

LITERATURE REVIEW ON THE DEVELOPMENT OF STUDENT WORKSHEET BASED ON MIKIR STRATEGIES TO IMPROVE NUMERACY ABILITIES

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ARTICLE HISTORY

Received : 20-10-2025

Revised : 07-11-2025

Accepted : 20-01-2026

KEYWORDS

*student worksheet,
MIKiR strategy,
mathematics,
thinking process,
numeracy,*

ABSTRACT

Mathematical numeracy skills are essential competencies needed by students to understand and solve contextual problems in everyday life. However, various assessment results indicate that the numeracy skills of junior high school students in Indonesia are still relatively low, necessitating innovation in mathematics learning. One effort that can be done is through the development of Student Worksheets (SW) that are systematically designed and oriented towards students' thinking processes. This article aims to systematically review the research literature related to SW development, mathematical numeracy skills, and the potential integration of the MIKiR (Experience, Interaction, Communication, and Reflection) strategy in junior high school mathematics learning. The research method used is a systematic literature review of journal articles. The results of the study indicate that contextual SW can improve students' numeracy skills, but most studies have not integrated learning strategies explicitly into the SW design. This study confirms a research gap related to the development of SW based on the MIKiR strategy to improve junior high school students' mathematical numeracy skills.

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INTRODUCTION

Mathematics learning in junior high school plays a strategic role in building the foundations of numeracy because at this level, students begin to encounter abstract concepts that require mathematical reasoning and modeling (Goos, 2020). However, mathematics learning practices in schools are often oriented towards procedures and routine exercises, thus providing little opportunity for students to connect mathematical concepts to real-world situations

(Susanti, 2025). This situation impacts students' low ability to apply mathematical knowledge to solve contextual problems that require numeracy (Repi et al., 2025).

One effort that can be made to improve the quality of mathematics learning and enhance student numeracy is through the development of appropriate teaching materials, one of which is the Student Worksheet (SW) (Prastowo, 2015). SW serves as a learning guide that facilitates systematic and directed student activities so that learning is not solely teacher-centered (Salsabila et al., 2024). Research shows that contextually designed, problem-solving-oriented worksheets can significantly improve students' conceptual understanding and numeracy skills (Fauziyah et al., 2025).

Several recent studies confirm that SW that integrates real-life contexts can help students understand the meaning of mathematics and develop numeracy skills more effectively (Silaban, 2023). Contextual SW allows students to practice interpreting numerical information, selecting solution strategies, and communicating results logically (Jannah & Handayani, 2025). However, most SW development still focuses on specific learning models such as problem-based learning or realistic approaches without being supported by a learning strategy framework that emphasizes students' holistic thinking processes (Salsabila et al., 2024).

On the other hand, effective mathematics learning to strengthen numeracy requires attention to students' learning processes, from early experiences, social interactions, mathematical communication, and reflection on the strategies used (Purwoko, 2025). Learning that solely emphasizes problem solving without mathematical reflection and communication tends to produce shallow and less sustainable understanding (Maulani et al., 2025). Therefore, a learning strategy is needed that systematically accommodates all stages of students' thinking processes.

The MIKiR (Experiencing, Interaction, Communication, and Reflection) strategy is a learning approach that emphasizes active student involvement in constructing understanding through direct experience, discussion, idea sharing, and reflection (Saragih, 2022). This strategy aligns with constructivism and social interactionism theories, which emphasize that knowledge is built through experience and interaction with the social environment (Salsabila, 2024). Research shows that learning that emphasizes mathematical communication and metacognitive reflection contributes positively to improving student literacy and numeracy (Wicaksono, 2025). Although the MIKiR strategy has great potential to support numeracy learning, its implementation in the development of teaching materials, particularly junior high school mathematics worksheets, remains very limited. Most numeracy-related research focuses more on classroom learning models, rather than on the design of student worksheets as a tool directly used by students in the learning process. Consequently, the integration of learning strategies and teaching materials has not been systematically developed.

The literature review also shows that research on SW and numeracy is generally conducted separately, thus failing to produce a comprehensive conceptual framework for developing numeracy SW based on specific learning strategies (Salsabila et al., 2024). SW research often only assesses the validity and practicality of the product without examining how learning stages influence students' numeracy thinking processes (Darmastuti et al., 2025). Furthermore, numeracy research focuses more on learning outcomes and test scores without linking them to the design of the teaching materials used (OECD, 2023).

Based on these conditions, a literature review is needed that specifically integrates three main aspects: SW development, mathematical numeracy skills, and the MIKiR strategy as a pedagogical framework. This literature review is important for mapping current research developments, identifying research gaps, and formulating a conceptual framework for developing student worksheets based on the MIKiR strategy, which is oriented towards improving junior high school students' mathematical numeracy. Therefore, this study is expected to provide theoretical and practical contributions to mathematics education.

METHOD

This study employed a systematic literature review design to examine and synthesize previous research related to the development of student worksheets based on MIKiR strategies (Mengalami, Interaksi, Komunikasi, dan Refleksi) aimed at improving students' numeracy abilities. A literature review design was selected because it

enables a comprehensive analysis of existing empirical and theoretical studies, allowing the identification of research trends, effective instructional strategies, and gaps in the current body of knowledge.

The review focused on scholarly articles, conference proceedings, and research reports published in reputable national and international journals. The selected studies primarily addressed worksheet development, MIKIR-based learning approaches, numeracy skills, and mathematics education. By systematically analyzing and comparing findings from multiple sources, this research provides an integrative understanding of how MIKIR-based student worksheets contribute to the enhancement of numeracy competencies. The literature review followed several structured stages, including (1) identification of relevant literature, (2) screening and selection based on predefined inclusion and exclusion criteria, (3) critical appraisal of the selected studies, and (4) synthesis and interpretation of the findings. This design ensures the validity and reliability of the review results and supports evidence-based conclusions regarding effective worksheet design grounded in MIKIR strategies. Overall, the literature review design is appropriate for this study as it facilitates a holistic evaluation of existing research and offers conceptual and practical insights for future development and implementation of MIKIR-based student worksheets to improve numeracy abilities. (Pugu et al., 2024).

The literature review stages in this research adhere to the SLR procedure, which includes systematic planning, implementation, and reporting of study results. During the planning stage, the researcher formulated the study's focus and research questions, addressing three main aspects: (1) the characteristics of developing junior high school mathematics worksheets, (2) the role of SW in improving mathematical numeracy skills, and (3) the potential for integrating the MIKIR strategy into numeracy-based SW development.

The data sources for this research were scientific journal articles published between 2021 and 2025, to ensure the novelty and relevance of the research findings. Article searches were conducted through Scopus, Google Scholar, and accredited national journal portals using keywords such as student worksheet, mathematics worksheet, numeracy, mathematical literacy, MIKiR, and junior high school. Inclusion criteria for this study included articles discussing the development or use of mathematics worksheets, research of numeracy or mathematical literacy skills, and articles examining active, reflective, or constructivist learning strategies relevant to the principles of the MIKiR strategy.

The selected articles were then analyzed using content analysis techniques to identify the research objectives, methods, key findings, and pedagogical implications of each study. The analysis results were then grouped into three broad themes: worksheets in mathematics learning, junior high school students' mathematical numeracy, and the integration of learning strategies in developing worksheets. This grouping process aimed to facilitate the synthesis of findings and the mapping of research gaps. The synthesis of the study results was conducted narratively by linking findings between studies to obtain a complete understanding of the position of the MIKiR strategy in developing SW to improve mathematical numeracy. With this methodology, it is hoped that the literature review conducted can provide a strong conceptual foundation for research and development (R&D) of SW based on the MIKIR strategy at the junior high school level.

RESULT AND DISCUSSION

Mathematical numeracy skills are a core competency of the 21st century, playing a crucial role in equipping students to face the challenges of modern social, economic, and technological life (OECD, 2021). Numeracy is not simply about calculation skills, but encompasses the ability to understand, use, and interpret quantitative information in various real-life contexts (OECD, 2023). At the junior high school (SMP) level, numeracy serves as a crucial foundation for mastering advanced mathematical concepts and data-driven decision-making (Isnaintri & Novaliyosi, 2024).

Various national and international assessment results indicate that Indonesian students' numeracy skills remain in the low to moderate category, particularly in contextual problem-solving and mathematical reasoning (OECD, 2022). Students tend to be able to solve routine problems but struggle when faced with numeracy problems that require data interpretation, strategy selection, and reflection on results (Jannah & Handayani, 2025). This

situation indicates that mathematics learning in schools is still predominantly oriented toward procedures and end results, rather than toward students' numerical thinking processes (Pakaya et al., 2025).

In this context, numeracy strengthening cannot be achieved solely through curriculum changes but also requires innovation in the development of learning tools capable of facilitating numerical thinking processes systematically and meaningfully (Salsabila et al., 2024). One strategic learning tool for this purpose is the Student Worksheet, as it can be designed to guide students' learning activities both independently and collaboratively (Latifa et al., 2024).

SW are printed or digital teaching materials designed to guide students in learning activities through a series of tasks, questions, and reflections (Pratiwi et al., 2025). In mathematics learning, SW serve as a means to activate students, structure their thinking processes, and connect mathematical concepts to real-life contexts (Mailani et al., 2024). Research shows that contextually designed and problem-based worksheets can increase student engagement and conceptual understanding of mathematics (Salsabila et al., 2024).

Numeracy-oriented SW emphasizes the presentation of real-world problems that require data interpretation, estimation, modeling, and mathematical reasoning (Isnaintri & Novaliyosi, 2024). Through these activities, students not only practice counting but also learn to understand the meaning of numbers and their relationships in specific contexts (Latifa et al., 2024). Research by Jannah and Handayani (2025) showed that Realistic Mathematics Education (RME)-based SW significantly improved the numeracy literacy of junior high school students.

However, most numeracy SW development focuses on the content and context of the problem, while aspects of students' thinking processes have not been explicitly and systematically designed (Pratiwi et al., 2025). Many student worksheets only present contextual problems without adequate scaffolding to help students navigate the thinking stages necessary to solve numeracy problems (Salsabila et al., 2024). This has led to the underutilization of student worksheets potential as a numeracy development tool.

The MIKiR (Experiencing, Interaction, Communication, and Reflection) strategy is a learning approach that emphasizes active student involvement in the learning process through direct experience, collaboration, mathematical communication, and metacognitive reflection (Saragih, 2022). This strategy aligns with constructivist theory, which states that knowledge is constructed through active interactions between individuals and their environment (Nurjamilah et al., 2025).

In the Experiencing stage, students are confronted with contextual situations or problems relevant to their lives, encouraging them to observe, interpret, and explore available numerical information (Bhoke, 2024). This stage is crucial in numeracy learning because it helps students connect mathematical concepts to everyday reality (OECD, 2023).

The Interaction stage encourages students to discuss, exchange ideas, and collaborate on problem-solving (Karina et al., 2024). Through social interaction, students can develop a wider range of problem-solving strategies and improve their numerical understanding through peer feedback (Susanto, 2024).

The Communication stage focuses on students' ability to express mathematical ideas, strategies, and solutions verbally and in writing (Lubis et al., 2023). Mathematical communication skills are a crucial component of numeracy, as they enable students to explain the rationale behind numerical decisions (OECD, 2021).

The Reflection stage helps students evaluate their thinking processes and results, and recognize the strengths and weaknesses of the strategies used (Isnaintri & Novaliyosi, 2024). Metacognitive reflection has been shown to positively contribute to improving numeracy skills by encouraging students to think critically and adaptively (Wicaksana et al., 2025).

The integration of the MIKiR strategy into student worksheets allows for the design of teaching materials that not only present problems but also guide students' thinking processes in a structured manner. In MIKiR-based SW, each activity is designed according to the MIKiR stages, from problem exploration to reflection on learning outcomes (Masfufah et al., 2023).

Research shows that student worksheets that explicitly accommodate students' thinking stages are more effective in improving higher-order thinking skills, including numeracy (Salsabila et al., 2024). However, empirical

studies specifically developing and testing student worksheets based on the MIKiR strategy in the numeracy context of junior high school students are still very limited (Latifa et al., 2024).

Most numeracy SW research only integrates one or two aspects of the MIKiR strategy, such as contextual experiences or group discussions, without systematically incorporating metacognitive reflection (Pratiwi et al., 2025). Reflection is a key component of numeracy development because it helps students understand their numerical thinking processes (OECD, 2023).

The following is a research gap analysis table:

Table 1. Analysis of Research Gap

No.	Name & Year	Research Focus	Key Findings	Research Limitations	Research Gap
1	Salsabila et al. (2024)	PBL-based student worksheet (SW) & numeracy	Practical numeracy-oriented SW	Does not measure reflective thinking processes	MIKiR strategy integration
2	Bhoke (2024)	Inquiry-based SW & numeracy	Numeracy increased significantly	The communication stage is less explored	MIKiR components are not yet complete
3	Jannah & Handayani (2025)	Realistic math SW & numeracy	Numeracy & literacy improvement	Focus on RME only	Integration of MIKiR strategies
4	Yanti et al. (2025)	E-SW numeracy (digital SW)	E-SW effectively improves numeracy	Non-explicit strategy	Need for MIKiR pedagogical framework
5	Latifa et al. (2024)	Numeracy SW with cultural context	Valid and effective SW	Detailed thinking strategies are not discussed.	Integration of MIKiR in numeracy SW
6	Pratiwi et al. (2025)	Contextual worksheets & problem solving	Increased understanding	There is no systematic reflection	The reflective stage of MIKiR has not been utilized
7	Mustika Nurbayeni & Siregar (2025)	Contextual worksheets general	Valid and effective for learning outcomes	Focus is not on junior high school numeracy	Junior High School Numeracy Research Gap
8	(Isnaintri & Novaliyosi, 2024)	Review numeracy activities	Numeracy activities are effective	Not related to specific SW	Gap in strategic SW media
9	Indriani & Ananda (2025)	PBL SW	Problem solving increases	Focus is not on junior high school numeracy	Need to focus on numeracy and MIKiR strategy

10	Masfufah & Santosa (2023)	Improving Learning Outcomes Through the MIKIR Approach	Learning outcomes improved	Not related to specific SW	Need to focus on numeracy
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Table analysis shows that no research has comprehensively integrated the MIKIR strategy into the development of numeracy worksheets for junior high school students, thus creating a significant research gap. Theoretically, this study reinforces the concept that numeracy is the result of a learning process that involves experience, interaction, communication, and reflection in an integrated manner. The MIKIR strategy provides a pedagogical framework aligned with constructivism and metacognition theories in mathematics learning. Practically, the results of this study provide a foundation for teachers and teaching materials developers to design more meaningful worksheets that are oriented toward students' numerical thinking processes (Latifa et al., 2024). MIKIR-based worksheets can be an innovative solution to improve the quality of mathematics learning in junior high schools, particularly in the context of implementing the Merdeka Curriculum (Jannah & Handayani, 2025).

Discussion

The findings of this literature review indicate that the development of student worksheets based on MIKIR strategies has significant potential to improve students' numeracy abilities. Across the reviewed studies, MIKIR-oriented learning materials consistently emphasized active student engagement through experiential learning (Mengalami), collaborative interaction (Interaksi), mathematical communication (Komunikasi), and reflective thinking (Refleksi). These components align closely with contemporary constructivist learning theories, which stress that numeracy skills are best developed when students actively construct mathematical understanding rather than passively receiving information.

The Mengalami component was frequently associated with contextual and problem-based tasks embedded in student worksheets. Several studies reported that worksheets integrating real-life numerical problems enabled students to better understand mathematical concepts and apply them meaningfully. This finding supports previous research suggesting that contextual learning strengthens numeracy by connecting abstract mathematical ideas with students' everyday experiences.

The Interaksi aspect of MIKIR-based worksheets was found to foster collaborative problem-solving and peer discussion. The reviewed literature highlighted that interaction among students enhances numerical reasoning, as learners are exposed to multiple problem-solving strategies. This collaborative dimension also supports the development of higher-order thinking skills, which are essential for numeracy proficiency.

Furthermore, the Komunikasi element played a crucial role in improving students' ability to express mathematical ideas using symbols, diagrams, tables, and verbal explanations. Studies consistently showed that worksheets encouraging students to explain their reasoning contributed to deeper conceptual understanding and reduced common misconceptions in numeracy learning.

The Refleksi stage was identified as a key factor in reinforcing numeracy skills. Worksheets that included reflective questions enabled students to evaluate their problem-solving processes and learning outcomes. Reflection not only strengthened conceptual retention but also promoted metacognitive awareness, which is critical for long-term numeracy development.

Despite these positive findings, this review also identified several limitations in existing studies. Many studies employed small sample sizes or short intervention durations, which may limit the generalizability of the results. In addition, not all studies explicitly measured numeracy outcomes using standardized assessment instruments, making it difficult to compare effectiveness across different contexts.

Overall, this literature review suggests that student worksheets developed based on MIKIR strategies provide a structured and effective approach to enhancing numeracy abilities. However, further empirical research with robust experimental designs and standardized measurement tools is needed to strengthen the evidence base and guide large-scale implementation in diverse educational settings.

Based on the literature review discussed, it can be concluded that developing worksheets based on the MIKiR strategy has significant potential to comprehensively improve junior high school students' mathematical numeracy skills. The integration of contextual experiences, social interactions, mathematical communication, and metacognitive reflection in student worksheets enables students to develop a deeper and more applicable understanding of numeracy. However, further development research and empirical experiments are needed to test the effectiveness of MIKiR-based SW more broadly and systematically.

CONCLUSION

This literature review confirms that mathematical numeracy skills are a fundamental competency that needs to be systematically developed at the junior high school level to equip students to understand and solve contextual problems in everyday life. The study results indicate that students' low numeracy skills are not only caused by limited mastery of mathematical concepts, but also by a suboptimal learning process that facilitates meaningful learning experiences, social interaction, mathematical communication, and reflective thinking. Therefore, the development of learning tools that can accommodate all these processes is an urgent need in junior high school mathematics instruction.

Based on a synthesis of various studies indexed by Scopus and SINTA between 2021 and 2025, it can be concluded that Student Worksheets play a strategic role in improving students' mathematical numeracy skills, especially when designed contextually and oriented toward student activity. However, most research on numeracy Student Worksheets still focuses on the content and context of the questions, while the design of student thinking stages has not been explicitly integrated into the Student Worksheets design. This indicates that the Student Worksheets potential as a tool for numeracy development has not been optimally utilized.

The MIKiR (Experience, Interaction, Communication, and Reflection) strategy emerged as a relevant and comprehensive pedagogical framework to address these challenges. This strategy aligns with the characteristics of mathematical numeracy, which requires active student engagement in understanding problems, discussing, communicating ideas, and reflecting on the learning process and outcomes. This study found that although MIKiR elements have been partially adopted in various mathematics learning studies, no research has fully integrated the MIKiR strategy into the development of numeracy worksheets for junior high school students.

Thus, this literature review confirms a significant research gap regarding the development of MIKiR-based worksheets to improve junior high school students' mathematical numeracy skills. These findings provide a theoretical contribution by strengthening the conceptual framework for integrating worksheets, numeracy, and the MIKiR strategy, as well as a practical contribution as a basis for future research on the development and implementation of MIKiR-based worksheets in junior high school mathematics learning.

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