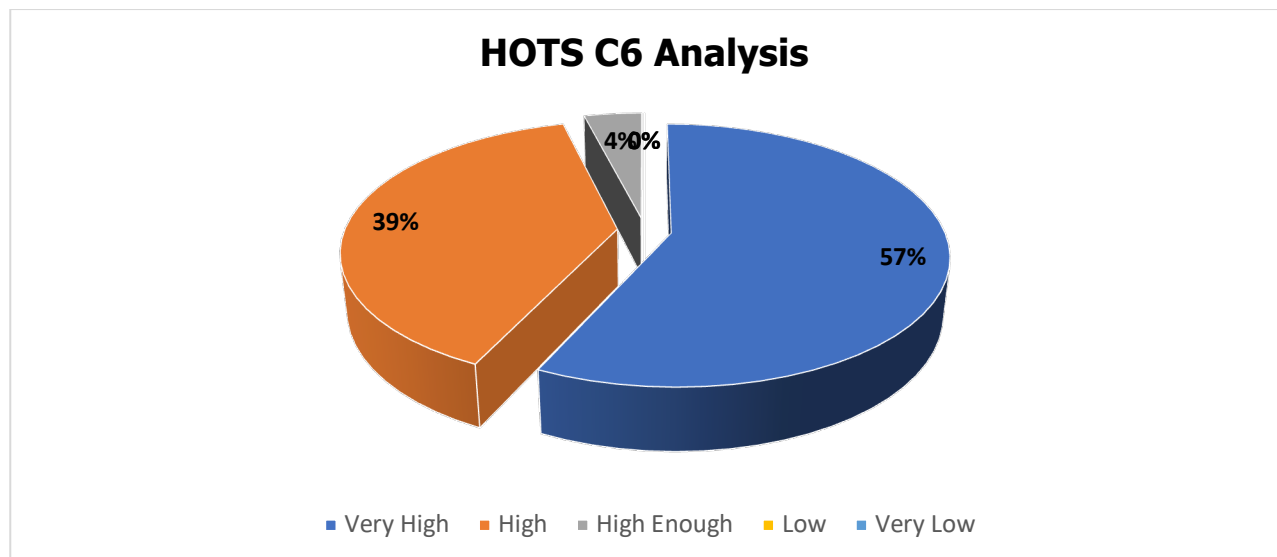
Test Results Assessing/evaluating (C5) in large-scale tests in Figure 2 shows that large-scale HOTS analysis for the ability to assess or evaluate is very high, reaching 20%. Whereas those in the high category can assess or evaluate with a presentation of 30%, then fall again in the fairly high category, namely 26%, then continue to fall in the low category of 24% and very low of 0%, the results of the analysis can be seen in Figure

Figure 7. Analysis of HOTS C5



Results of the Hots Create/Create test on a large-scale test in Figure 3, we can see the results of students' abilities at the creative or creative level of 57% of students in the very high category, 39% of students in the high category, 4% of students in the very high category quite high, 0% of participants in the low category and 0% of students in the very low category, the results of the analysis can be seen in Figure 8.

Figure 8. Analysis of HOTS C6



The development of HOTS questions in measuring numeracy literacy is very important for a teacher, especially a class VIII teacher in junior high school. This is because students need to get used to it before taking the AKM test. AKM-based questions have been taught since they entered elementary school, but if students are already in class VIII, then the easy way is lots of practice (Anshari & Putra, 2020). In addition, the learning model used by the teacher must be a model that allows students to be able to solve HOTS questions, one of which is the problem-based learning model (Agustin & Mayasari, 2022).

Mastering mathematical literacy needs to be balanced with developing higher-order thinking skills, namely, getting students used to working on high-level, non-routine questions equivalent to PISA (OECD, 2019). Solving math problems using context is also a way that can be done to help students use math skills in everyday life (Amalia et al., 2021). Many teachers currently feel learning to be the highest point in teaching students, especially in mathematics. This is due to the negative influence of learning carried out during the pandemic. Even so, based on the results of Suarlin et al.'s research in 2022, it was concluded that online learning had a positive and significant influence on learning interest in class V SD Inpres Mangasa 1 Makassar City by 17.3%. Meanwhile, internal and external factors influenced 82.7% of learning outcomes. Internal factors include intelligence, perseverance, attitude, study habits, and physical and health conditions (Suarlin et al., 2022). Research on the development of HOTS questions in measuring literacy that previous researchers have compiled provides an understanding that the AKM questions are HOTS questions. The results of developing the ethnic math HOTS assessment instrument can support students' numerical literacy skills (Herliana & Kurniawan, 2021; Meiliasari et al., 2022). Numerical literacy is the ability of individuals to formulate, apply, and interpret mathematics in various contexts (Tanujaya, 2021; Umbara et al., 2020). Indicators of numeracy literacy are related to the ability of HOTS (Helmawati, 2019; Wahyu, 2021), such as C4 (analyzing) in numeracy literacy at the Reasoning level with sub-level analyzing, C5 (assessing) in numeracy literacy at the Knowing level with sub-level calculating and measuring, as well as C6 (creating) equivalent to the Applying level with sub-level modeling and interpreting.

CONCLUSION

Based on the research and discussion results, the following conclusions are obtained: The final product in this study produced an Ethnic Math-HOTS assessment instrument to measure the numerical literacy of junior high school students in grade VIII. The results of testing the feasibility of Assessment experts, the feasibility of material experts, the feasibility of media experts, small-scale trials, and large-scale trials are also valid and reliable. In short, the Ethnic Math HOTS assessment instrument can provide information about students' ability in numerical literacy. The Ethnic Math HOTS assessment instrument is eligible to be used as an assessment tool in the learning process.

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