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Minimum Competency Assessment to Measure Mathematical Literacy of Junior High School Students

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ABSTRAK

Merujuk pada hasil tes internasional, baik PISA maupun TIMSS, Indonesia terus berupaya meningkatkan kemampuan literasi matematika siswa melalui berbagai kebijakan. Namun, sebagian besar siswa tampil lebih baik dalam hal literasi daripada pada tes aritmatika. Penelitian ini bertujuan untuk mengembangkan instrumen penilaian kompetensi minimal yang valid dan reliabel untuk mengukur dan mendeskripsikan kompetensi literasi matematika siswa SMP dalam melaksanakan penilaian kompetensi minimal (MCA). Jenis penelitian ini yaitu Research & Development (R&D) menggunakan tahapan pengembangan model Oriondo dan Antonio yang telah dimodifikasi. Penelitian ini melibatkan 60 siswa. Subjek yang digunakan untuk uji coba adalah siswa SMP sebanyak 15 orang. Metode yang digunakan untuk mengumpulkan data adalah observasi dan angket. Instrumen yang digunakan untuk mengumpulkan data adalah kuesioner. Teknik analisis data yang digunakan adalah deskriptif kualitatif dan analisis kuantitatif. Hasil penelitian menunjukkan bahwa 17 soal valid dan reliabel, dengan reliabilitas Alpha 0,853, dan sesuai untuk mengukur kompetensi literasi berhitung siswa SMP. Rata-rata kompetensi literasi numerasi siswa SMP sebesar 53,3 dikategorikan 'kurang'. Temuan penelitian menunjukkan bahwa guru dapat memanfaatkan tes MCA untuk menilai literasi matematika siswa dan mengidentifikasi area di mana siswa perlu meningkatkan pembelajaran di kelas.

ABSTRACT

Referring to the results of international tests, both PISA and TIMSS, Indonesia continues to strive to improve students' mathematical literacy skills through various policies. However, most students performed better in terms of literacy than on the arithmetic test. This study aims to develop a valid and reliable minimum competency assessment instrument to measure and describe the mathematical literacy competence of junior high school students in carrying out the minimum competency assessment (MCA). This type of Research & Development (R&D) research uses the development stages of the modified Oriondo and Antonio models. This study involved 60 students. The subjects used for the trial were 15 junior high school students. The methods used to collect data are observation and questionnaires. The instrument used to collect data is a questionnaire. The data analysis technique is descriptive qualitative and quantitative analysis. The results showed that 17 questions were valid and reliable, with Alpha reliability of 0.853, and suitable for measuring the numeracy literacy competence of junior high school students. The average numeracy literacy competence of junior high school students is 53.3, categorized as 'less.' The research findings suggest that teachers can utilize the MCA test to assess students' mathematical literacy and identify areas where students need to improve classroom learning.

1. INTRODUCTION

Assessment is one of the activities carried out to measure the success or failure of the learning process (Gonzalez et al., 2020; Scheopner Torres et al., 2018), and can be used by teachers to review the learning that has been done to improve it (Azim & Khan, 2012; Lo & Hew, 2017). Assessment can help teachers get useful feedback on what, how much, and how well their students are learning (Büyükkarci, 2014; Mamoon-Al-Bashir et al., 2016). The quality of assessment is very important in good learning and is undeniably an important component in a learning environment that facilitates student understanding in learning (Edwards, 2013; Ibarra-Sáiz et al., 2021). Assessment of learning outcomes by educators serves a function to monitor learning progress, monitor learning outcomes, and detect the need for continuous improvement of student learning outcomes. Good assessment is an integral part of good learning. Assessment is also a systematic activity to collect, analyze and present useful information to see students' learning success (Rosidin et al., 2019; Schildkamp et al., 2020). In general, the assessment of learning outcomes by educators has the aim of knowing the level of mastery of competencies, determining the completeness of competencies mastery, establishing improvement or enrichment programs based on the level of competencies mastery and improving the learning process.

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Appropriate assessment is oriented to at least two main priorities: (1) the main goal of education, namely learning how to learn from an experience, so that the next lesson plan becomes meaningful, and (2) accommodating student diversity, especially in terms of learning styles in order to help planning for improvement of the learning process (Lorbis, 2019; Okoye, 2014). One of the roles of national assessment or assessment is the implementation of the National Examination in Indonesia to measure students' competence, one of which is mathematics (Burhanudin & Yusuf, 2020). Base on government regulation number 57 of 2021, student competence in evaluating the national education system is carried out in the form of a national assessment. One of the important instruments in NA is the minimum competency assessment (MCA). MCA is a minimum competency assessment required by all students to be able to develop self-capacity and participate positively in society. Minimum Competency Assessment (MCA) is carried out to measure students' reading literacy and mathematical numeracy (Handayani et al., 2021; Yamtinah et al., 2022). MCA – numerical literacy is a new national assessment model whose development orientation refers to the PISA problem model. The numeracy literacy assessment in the MCA consists of 3 components, namely content, cognitive processes and context. The content component consists of algebra, numbers, geometry, measurements, data, and uncertainty.

The development of mathematical literacy skills aims that student is not only equipped with formulas or calculations in solving problems, but students are able to involve reasoning skills, analytical skills, and problem-solving abilities in learning (Anderson et al., 2001; Putri & Sulistyaningrum, 2021). According to the Organization for Economic Cooperation and Development (OECD), mathematical literacy skills are students' skills in formulating, reasoning mathematically, using concepts or procedures, and communicating mathematics in various contexts (Schoenfeld, 2016). Mathematical literacy ability according to PISA is closely related to students' ability to identify information, to reason, and communicate opinions in various situations by formulating, solving, and interpreting mathematics (Mansur, 2018). Mathematical literacy has five parts of competency, namely problem solving, reasoning and proof, communication, connections, representations (Pugalee, 1999). Mathematical literacy that is connected with everyday life can apply or use mathematics (Lengnink, 2005; Umbara & Suryadi, 2019). A person's ability to solve daily problems requires high-level thinking skills that require basic knowledge to be able to formulate problems and a series of activities to be able to communicate (Liu et al., 2021; Rahman, 2019). Referring to the results of international tests both PISA and TIMSS, Indonesia continues to strive to improve students' mathematical literacy skills through various policies (Argina et al., 2017; Chamisah, 2017).

Research regarding the development of MCA questions was carried out by several previous researchers. One of the previous research reveals that MCA questions can measure students' numeracy literacy skills (Megawati & Sutarto, 2021). The development of MCA questions based on the PISA framework in order to train students' numeracy skills. In other study the development of infographic-based MCA questions has also been carried out on history subject (Nasution et al., 2021). The development of MCA questions is not only intended for students but also to assist teachers in compiling them. The results show that most of the students performed better on literacy than numeracy tests. The previous research above has emphasized the measurement of mathematical literacy using essay test, while the use of the MCA test in the form of conventional multiple choice and complex multiple choice and its characteristics have not been widely studied. Likewise, the use of complex multiple-choice questions becomes something new for students and is classified into difficult questions (Inko-Tariah, 2014; Machromah et al., 2021; Rini & Solehah, 2021; Ulyah et al., 2021).

The novelty of this research is the production of the MCA test to assess the numeracy (mathematical) literacy of junior high school students. This test meets the valid and reliable criteria so that it can be used widely by teachers throughout Indonesia or teachers in countries that have the same characteristics. Valid nature is shown by the high validity of the measurement results of a test. An invalid measuring instrument will provide erroneous information about the condition of the subject or individual who is subjected to the test. If the erroneous information is consciously or unconsciously used as a basis for consideration in making a decision, then the decision is certainly not the right decision (Gong et al., 2019; Sullivan, 2011).

Therefore, it is necessary to study the characteristics of the MCA test in the form of ordinary multiple choice and complex multiple choice to provide information about the characteristics of the questions so that future MCA tes developments consider the number of question forms used more proportionally (Hidayah et al., 2021; Yamtinah et al., 2022). Based on the description above, the research objective is to develop valid and reliable minimum competency assessment questions and describe the mathematical literacy competencies of junior high school students. This research has an important urgency to be conducted because the numeracy literacy assessment at MCA is a national policy whose

implementation was just be carried out in 2021 so that it will become an example for the development of similar assessments in the future.

2. METHODS

The type of this research is Research & Development (R & D). The R & D procedure uses a modification of the Wilson model and Oriondo and Antonio model with the steps of developing test instruments including test design, test trials, and test measurements (Heru & Suparno, 2019; Istiyono, 2014). The steps for developing the MCA test are presented in Figure 1.

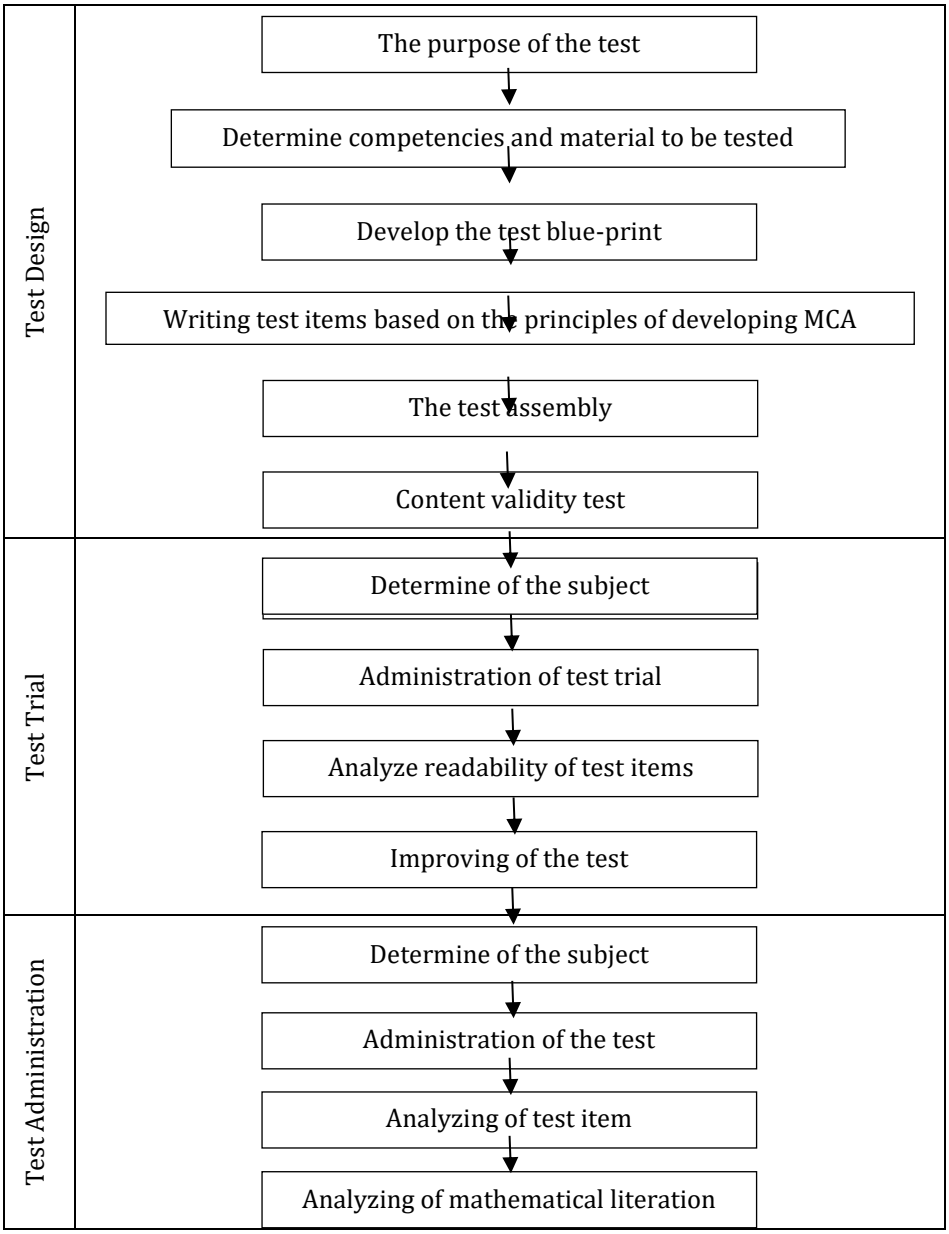

Figure 1. MCA test development steps

Based on Figure 1 shown that on the test design stage consisted of determining the purpose of the test, determining the competence and materials to be tested, develop the test blue-pint, writing test items based on the principles of developing MCA, test assembly, content validity test, and test revision. The purpose of developing the MCA test is to produce a valid and reliable test to measure the mathematical literacy ability of junior high school students. At the stage of determining competence and the material being tested is based on the characteristics of the MCA test. In developing the MCA test blueprint, it specifically refers to the characteristics of the MCA test, namely content, context, cognitive processes. The

content on the MCA test is material of numbers, measurements, statistics, geometry, and algebra, while the context is personal, socio-cultural, and science. Cognitive processes used in the MCA test are cognitive levels of understanding, application, analysis, evaluation. Referring to the MCA test blueprint, the next step is writing test items. The test items are written with reference to the assessment indicators contained in the MCA test blueprint. The next stage is the MCA test content validity test. The content validity test of the MCA test involved two mathematics education experts, namely mathematics education lecturer and mathematics teacher in junior high school. Content validity is used to assess aspects of the material, language, test items, the suitability of the test with the characteristics of the MCA test. The last activity of this stage is the revision of the test based on the suggestions given by the expert.

On the second stage, the test trial stage includes determine of the subject, administration of test trials, analyze readability of test items, and test revision. The subjects used for the test trials were 15 junior high school students in Malang Regency. The purpose of this test trial is to assess the readability of the text on the test items both in terms of context in the form of text, images, or graphics and materials. The results of this trial are used to improve the quality of the text from the language and material aspects

Furthermore, the final stage is test administration. On this stage includes determine of the subject, test administration, and analysis of test results. The subjects used in the MCA test administration were 60 junior high school students in Malang Regency and Batu City. At this stage, an analysis of the results of the test administration was also carried out including empirical validity tests, tests of item difficulty levels, tests of differentiating power, reliability, and mathematical literacy. The data in this study were the content validity, the MCA test parameters, and students' mathematical literacy skills. The content validity data were collected using a validation sheet, and MCA test parameter data including empirical validity, level of item difficulty (P), item discriminating power (D) and test reliability, and students' mathematical literacy skills were collected using the MCA test.

Validity is the extent to which a test measures what it is supposed to measure (McCowan & McCowan, 1999). Reliability, which is the best single measure of test accuracy, is the extent to which test results are consistent, stable, and free of error variance (Bichi & Embong, 2018; McCowan & McCowan, 1999). The difficulty level has the following criteria, according to Miller (Miller et al., 2009; Oermann & Gaberson, 2009). The item difficulty index is calculated as percentage of the total number of correct responses to the test item. It is calculated using the formula P=R/T, where P is the item difficulty index, R is the number of correct responses and T is the total number of responses (Miller et al., 2009). An item was considered difficult when the difficulty index value was less than 30%, the item was considered easy when the index value was greater than 70%, and P-values of .30 to .70 for test items are desirable (Miller et al., 2009; Oermann & Gaberson, 2009). The higher the discrimination index, the test item can discriminate better between students with higher test scores and those with lower test scores. The item with negative discrimination index (D) was considered to be discarded; D: 0.0 – 0.19 – poor item – to be revised; D: 0.2 – 0.29 – acceptable; D: 0.3 – 0.39 – good; D: > 0.4 – excellent. The difficulty level has the following criteria, according to Miller (Miller et al., 2009; Oermann & Gaberson, 2009). The data on the characteristics of the MCA test parameter were analyzed using the Conquest Program. The validity of each item was analyzed using SPSS. Furthermore, students' mathematical literacy competence was analyzed descriptively by calculating the number of students who scored in the very good, good, moderate, poor, and very poor categories.

3. RESULT AND DISCUSSION

Results

The MCA Test Development

Test Design

The results of the test design stage included the objective of test development, a blue-print test table containing competencies, materials, types and number of questions, content validity analysis, and test assembly. The purpose of developing the MCA test is to produce a valid and reliable MCA test to measure the mathematical literacy of junior high school students on the subject matter of numbers, geometry, staatistica, and algebra. The development of the MCA test is based on a test developed by the Center for Assessment and Learning of the Ministry of Education and Culture of the Republic of Indonesia. The MCA test was developed on the subject matter of numbers, geometry, statistics, and algebra. The components of the numeracy literacy assessment in the MCA consist of content, cognitive processes, and context. The number of MCA items is 20 questions consisting of 10 conventional multiple-choice (MC) questions and 10 complex multiple-choice (C-MC) questions. The part of the blue-print test is presented in the following Table 1.

Table 1. The Part of Test Blue-print

Competency	Subject Matter	Type and number of test items.		
		MC	C-MC	Total
Students are able to solve number problems	Number	2	1	3
Students are able to solve geometry problems	Geometry	4	5	9
Students are able to solve statistical problems	Statistic	2	2	4
Students are able to solve algebraic problems	Algebra	2	2	4

Furthermore, after the test MCA were assembled, content validation is carried out.The results of the content validity test of the MCA test by 2 mathematics education experts are presented in the following Table 2.

Table 2. Content Validity Test

No.	Validator	Score	Category
1.	Validator 1	86	Valid
2.	Validator 2	92	Valid
Mean		**89**	**Valid**

Table 2 shows that the average percentage of the content validation test results is 89%. These results indicate that the MCA test can be used to measure mathematical literacy and is in accordance with the characteristics of MCA. Qualitatively, improvements have also been made to the suggestions given, especially on aspects of language which are considered ambiguous and can make students confused in interpreting the answers, grouping ordinary and complex multiple-choice questions.

Test Trial

The results of the MCA test trial for 15 junior high school students are presented in Table 3.

Table 3. Content Validity Test

No.	Statement	Score	Category
1.	Readability of the text in the item test	84	High
2.	Materials cover in MCA test have been taught	100	It's been taught

The test trial results on Table 3 shown that the MCA test can be used to measure the mathematical literacy of junior high school students, because the readability of the text in the item test is in the high catoery. This means, students understand the text in the items test and there are no ambiguous sentences in the text. Also, the subject matter being tested has been taught at the school. Based on interviews with students, it was shown that complex multiple-choice questions were difficult for students. This is because students are not familiar with complex multiple-choice questions.

Test Administration

The test, which was administered to 60 junior high school students, was analyzed for the validity and reliability of the MCA test, test parameters, and mathematical literacy competencies.

Validity and Reliability of MCA Test

Based on the results of the analysis of the 20 items of the MCA test using SPSS and Conquest programs, the results of the validity of each item and the reliability of the test are show in Table 4.

Table 4. Validity of MCA Test Items

No.	Validity	Number of items	%	Items	Test Reliability Index
1.	Valid	17	85	1,3,5,6, 8-20	0.853
2.	Invalid	3	15	2,4,7	
	Total	**20**	**100**	**-**	

Table 4 shows that the MCA test has 17 (85%) valid items and 3 (15%) invalid items. The MCA test reliability index is high with alpha reliability coefficient of 0.853. This means that the minimum competency assessment is reliable.

MCA Test Parameters

Based on the results of the analysis of the 20 items of the MCA test, the results of the MCA test difficulty level parameters are show in Table 5.

Table 5. MCA Test Level Difficulty

No.	Difficulty	MC	%	Items	C-MC	%	Items	Total Test Item	%
1.	Easy	1	10	9	0	0	-	1	5
2.	Moderate	9	90	1-8, 10	3	30	16, 17, 18	12	60
3.	Difficult	0			7	70	11-15, 19-20	7	35

Table 5 shows that of the 20 MCA questions, there was 1 question classified as easy (5%), 12 questions were in the moderate category (60%), and 7 questions were in the difficult category (35%). The questions that were included in the difficult category were in the form of complex multiple-choice questions. The results of the analysis above show that in the MCA questions, very few questions were considered easy by students, and they tended to be in the moderate and difficult categories. Through interviews, it was found that students were not familiar with complex multiple-choice model questions. While the results of the analysis of the discrimination power of the questions are presented in Table 6.

Table 6. Discrimination Power of MCA Test Items (N=60)

No.	Discrimination Power	MC	%	Item Number	C-MC	%	Item Number	Total Test Item	%
1.	Poor	2	20	2, 4	0	0	0	2	10
2.	Fair	5	50	1, 6-9	2	20	12, 15	7	35
3.	Good	2	20	3, 10	2	20	11, 20	4	20
4.	Very Good	1	19	5	6	60	14-15, 16-19	7	35

Table 6 shows that of the 20 MCA questions, there were 2 questions that had poor discrimination power (10%), 7 questions with fair discrimination power (35%), and 4 questions had good discrimination power (20%), and 7 questions had a very good discrimination power (35%). The questions that were classified as having a very good discrimination power were dominated by complex multiple-choice questions. These findings indicate that the group of students who had good competency were able to correctly answer the complex multiple-choice questions and the group with lower competency were unable to answer correctly. The results of the analysis above also show that the 2 questions, namely questions number 2 and 4, are in the poor category. This finding is in line with the test of the validity of the test items, that these items are not valid. The results of the validity and discrimination power of the MCA test show that there are 17 questions that are very suitable to be used to measure the numerical literacy of junior high school students. While the other 3 questions are not suitable to be used to measure the numerical literacy of junior high school students, which are items 2, 4, and 7.

Mathematical Literacy Competence

The results of the analysis of students' mathematical literacy competence were divided into two parts, which were a) calculated based on the true or false of each developed question, and b) calculated on the correct answer on the selected answer option. In the second part, the assumption used was that students had one or more answers from the options given to each question. The data from this analysis are presented in Table 7.

Table 7. Students' Mathematical Literacy Competence Model 1 (N=60)

Competence	Number of students	%	Average
Very Good (80-100)	7	11.67	
Good (70-79)	8	13.33	
Fair (60-69)	12	20.00	53.3
Poor (50-59)	6	10.00	(Poor)
Very Poor (0-49)	27	45	

Base on Table 7 shows that the mathematical literacy competence of junior high school students had an average of 53.3, which is included in 'poor' category. The distribution is 7 students with very good competence (11.67%), 8 students with good competence (13.33%), 12 students with fair competence (20%), 6 students with poor competence (10%), and 27 students with very poor competence (45%). These results indicate that students were not used to dealing with MCA-characterized questions, especially complex multiple-choice questions. Meanwhile, when viewed from the right and wrong of each question answered by students, the mathematical literacy competence of junior high school students slightly different, which is presented in Table 8.

Table 8. Students' Mathematical Literacy Competence Model 2

Competence	Number of students	%	Average
Very Good (80-100)	6	10	
Good (70-79)	1	1.67	
Fair (60-69)	7	11.67	41.17
Poor (50-59)	13	21.67	(Very Poor)
Very Poor (0-49)	33	55	

Table 8 shows that the numeracy literacy competence of junior high school students had an average of 41.17 with a very poor category. The results of this analysis show a lower number than the calculation of competence which gives a value for each correct option. The distribution is that 6 students had very good competence (10%), 1 student had good competence (1.67%), 7 students had fair competence (11.67%), 13 students had poor competence (21.67%), and 33 students had very poor competence (55%). These results indicate that students were not used to dealing with MCA-characterized questions, especially with complex multiple-choice questions.

Discussion

A measuring instrument is said to be reliable if the measuring instrument shows the extent to which the measurement results with the tool can be trusted. This is indicated by the level of consistency (consistency) of the scores obtained by the subjects measured with the same instrument, or measured with the same instrument under different conditions. In the broadest sense, the reliability of the measuring instrument refers to the extent to which the differences in the acquisition scores reflect the actual differences in the attributes (Nusri et al., 2018; Sechrest, 2005), and ensure that the measurements of the tools developed are appropriate and that implementation in the learning process program runs well (Hadi et al., 2022).

The results of the study indicate that the development of MCA instruments is important, one of which is to measure students' mathematical literacy competence. The MCA questions that were developed obtained valid and high reliability results. High validity and reliability values indicates that the development of the MCA instrument had consistency for each item (Sugiyono, 2017; Ulfah et al., 2020). The level of difficulty and discrimination power of the MCA questions that were developed obtained suitable results to be applied in measuring numeracy literacy for each item (Rosidah & Sunarti, 2017). Numbers that indicate the difficulty and ease of an item are called the difficulty index. The difficulty index is between 0.00 and 1.0. This difficulty index shows the level of difficulty of the questions. A question with a difficulty index of 0.0 indicates that the item is too difficult, on the other hand, an index of 1.0 indicates that the item is too easy (Bichi & Embong, 2018; McCowan & McCowan, 1999; Vincent & Shanmugam, 2020). The purpose of giving the difficulty test is to find the percentage of students who answer correctly. We can estimate the difficulty of the problem by determining the percentage of students who choose the correct answer or work on the correct question. The simplest procedure is to base this estimate only on students belonging to the item analysis group (Karim et al., 2021).

Research shows the factors causing a lack of numeracy literacy, which were because most students considered that MCA questions were not in accordance with the materials learned in class. In addition, students' abilities are still below the minimum completeness criteria (Aufa & Manoy, 2022; Handayani et al., 2021; Syaifuddin, 2020). Teachers must familiarize students with solving MCA questions to improve students' numeracy literacy outcomes (Aufa & Manoy, 2022; Lin et al., 2017). In the learning process, to support students' understanding of the types of MCA questions, teachers can apply learning models that encourage students to solve problems related to story questions in personal, social and cultural contexts, as well as scientific ones, as well as non-routine questions. Such as problem-based learning models, project-based learning, contextual learning, and the like (Almazova et al., 2021; Hidayah et al., 2021; Szabo et al., 2020; Warniatun & Junaedi, 2019). The provision of interesting learning media

such as appropriate interactive learning games can improve students' literacy skills. The implication of the research results is that teachers can use the MCA test to measure students' numeracy literacy and identify aspects that have not been mastered by students for improvement in classroom learning (Bichi & Embong, 2018; Clarke, 2020; McCowan & McCowan, 1999; Vincent & Shanmugam, 2020).

It is in line with previous research that measured the numeracy literacy ability of high school students from the MCA questions and obtained a dominantly high result (Megawati & Sutarto, 2021). This is because there were several influencing factors including physical, psychological, student analytical abilities and environmental factors, as well as question factors and number of questions. It is also reinforce by other researcher that analyzed the competence of 4 elementary students, 8 junior high school students and 11 high school/vocational high school students who obtained dominantly moderate results(Cahyanovianty & Wahidin, 2021). The variety of students' numeracy literacy results in solving MCA questions can occur due to several factors, both from teachers and students. In the questions that were being developed, literacy skills were lacking due to complex multiple-choice questions. The results of interviews with several students demonstrate that students had difficulty in answering complex multiple-choice questions, and it was hoped that the scoring was not based on all correct answers but on the correct answer options. There are theoretical and practical significant from this result. Theoretically, this research will provide knowledge about the characteristics of the MCA test and provide suggestions on determining the percentage of ordinary and complex multiple-choice questions in the development of the MCA test. Practically, this MCA test can be used by teachers to measure mathematical literacy competence. Referring to the national MCA test development policy which states that the proportion of complex multiple choice on the MCA test is 60%, theoretically, the results of this study provide input to national policy makers so that the percentage of complex multiple-choice questions on the MCA test is less than 60% because these questions are included in the difficult category.

4. CONCLUSION

The results show that the MCA test was valid and reliable with high alpha reliability index. The MCA test can be used to measure the mathematical literacy competence of junior high school students. The average mathematical literacy competence of junior high school students in answering MCA test was in poor category. The implication of the research finding that the MCA test can be used widely by teachers to measure mathematical literacy, and the teachers can use this MCA test model during the learning process, so that students' mathematical literacy becomes better. Recommendations for further research are researchers develop the MCA test using various other types of tests and analysis of the MCA test item parameters using the Items Response Theory (IRT).

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