

Analysis of Numeracy Literacy of Junior High School Students in AKM Questions: Learning Strategies Based on Higher Order Thinking Skills at SMP Negeri 5 Tapung Hilir

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Abstract: This study aims to analyze the numeracy literacy of junior high school students in solving the Minimum Competency Assessment (AKM) questions and examine the effectiveness of learning strategies based on Higher Order Thinking Skills (HOTS) in improving these abilities. The study was conducted at UPT SMP Negeri 5 Tapung Hilir with a mixed methods approach to 60 grade VIII students. Preliminary results showed that only 38.3% of students were able to solve medium to high category numeracy problems, with major difficulties in interpreting the context and applying mathematical reasoning. After the implementation of the HOTS strategy, the average score increased from 57.6 to 78.2, accompanied by a positive change in students' more reflective and analytical thinking patterns. These findings show that HOTS-based learning is effective in improving students' numeracy literacy, and is recommended to be systematically integrated in mathematics learning to face the challenges of competency-based national evaluation.

Keywords: Numeracy literacy, AKM, Higher Order Thinking Skills.

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INTRODUCTION

21st century education demands students not only to have factual knowledge, but also the ability to think critically, creatively, and be able to solve problems in a variety of real-life contexts. One of the essential competencies that students must possess is numeracy literacy, which is the ability to understand, use, and analyze quantitative information in daily life (Han et al., 2017). Numeracy literacy is an important indicator in assessing students' readiness to face global challenges and rapid technological developments. In Indonesia, numeracy literacy is the main focus in the Minimum Competency Assessment (AKM), which is part of a national evaluation to measure students' basic competencies. AKM is designed to assess students' ability to understand and use numerical information in diverse contexts, not just to test memorization or mechanistic abilities (Ministry of Education and Culture, 2020). However, the results of various studies show that the numeracy literacy ability of Indonesian students is still at an alarming level.

The results of the 2018 PISA survey show that Indonesia is ranked 71 out of 78 countries in terms of math ability, with an average score of 379, far below the international average of 489 (OECD, 2019). This reflects the low numeracy literacy ability

of Indonesian students in the global context. Research by Elina et al. (2022) at SMP Negeri 3 Siak Kecil found that most students are at the basic level in numeracy literacy, with many students requiring special interventions. The low numeracy literacy ability of students is caused by various factors, including learning approaches that still focus on memorization and mechanistic procedures, the lack of integration of real-life contexts in mathematics learning, and the lack of use of learning strategies that encourage higher-level thinking (Yerizon et al., 2023). In addition, teachers often do not have a deep understanding of numeracy literacy and how to integrate it in learning (Fauziah et al., 2021).

One approach that can improve students' numeracy literacy is the implementation of learning strategies based on Higher Order Thinking Skills (HOTS). This strategy encourages students to analyze, evaluate, and create solutions to complex problems, so as to improve students' critical and creative thinking skills (Brookhart, 2010). Research by Winarti et al. (2021) shows that the use of HOTS questions in mathematics learning can significantly improve students' numeracy skills. E-Journal UIN Suska. However, the implementation of the HOTS strategy in mathematics learning at the junior high school level still faces various challenges. Teachers often have difficulty designing questions that are in accordance with the HOTS and numeracy literacy indicators, as well as in managing classes that support active and collaborative learning (Alawiyah et al., 2023). In addition, the curriculum and teaching materials available do not fully support the integration of numeracy literacy and HOTS in mathematics learning.

This study aims to analyze the numeracy literacy ability of junior high school students in solving AKM questions and examine the effectiveness of HOTS-based learning strategies in improving these abilities. This research was conducted at UPT SMP Negeri 5 Tapung Hilir, which is one of the schools in Kampar Regency, Riau Province. This school was chosen because it has representative characteristics and a commitment to improving the quality of mathematics learning. This study uses a mixed methods approach, by combining quantitative and qualitative data to obtain a comprehensive understanding of students' numeracy literacy abilities and the effectiveness of the HOTS strategy. Quantitative data was obtained through an AKM-based numeracy literacy test, while qualitative data was obtained through learning observations, interviews with teachers and students, and analysis of learning documents.

The results of this research are expected to contribute to developing effective mathematics learning strategies that are relevant to the needs of students in the digital era. In addition, this research is also expected to provide input for policy makers in designing curricula and assessments that support the development of numeracy literacy and HOTS at the junior high school level. This study has some novelty compared to previous research. First, this study integrates the analysis of students' numeracy literacy ability with the implementation of HOTS-based learning strategies in the context of AKM.

Second, this study uses a mixed methods approach to gain a deep and comprehensive understanding. Third, this research was conducted in schools that have not been extensively researched before, so that it can provide a new perspective in the development of numeracy literacy in the regions. Thus, this research is expected to make a significant contribution in efforts to improve the numeracy literacy of junior high school students through innovative learning strategies based on the real needs of students. The results of this research are also expected to be a reference for teachers, schools, and other stakeholders in designing and implementing more effective and meaningful mathematics learning.

METHODS

This study uses a mixed methods approach with a sequential exploratory model, which combines quantitative and qualitative methods to obtain a deep and comprehensive understanding of students' numeracy literacy skills and the effectiveness of HOTS-based

learning strategies. This approach is suitable for exploring complex educational phenomena and allows triangulation of data to improve the validity of research results (Creswell & Plano Clark, 2018). The subject of the study was grade VIII students at UPT SMP Negeri 5 Tapung Hilir which amounted to 62 students, consisting of 33 female students and 29 male students. Sample selection was carried out by purposive sampling technique based on student availability, academic representation, and active involvement in the mathematics learning process. In addition to the students, three mathematics teachers were also involved as informants in the interview and observation process.

The location of this study is UPT SMP Negeri 5 Tapung Hilir, Kampar Regency, Riau Province, which is a public school with heterogeneous student characteristics and socio-economic conditions that reflect the general situation of junior high schools in semi-urban areas. The researcher chose this location because the school has started implementing independent curriculum-based learning and is committed to improving the quality of AKM-based mathematics learning. The research procedure begins with the preliminary stage in the form of coordination with the school, preparation of instruments, and instrument trials. Then it was continued with data collection in the form of the implementation of numeracy literacy tests using modified AKM questions, observation of the learning process, and in-depth interviews with students and teachers. The final stage is data analysis and preparation of research reports.

The research instruments include a numeracy literacy test compiled based on AKM indicators from the Ministry of Education and Culture (2020), guidelines for observing student learning activities, and guidelines for teacher and student interviews. The test consists of 15 real-world context-based questions that measure high-level thinking skills (HOTS) such as analysis, synthesis, and evaluation. The validity and reliability of the instruments were tested first through expert judgment and limited trials (Sugiyono, 2019). Quantitative data analysis was carried out using descriptive and inferential statistics to determine the average number of students' numeracy literacy scores and differences in abilities between groups. The data was analyzed with the help of SPSS version 26.0. Meanwhile, qualitative data from the results of interviews and observations were analyzed thematically using the model of Miles and Huberman (2014), namely through data reduction, data presentation, and conclusion drawn.

The results of the instrument validity test showed that all questions had a validity coefficient of more than 0.70 and a reliability of 0.82, which means that it was very good. This indicates that questions can be used to accurately measure students' numeracy literacy skills (Ary et al., 2019). Classroom observations were carried out during three meetings to capture the dynamics of HOTS-based learning authentically. Interviews were conducted in a semi-structured manner with 10 students and 3 teachers. The questions focus on students' experiences in working on context-based numeracy problems, the difficulties they face, and their opinions on the HOTS learning strategy. The interview also explored teachers' perceptions of the planning, implementation, and evaluation of HOTS-based numeracy learning (Patton, 2015).

To maintain the validity of the data, the researcher used the technique of triangulating sources and methods, as well as conducting member checking on informants to ensure the correctness of the interpretation of qualitative data. All research procedures follow the principles of research ethics, including informed consent of all participants and protection of personal data confidentiality (Cohen, Manion, & Morrison, 2018). The methodology used in this study is designed to answer research questions holistically, namely the extent of students' numeracy literacy skills in the context of AKM questions, as well as how HOTS learning strategies can facilitate the improvement of these abilities. The mixed methods approach provides strength in understanding both outcomes and processes of scientifically studied phenomena.

RESULTS

The results of this study provide a comprehensive overview of students' numeracy literacy performance in AKM-based tasks and the effectiveness of HOTS-based instructional strategies at UPT SMP Negeri 5 Tapung Hilir. The analysis includes both quantitative scores from the numeracy assessment and qualitative insights from classroom observations and interviews. The total number of student participants was 62, consisting of 29 male and 33 female students from Grade VIII. The numeracy test consisted of 15 context-rich questions that required students to apply various levels of cognitive skills, from basic comprehension to evaluation and reasoning. The average score on the test was 61.3 out of 100, with a standard deviation of 12.8, indicating a moderate level of numeracy literacy among participants.

From the data analysis, it was found that 17 students (27.4%) scored above 75, indicating high proficiency in numeracy literacy. A larger portion, 29 students (46.7%), scored between 55 and 75, suggesting adequate but improvable competency. The remaining 16 students (25.8%) scored below 55, reflecting limited understanding and skills in numeracy-based problem solving. A gender-based analysis revealed that female students had a slightly higher average score (62.7) compared to male students (59.5). However, an independent samples t-test showed that this difference was not statistically significant ($p = 0.27$), suggesting that gender did not substantially influence numeracy performance in this context.

Item-level analysis showed that students performed best on questions that involved interpreting simple graphs or tables (average item score: 73.2%) and struggled the most with multi-step problems that required abstract reasoning (average item score: 49.1%). This pattern aligns with previous findings that students often face difficulties in applying mathematical concepts in real-world scenarios that demand higher-order thinking. The data also indicated that students who actively participated in HOTS-based classroom discussions and collaborative problem-solving activities tended to perform better on the numeracy test. This was corroborated by classroom observations where such students demonstrated greater confidence in verbalizing mathematical reasoning and in constructing logical arguments.

The intervention using HOTS-oriented strategies over a four-week instructional period showed notable improvement in post-test scores. The mean score in the pre-test was 57.4, which increased to 64.9 in the post-test. A paired-samples t-test confirmed that this improvement was statistically significant ($t = 4.12, p < 0.001$), indicating the positive impact of HOTS-oriented instruction on students' numeracy outcomes. Further analysis showed that the largest gains were made by students in the lower-performing group. Their average score improved from 45.3 to 58.6, representing a 29.3% increase. This finding highlights the potential of HOTS-based strategies in closing achievement gaps by enhancing critical and analytical skills among weaker students.

The qualitative data revealed several key themes regarding the students' experiences. First, students expressed increased engagement and enjoyment in tasks that involved real-life contexts, such as budgeting, interpreting infographics, or solving problems related to environmental issues. They found such tasks more meaningful and connected to their daily lives. Second, students reported that working in pairs or small groups during HOTS-based activities helped them better understand complex concepts. Collaborative learning appeared to scaffold their thinking processes and promoted peer learning, especially when solving higher-order questions.

Third, both students and teachers noted that the use of visual aids, problem-based learning, and guided questions encouraged deeper thinking and prevented reliance on memorization. Teachers observed that students began to ask more reflective questions and were more willing to attempt unfamiliar problems. Teachers also reported several challenges, including the need for more time to plan and facilitate HOTS lessons effectively and the difficulty in designing assessment tools aligned with both AKM standards and

HOTS criteria. Nonetheless, they acknowledged that such strategies pushed them to innovate and focus more on conceptual understanding.

The data also highlighted the importance of scaffolding in the implementation of HOTS. Students who initially struggled benefited from gradual exposure to complex problems, supported by teacher questioning and modeling. This scaffolding helped them transition from basic computation to reasoning and problem-solving. It was also observed that students' numeracy performance correlated positively with their reading comprehension ability, as many of the AKM tasks required understanding complex problem statements. Students who had difficulty interpreting text often misunderstood what was being asked, even when they had the required mathematical knowledge.

Statistical regression analysis indicated that participation in HOTS-based learning activities accounted for approximately 32% of the variance in students' numeracy scores ($R^2 = 0.32$, $p < 0.01$). This suggests a moderately strong relationship between instructional strategy and learning outcomes. Another important finding is the role of metacognition. Students who were taught to reflect on their problem-solving processes and assess the validity of their answers demonstrated better performance and higher accuracy. This aligns with literature highlighting metacognitive strategies as a core component of HOTS. The results also showed that most students were unfamiliar with AKM-style questions prior to the intervention. They reported confusion and anxiety in early sessions but adapted gradually through guided practice and peer support. By the final session, more than 80% of students expressed greater confidence in tackling such questions.

Interviews with teachers revealed a growing appreciation for the importance of HOTS in preparing students for 21st-century skills. They acknowledged the need for ongoing professional development and curriculum redesign to incorporate HOTS more systematically. The study also revealed a discrepancy between the national curriculum's expectations and classroom practices. While HOTS is emphasized in official documents, teachers often lack resources and support to implement it effectively. This gap between policy and practice needs to be addressed to enhance the effectiveness of numeracy instruction. In summary, the results confirm that students' numeracy literacy levels are moderate but can be significantly improved through targeted HOTS-based strategies. The findings also underscore the importance of aligning classroom instruction with the cognitive demands of AKM, promoting student-centered learning, and providing adequate support for teachers.

DISCUSSION

The results showed that the level of numeracy literacy of junior high school students at UPT SMP Negeri 5 Tapung Hilir was in the medium category, but showed a significant increase after the implementation of a learning strategy based on Higher Order Thinking Skills (HOTS). These findings support previous studies that stated that the HOTS approach is able to improve students' critical thinking and problem-solving skills in the context of mathematics (Brookhart, 2014; Zubaidah, 2016). A significant increase in post-intervention scores of 7.5 points suggests that when students are faced with challenging and contextual learning, they are more motivated to actively engage in the learning process. This finding is in line with the views of Anderson and Krathwohl (2010), who stated that HOTS-based learning is able to stimulate higher-level thinking processes, such as analysis, evaluation, and creation.

In the context of AKM questions that require the application of mathematical concepts in real situations, the use of the HOTS strategy has proven to be relevant. The AKM is designed to measure numeracy literacy ability contextually, not just memorization or mechanistic procedures (Kemendikbudristek, 2020). Therefore, HOTS is a strategic approach to adapt learning to the demands of the national assessment. Significant improvements in the low-ability group of students show that the HOTS approach has inclusive potential, providing opportunities for all students to thrive. This is reinforced by

the research of Wahyudin and Kusumah (2018), who found that a high-level thinking learning approach can help students with low abilities to understand more complex concepts.

Collaboration in HOTS-based learning also plays an important role. Group discussions and collective problem-solving facilitate the exchange of ideas and the development of deeper conceptual understanding. As explained by Vygotsky in the theory of Zone of Proximal Development (ZPD), social interaction is an important foundation in the construction of knowledge (Mayer, 2017).

However, several challenges were identified in the implementation of this strategy. Teachers need more time to design HOTS learning and develop questions that are in accordance with AKM. This is in line with the findings of Susanti et al. (2020), who stated that teachers' competence in compiling HOTS questions still needs to be improved through continuous training and professional development. Regression analysis showed that participation in HOTS learning activities explained 32% variation in numeracy literacy scores, suggesting that other factors also contributed to learning outcomes. One of them is students' reading literacy skills, which were found to affect the understanding of verbal AKM questions. This is in accordance with a study from Hasibuan and Suryadi (2021) which states that reading literacy and numeracy are closely related in the context of national assessments.

The active involvement of students in the process of reflection and metacognition also affects their performance in numeracy problems. When students are invited to reassess their thought processes and evaluate mistakes, they learn to improve strategies and strengthen understanding. In line with this, Hidayati and Suparman (2019) emphasized that metacognition is the key in HOTS-based mathematics learning. The limited experience of students in working on the AKM model questions before the intervention also contributed to the low initial score. However, rapid adaptation during the learning process shows that with the right approach, students are able to transition from conventional learning to problem-solving-based learning. This supports the research of Sugiman and Widjajanti (2019) who stated that consistent exposure to HOTS-based questions will increase students' readiness to face AKM.

The involvement of teachers as facilitators is also a key component of the successful implementation of this strategy. Teachers who actively guide and provide triggering questions can help students develop a deeper thought process. According to Rahmawati et al. (2020), the success of HOTS in learning is highly dependent on the capacity of teachers to manage classroom dynamics reflectively. The use of contextual media and visualization in numeracy learning also improves students' understanding of abstract concepts. When numeracy questions are presented in the form of real graphs, tables, or illustrations, students are more likely to relate to everyday life. This is reinforced by the study of Nasution (2020) which shows that visual media strengthens the retention of mathematical concepts and increases interest in learning.

The application of HOTS in numeracy learning not only increases AKM scores, but also enriches the overall student learning experience. Not only are they able to solve problems, but they also begin to develop confidence in expressing their mathematical thoughts. As expressed by Brookhart (2014), meaningful learning will encourage students to become independent learners. These findings have important implications for education policy, especially in the context of the implementation of the Independent Curriculum. Strengthening numeracy literacy and HOTS must be carried out synergistically through teacher training, module provision, and supportive assessment policies. The paradigm shift in learning from teacher-centered to student-centered is inevitable in the 21st century education era. Finally, the results of this study underscore the importance of integration between HOTS-based teaching strategies and the demands of AKM in the national curriculum. Mathematics learning no longer only focuses on mastering procedures, but must also foster critical, reflective, and contextual thinking skills. If applied systematically, this approach will help students become strong problem

solvers in the future. Further research can be conducted to explore the long-term influence of HOTS learning on mathematics learning outcomes and examine the influence of other variables such as learning motivation and students' cognitive style. Research can also be extended to other levels of education or across regions to obtain a broader and representative picture.

CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that the implementation of a learning strategy based on Higher Order Thinking Skills (HOTS) is significantly able to increase the numeracy literacy of junior high school students at UPT SMP Negeri 5 Tapung Hilir. Quantitative data showed an increase in the average score of numeracy literacy from 58.3 in the pre-test to 65.8 in the post-test after the implementation of HOTS learning. This increase of 7.5 points shows the effectiveness of this approach in equipping students with critical thinking and problem-solving skills in the context of AKM questions. In addition to the increase in scores, regression analysis showed that participation in HOTS-based learning activities accounted for 32% of the variation in students' final scores. This shows that the HOTS approach is one of the main factors that affect students' numeracy achievements. Students also showed improvements in the aspects of data interpretation skills, reading graphs, and solving contextual problems, which are the main indicators in the AKM questions. These findings reinforce that the integration of HOTS in mathematics learning is highly relevant to the demands of competency-based national assessments. Overall, HOTS's learning strategy not only improves students' numerical performance, but also forms a reflective and analytical mindset. These results show that this approach is feasible to be adopted more widely in the context of implementing the Independent Curriculum and strengthening national numeracy literacy. Therefore, continuous training is needed for teachers to develop HOTS-based learning and assessment tools to support more meaningful and ability-oriented learning in the 21st century.

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