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MATHEMATICAL LITERACY-BASED LEARNING: WHAT ARE THE CHALLENGES?

[*)]Furintasari Setya Astuti[1], Endang Mulyatiningsih[2] , Raden Rosnawati[3], Heri Retnawati[4]

[1] *Educational Research and Evaluation Program, Graduate School, Universitas Negeri Yogyakarta, Indonesia*

[2]*Faculty of Engineering, Universitas Negeri Yogyakarta, Indonesia*

[3,4]*Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Indonesia*

[*)]*Corresponding author*

furintasari0024pasca.2021@student.uny.ac.id

Abstrak

Dalam konteks pendidikan, keberhasilan pada abad ke-21 semakin bergantung pada literasi matematis siswa, karena literasi ini membekali mereka dengan kemampuan bernalar, memecahkan masalah, dan membuat keputusan yang tepat berdasarkan informasi kuantitatif. Menurut PISA 2018, kinerja siswa Indonesia dalam literasi matematis berada jauh di bawah rata-rata OECD, menunjukkan adanya kesenjangan yang berkelanjutan dalam kemampuan siswa menerapkan konsep matematika pada konteks dunia nyata. Sebagai respons, pemerintah Indonesia meluncurkan program Asesmen Nasional, yang mencakup Asesmen Kompetensi Minimum (AKM) dengan subtes literasi membaca dan literasi matematika (numerasi). Penelitian ini bertujuan menganalisis bagaimana guru matematika sekolah menengah di Indonesia menerapkan literasi numerasi dalam praktik pembelajaran di kelas, dengan fokus pada identifikasi tantangan yang mereka hadapi serta solusi praktis yang mereka lakukan. Penelitian ini menggunakan pendekatan fenomenologi untuk mengeksplorasi pengalaman nyata (lived experiences) guru dalam mengimplementasikan pembelajaran berbasis literasi numerasi. Penelitian ini melibatkan 42 guru matematika dari jenjang SMP dan SMA yang dipilih untuk mewakili wilayah Indonesia Barat, Indonesia Tengah, dan Indonesia Timur. Pengumpulan data dilakukan melalui kuesioner dan wawancara yang diselenggarakan secara daring. Data dianalisis menggunakan pendekatan Bogdan dan Biklen. Hasil penelitian menunjukkan bahwa guru menghadapi sejumlah tantangan dalam menerapkan pembelajaran berbasis literasi matematis, termasuk keterbatasan sosialisasi dan pelatihan terkait literasi matematis, kompetensi guru yang belum memadai, rendahnya minat belajar siswa, keterbatasan waktu pembelajaran, kebutuhan penyesuaian pedagogis selama pandemi COVID-19, serta kurangnya sumber daya, buku, dan referensi yang memadai terkait literasi.

Kata kunci: Literasi; Matematika; Tantangan; Fenomenologi

Abstract

In the educational context, success in the 21st century increasingly depends on students' mathematical literacy, as it equips them with the ability to reason, solve problems, and make informed decisions based on quantitative information. According to PISA 2018, Indonesian students' performance in

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mathematical literacy is significantly below the OECD average, indicating persistent gaps in students' ability to apply mathematical concepts in real-world contexts. In response, the Indonesian government launched the National Assessment program, which includes the Minimum Competency Assessment consisting of reading literacy and mathematical literacy (numeracy) subtests. This study aims to analyze how middle school mathematics teachers in Indonesia implement numeracy literacy in their classroom practices, with a focus on identifying the challenges they encounter and the practical solutions they employ. This research adopts a phenomenological approach to explore teachers' lived experiences in implementing numeracy-based learning. This research is phenomenology research. This study involved 42 mathematics teachers from junior and senior high schools, selected to represent the regions of West Indonesia, Central Indonesia, and East Indonesia. Data was collected using a questionnaire and interviews were conducted through online media. The data were analyzed using Bogdan and Biklen. The results indicate that teachers face several challenges in implementing mathematical literacy–based learning. These include limited socialization and training related to mathematical literacy, insufficient teacher competence, low student interest, restricted instructional time, the need for pedagogical adjustments during the COVID-19 pandemic, and a lack of adequate resources, books, and references on literacy.
Keywords: Literacy; Mathematics; Challenges; Phenomenology

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INTRODUCTION

Mathematical literacy is increasingly important in Indonesia's workforce and society, where individuals are required to interpret data, analyze quantitative information, and make evidence-based decisions across educational, social, and professional domains (Murnane et al., 2012). Mathematical literacy is one of the essential competencies needed in the 21st century. It is not only limited to understanding basic calculations, but also involves using mathematical reasoning to solve complex problems, drawing logical conclusions, and choosing efficient strategies in diverse situations (Burns, 2007; Silver & Cai, 2005; Smith & Stein, 1998).

However, despite the increasing global attention to mathematical literacy, Indonesian students' performance in this domain remains low. The results of the Programme for International Student Assessment (PISA) consistently indicate that

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Indonesian students score below the OECD average in mathematical literacy (OECD, 2010, 2012, 2015, 2019, 2023a). One of the key factors contributing to this condition is the range of challenges faced by Indonesian mathematics teachers in implementing instruction that fosters students' mathematical literacy, including limited professional development, inadequate instructional resources, restricted teaching time, and low student motivation (Risdiyanti et al., 2024). These challenges are further compounded by the widespread misconception among teachers who often equate mathematical literacy with procedural fluency. For example, many teachers emphasize formula memorization and routine exercises, such as calculating area or solving linear equations without engaging students in interpreting contextual problems or constructing mathematical models, a pattern also identified in previous research on Indonesian classrooms (Wijaya, 2016). This misalignment contrasts with the conception of mathematical literacy emphasized in the PISA framework, which highlights the importance of reasoning, modeling, and applying mathematics in real-world contexts (Stacey & Turner, 2015).

In addition, several contextual challenges, such as limited understanding of the concept of mathematical literacy, insufficient teaching resources, and a lack of targeted professional development programs, make it difficult for teachers to design and deliver literacy-oriented mathematics lessons effectively (Dahlan et al., 2024; Risdiyanti et al., 2024). These challenges highlight the urgent need to investigate teachers' actual experiences and barriers in implementing mathematical literacy-based instruction. Therefore, this study aims to explore the challenges faced by Indonesian mathematics teachers in implementing mathematical literacy-oriented teaching practices.

Literacy is an important component in the development of a country. Consequently, mathematical literacy skills have become the focus of research in recent years (Garcia-Retamero et al., 2019; Niklas & Tayler, 2018; Nusantara et al., 2020; Umbara & Suryadi, 2019). In a globalised world, people are required to play an active role in wider scopes such as international conferences, research, and the

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global economy. Such active roles demand not only traditional literacies (reading and writing), but also more specialised forms like mathematical literacy, the ability to interpret, reason with, and apply mathematical information in unfamiliar real-life contexts. Mathematical literacy is increasingly recognized as a key factor contributing to national development and social well-being, since numeracy and literacy skills affect people's lives in ways that go far beyond labor-market earnings and economic growth (Grotlüschen et al., 2020). Furthermore, strong mathematical and literacy foundations are essential for academic success and later workforce readiness, which collectively support a country's human capital and competitiveness (Chang, 2023).

According to the Indonesian Ministry of Education and Culture, every individual must have good basic literacy skills and apply them in daily activities in order to be able to face the 21st century. The components of basic literacy are (1) literacy, reading and writing, (2) scientific literacy, (3) information and communication technology literacy, (4) financial literacy, (5) cultural literacy, and (6) citizenship literacy. In literacy, read-write-count is related to the ability to listen, speak, read, write, and count. One of the things that will help individuals in solving problems in everyday life is how individuals are able to read, write, and count or commonly referred to as mathematical literacy. Furthermore, the benefits of literacy are (1) literacy facilitates health, (2) literacy promotes social justice, (3) literacy creates individual opportunities, and (4) literacy promotes economic development (NCTM, 2016).

Mathematical literacy ability is an individual's ability to formulate, use and interpret mathematics in various contexts so helping a person make logical, constructive and reflective judgments and decisions (OECD, 2019; Ojose, 2011; Owens, 1988; Stacey & Turner, 2015). This ability includes mathematical reasoning and the ability to use mathematical facts, concepts, and procedures to describe, explain, and predict a phenomenon (Suharta & Suarjana, 2018). Mathematical literacy allows students to develop the ability and confidence to think

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numerically and spatially sequentially to interpret and critically analyze everyday situations and to solve problems (Ojose, 2011; Owens, 1988; Stacey & Turner, 2015).

By the PISA framework, aspects of mathematical literacy are content, context, and cognitive process. Content of mathematical literacy includes quantity, change and relation, space and shape, data and uncertainty. Context of mathematical literacy includes personal, social, occupational, and science. Cognitive process of mathematical literacy are formulate, employing, and interpreting (OECD, 2018)

By applying mathematical literacy learning, students wish will be able to make the right decisions in real life (Ojose, 2011; Owens, 1988; Stacey & Turner, 2015). Students are able to predict the possibilities that will occur in a problem and make decisions with the possibility of small risk. Students will be able to open mind in dealing with a problem. The short-term impact of having good mathematical literacy skills is good learning achievement.

Mathematical literacy is one of the subjects tested in PISA. Singapore is the country that ranks at the top of the 2022 PISA. The average reading score of Singapore students is 543 with an OECD average of 476, an average math score of 575 with an OECD average of 472, and an average science score of 561 with an OECD average of 485 (OECD, 2023b). Singapore emphasis on developing students' critical thinking and problem-solving skills. The curriculum also emphasizes the importance of creativity, collaboration, and communication skills, which are essential for success in the 21st century (Elems-Ikwegbu, 2023).

In other hand, the PISA results of Indonesian students have not shown maximum results. Based on PISA 2022 (OECD, 2023a), the average reading score of Indonesian students is 371 with an OECD average of 487. The average mathematics score of Indonesian students is 379 with an OECD average, and the average science score of Indonesian students of 396 with an OECD average of 489. The Indonesian government through the Ministry of Education, Culture, Research,

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and Technology launched a national assessment program which is a series of independent learning policies. In the national assessment, there are three instruments that will be given to selected students in all schools in Indonesia, namely a minimum competency assessment, a character survey, and a learning environment survey. In the minimum competency assessment, there are two subtests, namely literacy (reading literacy) and numeracy (mathematical literacy). National assessment activity which includes a minimum competency assessment is the holding of a class minimum competency assessment. It should be underlined that literacy and numeracy do not necessarily refer to certain subjects. Therefore, teachers must be able to literate and number all subjects. Teachers need sufficient references such as books, modules, or other learning media in developing mathematical literacy-based learning. In addition, a community is also needed to share good practices so that it can motivate other teachers in developing mathematical literacy-based learning.

However, in practice, many mathematics teachers experience difficulties in implementing mathematical literacy-based learning. Some teachers have not yet integrated mathematical literacy principles into their classroom practices. Several factors contribute to these challenges (Jupri & Rosjanuardi, 2020).First, teachers often have a limited understanding of the concept of mathematical literacy and its relation to curriculum goals (Risdiyanti et al., 2024). Second, there is a lack of adequate teaching resources, instructional models, and assessment tools aligned with literacy-oriented learning (Susanta et al., 2022). Third, professional development programs rarely provide practical examples or mentoring on how to design mathematical literacy tasks relevant to students' daily contexts (Dahlan et al., 2024).

Although many teachers are members of subject teacher associations at the district or provincial level, there are still few structured forums for sharing good practices in implementing mathematical literacy in schools. As a result, teachers tend to work individually without collaborative support to improve their literacy-

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based teaching skills (Agustin & Zumrotun, 2024; Napitupulu & Wibawanta, 2022).

Lack of information related to the concept of mathematical literacy is a major problem. The new class minimum competency assessment will be socialized starting at the end of 2020, and discusses the national level minimum competency assessment. Socialization and training on new learning have not been able to provide a good understanding to teachers (Retnawati, 2013). Not many teachers understand how to apply mathematical literacy in the classroom. Mathematical literacy is closely related to questions with the Higher Order Thinking Skill (HOTS) level. Many teachers do not understand how to prepare HOTS questions (Jailani et al., 2017).

In terms of students' abilities, the development of students' mathematical literacy skills has not been as expected. Several experts have conducted research and studies on the development of students' literacy skills. The mathematical literacy ability of students in East Kalimantan in solving PISA model questions is still below the OECD average (Hamidy & Jailani, 2019). Furthermore, other studies showed the same results, namely the mathematical literacy ability of high school students in the cities of Banjarmasin and Palangkaraya, Indonesia was still in the low category (Muhazir et al., 2021). These things indicate that the practice of literacy learning is experiencing a problem that deserves a solution.

In connection with these problems, it is necessary to conduct a study to find out the challenge by mathematics teachers in schools so that the implementation of mathematical literacy learning in schools runs as expected. In addition, teachers are given a comprehensive training on the implementation of mathematical literacy learning so as to improve students' mathematical literacy skills and ultimately improve the quality of education in Indonesia and be able to compete in international education. This research will reveal the challenges of mathematics teachers in schools, as well as accommodate suggestions from mathematics teachers to be followed up by related parties.

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METHOD

This study is a qualitative research employing a phenomenological approach (Taylor et al., 2016). A phenomenological design was selected because the aim of the study is to understand teachers' lived experiences, perceptions, and challenges in implementing mathematical literacy based learning, an inquiry focus that aligns with phenomenology's emphasis on capturing participants' subjective meaning-making processes. The phenomenon examined is the classroom implementation of mathematical literacy practices by middle and high school mathematics teachers in Indonesia. The data were analyzed using thematic analysis, involving systematic processes of data familiarization, coding, categorization, and theme development. Themes were generated inductively to represent teachers' authentic experiences and to capture the complexities they encounter in integrating mathematical literacy into their instructional practices (Taylor et al., 2016).

This study involved 42 mathematics teachers from junior and senior high schools across Indonesia. Participants were selected using purposive sampling to ensure representation from three major regions, West Indonesia, Central Indonesia, and East Indonesia. The inclusion criteria required teachers to have at least one year of experience teaching mathematics and prior exposure to the implementation of mathematical literacy or numeracy-related instructional practices. This selection aimed to capture diverse teaching contexts and varying levels of familiarity with mathematical literacy. The demographic distribution of participants is presented in Table 1.

Data were collected through a structured questionnaire complemented by semi-structured interviews. A total of 42 mathematics teachers participated in the survey, with questionnaires distributed entirely via online platforms. The use of online media was chosen to ensure broader accessibility and to accommodate varying school conditions, particularly related to limited in-person research access and the need for flexible participation schedules (Bryman, 2015; Creshwell, 2009). To enrich quantitative responses, follow-up interviews were conducted with

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selected participants, each lasting approximately 20–30 minutes. This combination of online questionnaires and interviews allowed the researchers to obtain both breadth and depth of data regarding teachers' perceptions and challenges in implementing literacy-based mathematics instruction (Fetters et al., 2013). The questionnaire was used to explore data related to the practice of teaching mathematical literacy in the classroom. For some teachers, both those who have implemented mathematical literacy and those who have not, the data collection was deepened by interviews.

Table 1. Demographics of Participants

Aspects	Number of Participant	Percentages
Area		
West of Indonesia	33 participants	80.49 %
Center of Indonesia	6 participants	14.63 %
East of Indonesia	2 participants	4.88 %
Employment Status		
Government Employes	19 participants	30.95 %
Non-Government Employes	23 participants	69.05 %
Gender		
Men	13 participants	45.24 %
Women	29 participants	54.76 %
Implementation		
Yes	13 participants	30.95 %
Not yet	29 participants	69.05 %

RESULT AND DISCUSSION

To categorize teachers' implementation of mathematical literacy, this study employed a direct self-report item asking participants whether they had implemented mathematical literacy–based instruction in their classrooms. Although the classification relied on a single dichotomous question, additional descriptive indicators, such as the integration of real-world contexts, the use of mathematical reasoning, and the incorporation of modelling activities, were used to further interpret teachers' responses during the analysis stage. These supplementary indicators did not determine the categorization but served to enrich the

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understanding of how teachers conceptualized and enacted mathematical literacy in practice. Based on their responses, teachers were grouped into two categories: those who reported having implemented mathematical literacy and those who reported not yet implementing it. This approach allowed for a clear distinction aligned with the study's phenomenological focus on teachers' lived experiences, while providing sufficient contextual depth for interpreting the variations in their instructional practices.

As many as 30.95% of participants were classified as teachers who have implemented mathematical literacy, while 69.05% were categorized as not having implemented it. Analysis of the questionnaire reveals several underlying factors influencing this condition. A majority of teachers who had not implemented mathematical literacy reported limited conceptual understanding, while a large proportion indicated insufficient access to appropriate teaching materials. In addition, a considerable number of respondents highlighted the lack of professional development programs as a barrier to adopting mathematical literacy practices. Although these factors vary in frequency, the combined evidence suggests systemic constraints that limit teachers' capacity to integrate mathematical literacy into classroom instruction. These findings are consistent with previous studies which reported that many teachers face challenges in translating the concept of mathematical literacy into classroom practices due to limited training and lack of institutional support (Jupri & Rosjanuardi, 2020; OECD, 2019; Risdiyanti et al., 2024).

Challenges

In response to the low performance of Indonesian students in the PISA assessments, the Government, through the Ministry of Education, Culture, Research, and Technology, launched the *Merdeka Belajar* (Independent Learning) policy, which includes the National Assessment program. This policy emphasizes the importance of strengthening students' mathematical literacy as part of

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improving educational quality. Mathematical literacy is encouraged to be integrated into classroom learning so that students can solve real-world problems and make reasoned decisions. However, despite this policy direction, many teachers continue to experience challenges in implementing mathematical literacy-based learning effectively. The reduced data are presented in Table 2.

Table 2. Results of Reduction of Constraints for not implementing mathematical literacy learning

No	Sub-theme	Relationship between sub-themes
1	Bits and pieces of knowledge	Information/socialization that is less comprehensive, resulting in teacher knowledge related to the implementation of mathematical literacy to be incomplete.
2	Lack of information and socialization about the implementation of mathematical literacy	
3	There is still a lack of knowledge about mathematical literacy	
4	There is no socialization related to mathematical literacy-based learning	
5	Making problems with mathematical literacy is rather difficult because they are not used to	The ability of teachers who are lacking in developing mathematical literacy-based questions so that it is difficult to provide problems related to daily life.
6	Self-efficacy is still minimal regarding mathematical literacy-based learning	
7	Less learning time Insufficient	Learning time during the pandemic era and so teachers have difficulty in allocating learning time, while online learning does not provide maximum results.
8	Very limited duration of meetings with students in person/offline/offline	
9	Difficulty in distributing subject matter	
10	Complicated division of lesson hours	
11	Lack of students interest	Interest and ability of students who are less in interpreting problems into mathematical models.
12	The rest still have difficulty interpreting the problem into mathematical language	
13	Policy change rapidly	School is in adaptation phase with the new curriculum so that the implementation of mathematical literacy has not become an urgency.
14	Still focusing on adjusting the new curriculum	
15	Technical guidelines or lesson plans have not yet been made	
16	Lack of learning resources	Lack of learning resources which makes it difficult for teachers to find examples of problems.
17	No library available	

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The challenges faced by teachers in implementing mathematical literacy–based learning are serious issues that require immediate attention. One major contributing factor is the limited and inconsistent socialization of government programs related to mathematical literacy. Questionnaire results show that 69.05% of teachers (n = 29) reported that they had not yet implemented mathematical literacy because they had never received adequate training or structured guidance from local or national authorities. This condition was also reflected in interview responses. For example, one teacher stated, "*Kami sering mendengar istilah literasi matematika, tetapi tidak ada pelatihan resmi tentang bagaimana menerapkannya dalam pembelajaran*." Another teacher from East Indonesia expressed, "*Informasinya datang tidak merata. Teman di daerah lain mendapatkan sosialisasi, tetapi kami tidak*." These findings demonstrate how uneven dissemination of government programs has resulted in confusion and hesitation among teachers when attempting to adopt mathematical literacy practices.

Moreover, mathematical literacy remains a relatively new and unfamiliar concept for many teachers, especially given that 69.05% of respondents were non-government employees who typically have fewer structured professional development opportunities. This limited conceptual understanding influences instructional practices, with most teachers still relying on procedural tasks and routine calculations. Interview data further illustrate this challenge. One teacher commented, "*Selama ini saya mengira literasi matematika hanya tentang kemampuan menghitung soal cerita sederhana. Saya belum terbiasa menyusun soal kontekstual*." Another added, "*Saya ingin mencoba pendekatan berbasis konteks, tapi saya bingung mencari contoh soal yang sesuai*." These insights highlight that, although teachers recognize the importance of mathematical literacy, gaps in understanding and limited access to pedagogical resources remain key obstacles to its successful implementation.

Mathematical literacy requires students to be able to interpret various problems in everyday life into mathematical contexts. For instance, students may

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analyze household electricity consumption data to determine energy efficiency, compare promotional discounts in shopping to make economical decisions, or estimate travel time based on distance and speed. These tasks encourage students to connect mathematical concepts with real-life reasoning and decision-making processes. However, challenges arise when students' interest in mathematical literacy-based questions remains low, often because such problems are unfamiliar or perceived as complex (Nusantara et al., 2020; Wijaya, 2016).

Strategic Plan

Regarding the implementation of mathematical literacy, 36% of teachers who have not implemented mathematical literacy have received instructions from the principal as well as from the department or related stakeholders. However, the various challenges made the implementation of mathematical literacy learning unable to run. However, the teachers have developed a strategy in order to implementation mathematical literacy learning. The results of data reduction from the strategic plans that the teachers developed are shown in Table 3.

Table 3. Reduction of the Strategic Plan for the Implementation of Mathematical Literacy Learning

No	Sub-theme	Relationship between sub-themes
1	Trying to make and adapting questions from books on mathematical literacy	Trying to make, adapt and prepare tools/materials and settings at the beginning of learning
2	Looking for and attending training on mathematical literacy	
3	Prepare chapters/materials and materials/ tools/ media	
4	Studying the steps/strategies for implementing mathematical literacy	
5	Students are asked to read the material or watch the learning video	

Suggestions to Stakeholders

The successful implementation of mathematical literacy is not only the responsibility of the teacher as the frontline who faces students directly but is a

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shared responsibility between teachers, school principals, subject teacher comunity, local offices, and even the government under the coordination of the Ministry of Education and Culture. However, in reality not all teachers are able to implement it. Regarding the challenge that have been described in Table 1, teachers have stakeholder suggestions which will be shown in Table 4.

Table 4. Reduction of suggestions for implementing mathematical literacy learning to Stake Holders

No	Sub-theme	Relationship between sub-themes
1	Availability of training, seminars, workshops with adequate time	Availability of training/ worksop, books/sources and adequate management of teaching hours
2	Provided guidance and references in the form of books/sources related to the implementation of mathematical literacy	
3	Arrangement of adequate teaching hours	
4	Collaboration and mutual communication within the school environment Collaboration with stakeholders	
5	Teachers must be willing and able to develop themselves	

Since implementation of the national assessment program where one of the instruments used is the minimum competency assessment, mathematical literacy has its own resonance in Indonesia. The government through Ministry of Primary and Secondary Education of the Republic of Indonesia provides three types of minimum competency assessments that will be implemented in Indonesia. National minimum competency assessment, minimum class competency assessment, and certification minimum competency assessment (Abduh, 2020). The implementation of National Assessment in 2021encourages the implementation of a minimum class competency assessment in all subjects including mathematics.

There is encouragement for the implementation of minimum competence assessment in the classroom, which also brings back the implementation of mathematical literacy learning. It is important to apply mathematical literacy so that students are able to do, understand, and apply mathematics, not only in the

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classroom but also in everyday life, besides that students are invited to think critically about the instructions given (Syahlan, 2015). In practice, not all teachers apply mathematical literacy-based learning. The problem of socialization (training, workshops) not optimal by teachers. This is in line with research conducted by Retnawati (Murnane et al., 2012; Retnawati, 2013). In addition, another obstacle by the group of teachers who have implemented mathematical literacy is the lack of interest in reading by students. This is in line with the research conducted by Harsono et al (Harsono et al., 2012). Research states that interest in learning also affects student achievement (Flora Siagian, 2015; Nugroho & Haryati, 2015; Sembiring & Mukhtar, 2013) .

The reduction in study hours in the pandemic era is a separate obstacle for the majority of teachers. The implementation of blended learning leaves various problems for teachers. The lack of face-to-face learning time requires the teacher to condense the material. While online learning is considered by the teacher to be less effective in understanding students in the subject matter. This is in line with research conducted by Dzalila (Dzalila et al., 2020). Another obstacle faced by teachers is the lack of adequate books or references. The majority of teachers use sources from the internet and then modify them so that they are more easily accepted by students. Some teachers choose to develop their own instruments even though it takes a long time and large funds. Books or references are very important in the success of a learning process. Anisah et al (Anisah & Ezi Nur Azizah, 2016) said that there is an effect of using textbooks on student learning outcomes.

CONCLUSION

Based on the analysis, this study concludes that the implementation of mathematical literacy learning in Indonesian schools is hindered by several interconnected challenges. First, internal challenges related to teachers' professional capacity remain predominant. A total of 69.05% of teachers reported not yet implementing mathematical literacy, largely due to limited understanding of its core concepts and the absence of systematic professional development. The

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lack of clear guidance and inconsistent socialization of government programs contributes to varied interpretations of mathematical literacy, leading many teachers to rely on procedural, calculation-focused instruction rather than contextual and reasoning-oriented approaches.

Second, external constraints also impede implementation. Teachers indicated that restricted instructional time, rigid curriculum structures, and limited access to high-quality learning resources, such as contextual problem sets or mathematical literacy–oriented textbooks, make it difficult to integrate mathematical literacy in a sustained and meaningful way. These constraints are particularly evident among teachers working in regions with fewer institutional supports.

Third, student-related factors present additional barriers. Many teachers noted that students' low learning motivation and limited reading interest reduce engagement with open-ended, context-based mathematical tasks. For example, several teachers reported that students often avoid word problems or tasks requiring interpretation of real-world information because they find the reading component difficult or uninteresting. This aligns with questionnaire findings showing that a majority of teachers perceive literacy-related dispositions as one of the central challenges in applying mathematical literacy-based instruction.

This study acknowledges several limitations that create opportunities for further research. The sample size of 42 teachers, although geographically diverse, may not fully capture the complexity of mathematical literacy implementation across Indonesia. The reliance on self-reported data may introduce subjectivity, and the absence of classroom observations limits the ability to confirm the alignment between teacher perceptions and classroom practices. Future research could employ larger samples, incorporate observational data, and explore targeted professional development or intervention models that strengthen teachers' capacity to implement mathematical literacy effectively.

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