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Learning Tools on Literacy and Numeracy to Enhance Students' Critical Thinking Skills

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ABSTRACT

This study seeks to describe the validity and practicality of learning tools, as well as to assess the effectiveness of literacy and numeracy-based learning tools. The study was conducted in an IX-grade class at SMP State 1 Kabila Junior High School, Bone Bolango Regency, involving 30 students. This development research utilized the Borg and Gall development model, modified by Sugiono, and focused on learning tools that include lesson plans, student worksheets, learning media, and test instruments. Data were collected using validation sheets, learning implementation sheets, student activity sheets, critical thinking tests, and student response questionnaires. The data obtained were analyzed by calculating the percentage of each score. The results showed that the teacher activity score averaged 89.75, while student activity was categorized as very good, with an average score of 94.5. Student responses were categorized as very good, with 49% of students strongly agreeing and 51% agreeing. Students' critical thinking abilities, measured through n-gain, were categorized as moderate to high. The analysis of the critical thinking test results also indicated improvements in every critical thinking indicator.

Keywords: Literacy, Numeracy, Critical Thinking

INTRODUCTION

Numeracy literacy refers to the knowledge and skills necessary to use various numbers and symbols related to basic mathematics to solve real-world problems in daily life. It involves presenting information in different formats, such as graphs, tables, and charts, and interpreting the analysis results to make informed decisions (Rosalina & Suhardi, 2020). However, real-world observations indicate that this numeracy literacy competency still requires significant improvement. Initial observations by the author at SMPN 1 Kabila Junior High School revealed that the learning tools developed by science teachers did not effectively facilitate active, independent learning, critical thinking, or strong communication skills. The students' lack of understanding is reflected in their low performance on the subject matter, indicating that the current teaching methods do not align with curriculum expectations (Yusuf et al., 2023).

Based on the 2023 Quality Report of SMPN 1 Kabila Junior High School, literacy and numeracy skills are still categorized as moderate (SMPN 1 Kabila Quality Report, 2023). It is necessary to design learning strategies to improve literacy and numeracy skills, including the development of literacy and numeracy-based learning tools that assist teachers in the learning process and guide students in enhancing their critical thinking skills. The learning tools that

teachers can design include: Lesson Plans, Student Worksheets, Media, and Critical Thinking Tests in accordance with the 2013 curriculum. These learning tools should be meticulously arranged as part of the planning process to achieve the expected competencies from students. Learning can be considered of high quality when the process is student-centered rather than teacher-centered (Jayawardana & Gita, 2020).

Science education today is less focused on fostering and improving critical thinking skills. Measurement results of high school students in Indonesia revealed that 50.49% of students have underdeveloped critical thinking skills (Sari et al., 2019). Students are unable to solve critical thinking questions because they rarely encounter such problems (Ate & Lede, 2022). Students tend to absorb information and recall it only when taking tests passively (Wasser, 2021). However, the goal of science education is for students to develop higher-order thinking skills (Romero Ariza et al., 2024). One contributing factor is the lack of well-planned learning tools. Good planning of learning tools has a significant impact on the success of teaching, especially in achieving 21st-century competencies.

Critical thinking skills need to be developed in students because these skills enable them to understand concepts better, apply them in different situations, be sensitive to problems, and solve them effectively. Low levels of critical thinking and communication skills negatively impact students' cognitive abilities and the subsequent learning process. As the cognitive level of the material increases, students with low critical thinking and communication skills will find it increasingly difficult to grasp the content. This difficulty also leads to lower learning outcomes, as literacy and numeracy skills required during the learning process have not been mastered by the students.

METHOD

This research is a development study or R&D using the Borg and Gall model. The study was conducted from May to July 2024. The research method used was descriptive quantitative, following the Borg and Gall development model. The research development process, according to the Borg and Gall procedure, was outlined as follows:

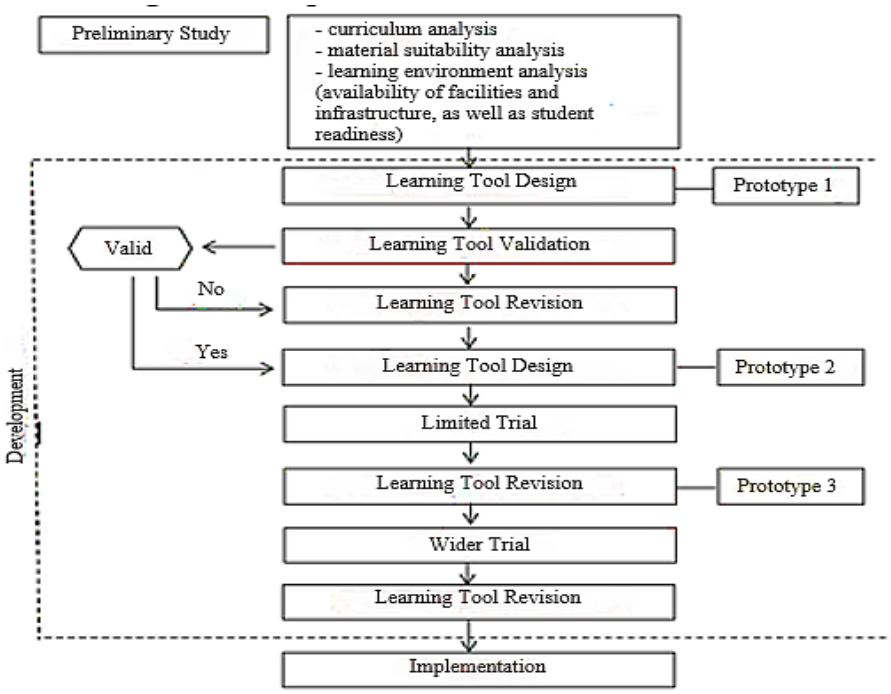

Figure 1. Borg & Gall Development Design

Validation was carried out by validators who assigned scores to each assessment aspect. To determine practicality, observers conducted observations of teacher and student activities, including the opening, core, and closing activities. This research used validation sheets to assess the validity of the learning tools. Validators validated the lesson plans, student worksheets, and learning outcome tests. Observations of the learning process implementation, student activity observation sheets, and student response questionnaires were also employed.

Observers assigned scores to each assessed aspect using a provided rubric. The results were analyzed and reviewed to determine the practicality of the developed learning tools. The effectiveness of the learning tool was determined through the analysis of learning outcome tests. Students were given pre-test questions, followed by the learning process, and completed a post-test at the end of the learning session.

The validation data of the learning tools provided by the three validators were analyzed using descriptive quantitative methods, where the average validation score was adjusted according to the following criteria: 100 < very valid ≤ 81; 61 < valid ≤ 80; 41 < less valid ≤ 60; 21 < invalid ≤ 40; and 0 < highly invalid ≤ 20 (Fatayah et al., 2022). The analysis of the learning implementation and student activity sheets was conducted by calculating the scores from the observers' observation sheets. Observations on the implementation of the learning process were conducted for four sessions. The data from the learning implementation and student response questionnaires during the learning activities were also analyzed descriptively and quantitatively by calculating the percentage of responses for each question. Meanwhile, pre-test and post-test learning outcome data were calculated using the normalized gain formula, with the results adjusted to the n-gain criteria shown in Table 1.

Table 1. Criteria for Categorizing Normalized Gain

No	Gain	Category
1.	(g) ≥ 0,7	High
2.	0,3 ≤ (g) < 0,7	Medium
3.	< g > < 0,3	Low

RESULT

Validation of Learning Tools

Validation of Lesson Plans (RPP)

The assessment of the Lesson Plan (RPP) consisted of 8 indicators. The results of the RPP validation are shown in Figure 2.

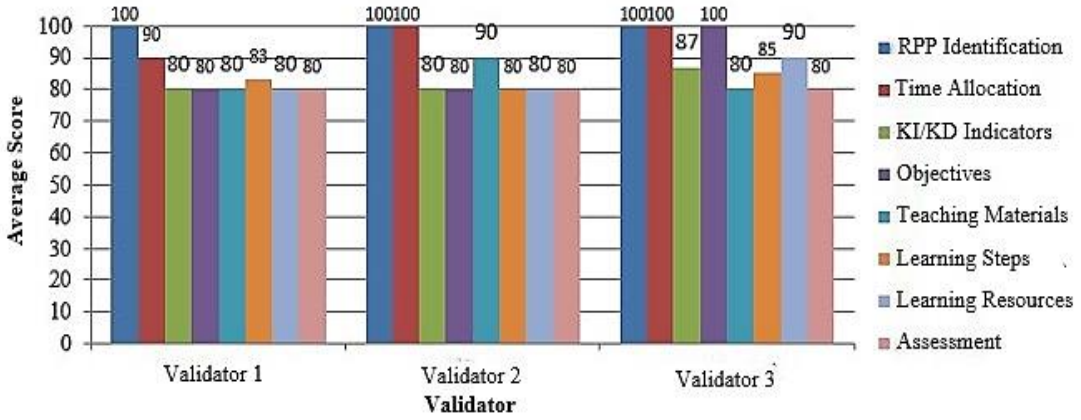

Figure 2 Average Validation Scores of Lesson Plans by Each Validator

The validation of the RPP was assessed by calculating the average validation score for each indicator and aligning it with the predetermined criteria. The validation results showed that Validator 1 gave the highest score for the RPP identification indicator, a score of 90 for the time allocation indicator, 83 for the learning steps indicator, and an equal score of 80 for five other indicators. Validator 2 awarded a score of 100 for both the RPP identification and time allocation indicators, a score of 80 for five other indicators, and 90 for the teaching material indicator. Validator 3 assigned a consistent score of 100 for the RPP identification, time allocation, and learning objectives indicators.

Validation of Student Worksheets (LKS)

The results of the student worksheet (LKS) validation are shown in Figure 3.

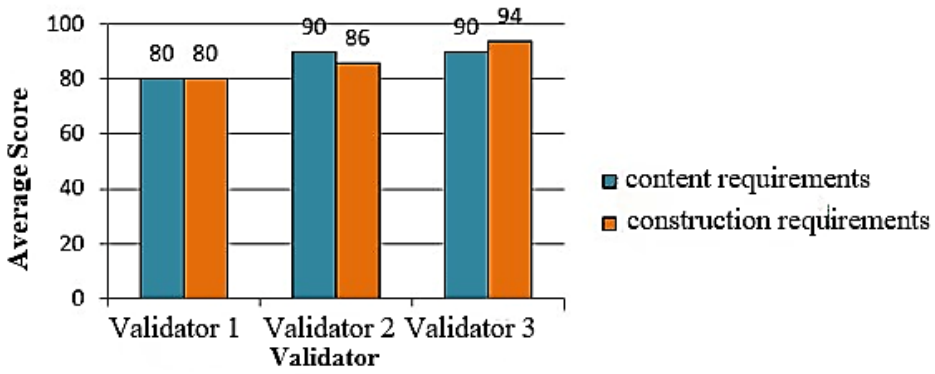

Figure 3. Validation Results of the Student Worksheets (LKS)

Similar to the RPP validation, the assessment of the LKS validation results was conducted by reviewing the average score for each indicator and aligning it with the established criteria. Based on the validation results presented in Figure 3, Validator 1 gave a score of 80 for both content and construction criteria. Validator 2 provided a score of 90 for content and 86 for construction, while Validator 3 awarded 90 for content and 94 for construction. 1The scores from Validators 2 and 3 are classified in the "very valid" category, while Validator 1's score is categorized as "valid."

Validation of Critical Thinking Tests

The learning outcome test was developed to be administered during the pre-test and post-test. Validators assigned scores to each aspect of the critical thinking test evaluation. The scores provided by the validators for each assessment aspect can be seen in Figure 4

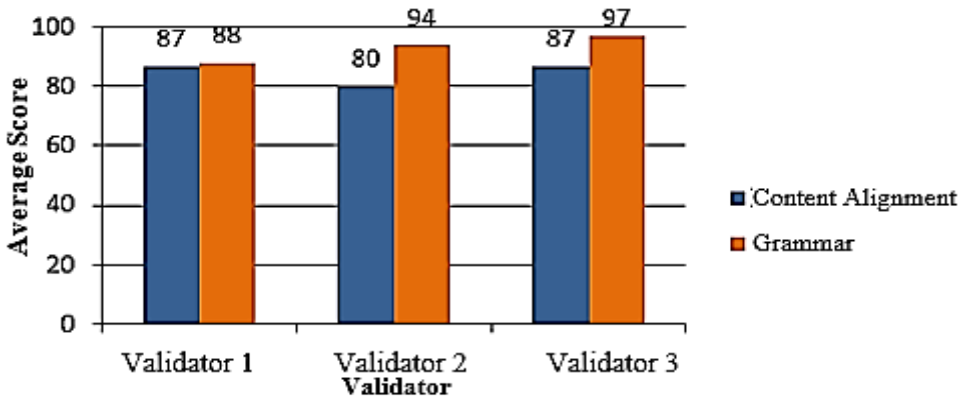

Figure 4. Validation Results of Critical Thinking Tests

The validation scores for the critical thinking tests were obtained by averaging the results for each indicator, namely content relevance and language usage, and aligning them with the established criteria. The critical thinking test validation results from Validator 1 were 87 for content relevance and 88 for language usage. Validator 2 gave a score of 80 for content relevance and 94 for language usage, while Validator 3 assigned 87 for content relevance and 97 for language usage. Overall, the scores are classified in the "very valid" category, except for the content relevance score from Validator 2, which is categorized as "valid."

Practicality Test Results

Analysis of Teacher Activity Implementation

Table 2. Analysis Results of Teacher Activity Implementation

Meeting	Observer 1	Category	Observer 2	Category
1	89	Very Good	86	Very Good
2	91	Very Good	86	Very Good
3	88	Very Good	83	Very Good
4	91	Very Good	86	Very Good
Average	89.75	Very Good	85.25	Very Good

Table 2 shows that the average score for teacher activity implementation in Grade IX from Observer 1 was 89.75, placing it in the very good category. The average score from Observer 2 was 85.25, which also falls in the very good category.

Analysis of Student Activity

Table 3. Analysis Results of Student Activity

Meeting	Observer 1	Category	Observer 2	Category
1	94	Very Good	86	Very Good
2	93	Very Good	93	Very Good
3	94	Very Good	92	Very Good
4	97	Very Good	93	Very Good
Average	94,5	Very Good	91	Very Good

The student activity observations by both Observer 1 and Observer 2 fell under the very good category. Observer 1 gave the highest score of 97 in the fourth meeting and the lowest score of 93 in the second meeting. Observer 1's average score was 94.5, categorized as very good. Observer 2 provided the highest score in the second and fourth meetings, with the lowest score in the first meeting, averaging 91 across all meetings, also in the very good category.

Student Response

The student response was collected through a questionnaire given after the completion of the learning process, from the first to the fourth meeting. This response aimed to evaluate the practicality of the literacy and numeracy-based learning tools.

Table 4. Percentage of Student Responses to the Learning Process

Student Response	Limited Trial (%)
Strongly Agree	49
Agree	51
Neutral	-
Disagree	-
Strongly Disagree	-

Table 4 shows the students' responses after using the literacy and numeracy-based learning tools, with 100% of the responses being positive. Further, 49% of students

strongly agree, and 51% agree with the learning experience. These results indicate that students were highly engaged and interested in the learning process.

Effectiveness Test Results

N-Gain Data Analysis

The evaluation of the learning outcomes test was conducted during both the limited and broader trials. The results obtained from the limited trial can be seen in Table 5.

Table 5. Pre-test and Post-test Results for Each Meeting

Description	*Average Score*		*N-Gain*	*Category*
	Pre-test	*Post-test*		
Meeting 1	51	81	0,61	Sedang
Meeting 2	52	81	0,60	Sedang
Meeting 3	53	84	0,70	Tinggi
Meeting 4	53	83	0,64	Sedang

Based on Table 5, the N-Gain scores obtained from the students' learning outcomes tests predominantly include the medium category. The high category is only observed during the third meeting, while the rest are classified as medium. These results demonstrate that the learning tools are effective and can be utilized for literacy and numeracy-based learning processes in Grade IX.

Critical Thinking Skills Analysis by Each Indicator

The critical thinking test indicators used are based on Ennis' critical thinking indicators. Each question represents a specific Ennis critical thinking indicator. The analysis of the critical thinking test assessment was conducted during both limited and broader trials. The critical thinking assessment results for each indicator in the limited trial can be seen in Figure 5.

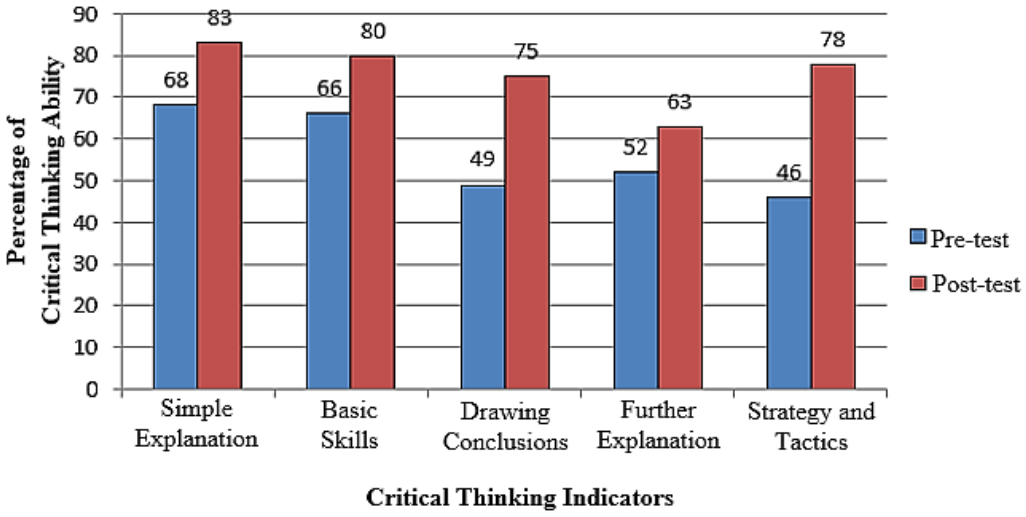

Figure 5. Analysis of Critical Thinking Test Results for Each Indicator

The critical thinking test results for each indicator, as shown in Figure 4.11, demonstrate differences between the pre-test and post-test in the broader trial. The pre-test scores were lower compared to the post-test scores. The lowest score in the pre-test was observed in the concluding indicator, while the highest score was found in the basic explanation indicator. In the post-test, the basic explanation indicator remained the highest, while the lowest score shifted to the providing further explanation indicator.

DISCUSSION

This study aimed to develop a learning tool that meets the criteria of being valid,

practical, and effective. Therefore, the discussion section focuses on the three main research aspects: the validity, practicality, and effectiveness of the developed product. The validation conducted by experts serves as the foundation for the validity of the learning tools. The implementation of learning, student activities, and student response questionnaires were used to measure the practicality of the learning tools. Meanwhile, measuring student learning outcomes through pre-test and post-test questions can be used to determine the effectiveness of the learning tools (Windari et al., 2022). According to (Latjompoh, 2018), a learning tool is considered valid if it meets subject matter requirements and all components within the tool are interconnected. Moreover, a valid instrument will impact students by providing them with clear knowledge and properly developing the critical thinking skills they aim to master (MZ et al., 2021).

The validated RPP is a literacy and numeracy-based learning tool designed for the topic of Genetic Inheritance, covering four meetings. Based on the average validation data from the validators, it received a validation score of 85.3, categorized as valid, with minor revisions. One of the suggestions provided was to recheck the learning material in the RPP using more relevant sources. These suggestions have been incorporated into the revised RPP, resulting in improvements. The second validation of the LKS showed an average score of 86, categorized as highly valid. This score indicates that the LKS can be used effectively in the learning process to improve students' critical thinking skills. The LKS serves as a supplementary tool to support the RPP. The validators suggested adding answer keys to the LKS so that students can refer to the correct answers as a guide. Proper use of the LKS can encourage students to be more active in learning activities, develop process skills, promote independent learning, elaborate on scientific attitudes, and foster students' motivation and interest in learning. (Maretha & Suparman, 2022) explained that the use of LKS in the learning process aims to reinforce and support learning, ensuring that the desired indicators and competencies are achieved in accordance with the curriculum.

The analysis of the implementation of teacher activities yielded scores indicating that the teachers' performance in the classroom is in the very good category. To achieve learning objectives, teachers must effectively implement what is outlined in the lesson plans while considering both material and pedagogical aspects (Shariffudin et al., 2012). In the literacy and numeracy-based learning process regarding the topic of Genetic Inheritance, IX-grade students demonstrated a good understanding, enabling them to apply the learning designs provided by their teachers. This successful implementation indicates that teachers effectively conducted the teaching and learning steps (Khaerani et al., 2020). The literacy and numeracy learning design incorporates steps and questions that encourage the improvement of students' literacy and numeracy skills. One strategy for strengthening literacy and numeracy is emphasizing reasoning and problem-solving within the learning process. Improving literacy and numeracy skills means improving students' abilities to understand information, represent objects, solve problems, reason, provide justifications, and interpret obtained results. In this context, the learning process must facilitate the cultivation of a literacy culture among students. Additionally, an analysis was conducted on student activities. The assessment of student engagement by observers aimed to derive a practicality score, which is a primary requirement in developmental research. (Arfandi & Samsudin, 2021) explained that students' performance in teaching and learning will improve when they actively participate in every learning activity. The material being studied should be beneficial both theoretically and practically, providing

opportunities for students to expand their knowledge and skills.

Critical thinking tests should be conducted at the end of each lesson to assess the effectiveness of the teaching and learning process. These tests are closely linked to students' engagement in the learning process. Observations in IX-grade classes by Observer 1 and Observer 2 indicated that student activity was rated as very good. This observation suggests that student activities in literacy and numeracy-based learning are highly practical, making this learning material suitable for implementation in IX-grade classes on the topic of Genetic Inheritance. The scores obtained are attributed to the discussion conducted during the learning process, allowing the lessons to progress in line with the intended learning sequence. The discussions focused on questions related to everyday life, which also served to enhance students' literacy and numeracy skills. Group discussions significantly support the learning process, as explained (Kemendikbud, 2015), which states that discussions can serve as a means for students to solidify their understanding of the concepts being studied. Additionally, discussions enable students to gather information, solve problems, and draw conclusions. All of these activities promote active participation, boosting students' confidence in expressing their ideas during the learning process.

The study also included a critical thinking test by providing questions aligned with critical thinking indicators and numeracy literacy. Based on the analysis, there was a notable improvement in students' critical thinking abilities. This improvement was evident from the comparison of pre-test and post-test results. The pre-test results showed that students had not yet engaged in critical thinking processes. Students are required to respond critically to every phenomenon. Being critical thinkers also helps them find solutions more easily. The process of becoming critical thinkers must begin with the teacher's initiative to incorporate critical thinking enhancement strategies into classroom activities (Nusantari et al., 2021). Typically, students rely only on their basic understanding to answer questions without engaging in deeper thinking processes. After numeracy literacy-based learning, students became more receptive to new understandings through critical thinking processes. The more they are accustomed to numeracy literacy, the more their critical thinking skills improve. This finding aligns with (Rohman, 2022) research, which explains that the higher the students' literacy skills, the higher their level of critical thinking. This is because literacy activities involve the processes of receiving and seeking information, processing it, critically assessing it, and making decisions or conclusions.

The indicators of providing simple explanations and strategies & tactics showed the highest improvement. Providing simple explanations is the most frequently performed indicator by students during each lesson, making them accustomed to answering questions in that format. The explanation indicator, or the ability to give explanations, demonstrated strong critical thinking skills, as students are already familiar with this practice, resulting in good scores in the good category. However, the indicator with the least improvement compared to others is providing further explanations. While providing simple explanations is a common task for students, offering more detailed explanations remains challenging. Students struggle with numeracy literacy questions related to genetic inheritance concepts, especially those requiring calculations and deeper analysis. This difficulty arises because students are not regularly exposed to numeracy literacy in their learning process. It is essential to make students accustomed to answering questions that require more advanced explanations to improve critical thinking skills in this indicator. As Oktariani and Ekadiansyah (2020) explain, critical thinking skills can be improved through practice and habituation.

The indicator of drawing conclusions showed a significant score improvement, indicating that students are able to conclude learning processes based on numeracy literacy effectively. Another study revealed that the inference indicator scored 62%, placing students in the category of being able to think critically well. Generally, students are capable of identifying and solving problems, leading to drawing accurate conclusions. Teachers play a key role in developing students' critical thinking skills by training them in these skills and facilitating learning activities with critical thinking indicators based on numeracy literacy. This aligns with the (Adinda, 2016) assertion that students who can think are those who can draw conclusions based on their current knowledge, understand how to use information to solve problems, and are capable of finding relevant sources of information to support problem-solving efforts.

CONCLUSION

The results of the development of teaching materials based on numeracy literacy have met the criteria for validation, effectiveness, and practicality. Based on the validator's assessment, it was found that the lesson plans, student worksheets, and critical thinking tests fall into the valid category. The practicality of the teaching materials was rated as excellent, with teacher activity implementation scores averaging 89.75 from Observer 1 and 85.25 from Observer 2. Student activities were also categorized as excellent, with average scores of 94.5 from Observer 1 and 91 from Observer 2. Students' responses to the learning process were also very positive, with 49% strongly agreeing and 51% agreeing. Furthermore, students' mastery in completing critical thinking skills questions met the required criteria, with an average N-gain score across four meetings falling into the medium and high categories. The analysis of critical thinking tests also demonstrated improvement across all critical thinking indicators.

Declaration by Authors

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