Understanding Mathematical Literacy Across Career Stages: Insights from Pre-service and In-service Teachers

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Mathematical literacy is essential for both pre-service and in-service teachers and plays a crucial role in mathematics teaching and broader educational practice. This study examines teachers' perceptions of mathematical literacy, focusing on theoretical and practical dimensions. Using a mixed-methods approach, the research combines qualitative and quantitative data from surveys of 245 participants, comprising 163 pre-service teachers and 82 in-service teachers, across diverse educational settings. The findings reveal distinct differences between the two groups. Pre-service teachers tend to conceptualise mathematical literacy as a theoretical construct, emphasising critical and logical thinking. In contrast, in-service teachers demonstrate a more comprehensive and practice-orientated understanding, connecting real-world applications and cross-disciplinary competencies. Despite these differences, both groups acknowledge the critical role of mathematical literacy in enhancing students' problem-solving abilities and preparing them for life beyond school. The study highlights the need to bridge theory and practice within teacher education programs by embedding authentic learning experiences and cross-curricular approaches. It also underscores the importance of sustained professional development to support teachers' evolving understanding and implementation of mathematical literacy.

Keywords • mathematical literacy • pre-service teachers • in-service teachers • teacher perceptions • teacher education programs • professional development

Introduction

Mathematical literacy is now a key area of concentration worldwide due to the growing need for critical, logical, and analytical thinking abilities in the modern world (Frejd & Geiger, 2017; Pillai et al., 2017; Rizki & Priatna, 2019; Short & Keller-Bell, 2019). Through the Programme for International Student Assessment (PISA), the Organisation for Economic Co-operation and Development (OECD) regularly highlights mathematics literacy as one of the key markers of a nation's educational system's effectiveness (OECD, 2023a). The capacity to use mathematical ideas and reasoning in a variety of real-world situations, including data analysis, social problem-solving, and financial decision-making, is sometimes referred to as mathematical literacy (Kramarski & Mizrachi, 2004; Maslihah et al., 2020; OECD, 2023a). In this context, mathematical literacy plays an important role as a cross-disciplinary skill that supports various fields of science and technology (Pugalee & Chamblee, 2000). The goal of mathematical literacy aligns with education for sustainable development, which is to prepare students to make sound decisions and solve problems in their personal, civic, and professional lives (Pan et al., 2023; Pillai et al., 2017). . The concept of mathematical literacy has evolved from a strongly mathematised view of school mathematics toward an emphasis on participation in society, citizenship, and the use of mathematics in real-life contexts, reflecting a move away from traditionally elitist perspectives toward broader participation and equitable access (North, 2024).

The Programme for International Student Assessment (PISA), developed by the OECD, is known widely as an established international assessment for measuring student mathematical literacy. It provides a standardised framework for assessing students' ability to formulate, apply, and interpret mathematics in various real-world contexts. PISA results show that students across the world continue to struggle with using mathematics as a means of reasoning, reflection, and informed decision-making in real-life contexts (OECD, 2023b). This pattern is also reflected in the Indonesian context. Although mathematical literacy is recognised as a fundamental skill for all students, Indonesian students' achievement levels remain significantly below the international average—only approximately 18% achieve at least Proficiency Level 2 in mathematics, compared to the OECD average of 69% (OECD, 2023a). These findings highlight fundamental challenges in mathematics education in Indonesia, particularly in relation to how students interpret and connect mathematics to real-life situations.

One important factor contributing to low student achievement in mathematical literacy is teachers' limited understanding of mathematical literacy concepts. Some studies reported that many teachers experience difficulties in addressing high-level PISA questions, especially levels 4-6 (Ahmad et al., 2018; Istiandaru et al., 2021). Jupri and Rosjanuardi (2020), for example, found that only 25% of the teachers surveyed were familiar with mathematical literacy questions. Similarly, Umbara and Suryadi (2019) found that 60% of the respondents, who were teachers, lacked knowledge of mathematical literacy. This limitation is arguably tied to a pedagogical culture that has long emphasised memorisation and teacher-centered learning, which prioritises procedural fluency over contextual reasoning (Mustafa, 2023; Zulfikar, 2018). As a result, an education system that emphasises compliance and routine practices tends to hinder learning innovation, making it difficult for teachers to integrate mathematical literacy into authentic and interdisciplinary learning (Bjork & Raihani, 2018; Genc & Erbas, 2019).

Although teachers' understanding of mathematical literacy may be limited, they continue to play a vital role in fostering students' mathematical reasoning and problem-solving skills (Istiandaru et al., 2021; Laitochová et al., 2021). Mathematical literacy itself is not only relevant in mathematics teaching, but also to a wide range of other disciplines (Maryani & Widjajanti, 2020). For example, science teachers need mathematical literacy to explain the concepts of measurement and experimentation, while language teachers can utilise mathematical logic patterns in grammatical analysis. However, research shows that the effectiveness of the teachers' role is often hampered by differences in educational background, teaching experience, and teachers' conceptual understanding of mathematical literacy (Genc & Erbas, 2019; Harisman et al., 2019). Similar limitations are also apparent in prospective teachers. Although many prospective teachers feel confident in their ability to support students' mathematical reasoning (Dofková & Chudý, 2019), research shows that they have difficulty in solving high-level mathematical literacy questions like those of PISA, suggesting the need for a more focused and contextual improvement of teacher education curricula (Istiandaru et al., 2021; Yustitia et al., 2020).

The limited understanding of mathematical literacy among teachers and prospective teachers necessitates investigating how they interpret this construct in the context of teaching because teachers' beliefs and understanding of mathematical literacy directly influence their teaching and assessment practices (Ernest, 1989). For example, teachers who view mathematical literacy solely as computational skills are more likely to design routine exercises as assessments. Conversely, teachers who believe mathematical literacy involves reasoning and solving real-world problems are more likely to include contextual tasks and open-ended questions in their classroom assessments. Existing literature, however, has predominantly focused on mathematical literacy in developing students' thinking and problem-solving skills (Fitrianawati et al., 2020; Hermawan et al., 2019; Maslihah et al., 2020; Retnawati & Wulandari, 2018; Rianti et al., 2022), rather than on how teachers understand and teach it.

To date, there have been few studies exploring the perceptions of teachers and prospective teachers regarding mathematical literacy, especially in developing countries such as Indonesia, where systemic and pedagogical factors influence how teachers interact with and apply this concept. In the Indonesian context, mathematical literacy has not been systematically positioned as a cross-disciplinary competency, as it is in Australia (Forgasz et al., 2017) nor as a school subject, as in South Africa (Pillai et al., 2017). Instead, mathematical literacy is often articulated primarily through assessment frameworks, both in the context of PISA and national assessment (*Asesmen Kompetensi Minimum* - Minimum

Competency Assessment), which can reduce its meaning to procedural numerical skills rather than context-based reasoning competencies that support lifelong learning and decision-making. Consequently, some teachers may interpret mathematical literacy as simply an assessment requirement rather than an integrated pedagogical goal.

The purpose of this study is therefore to explore teachers' and prospective teachers' perceptions of mathematical literacy to understand how these perceptions shape the way mathematical literacy is taught and developed in the classroom. This research aims to:

(1) explore how pre-service and in-service teachers perceive the role and importance of mathematical literacy;
(2) identify the factors that shape their perception; and
(3) examine the differences between the two groups to inform the design of teacher education programs that empower teachers to meaningfully integrate mathematical literacy into classroom practice.

This study is expected to provide an in-depth understanding of how in-service and pre-service teachers perceive mathematical literacy while strengthening the broader understanding of mathematical literacy as a core life competency that supports reasoning, problem-solving, and decision-making in various contexts. Additionally, the findings of this study are also expected to form the basis for the development of more strategic education policies and teacher training programs, oriented towards strengthening mathematical literacy as a cross-disciplinary competency. Thus, teachers can contribute more effectively to improving the quality of learning and education. Furthermore, by placing the research context in Indonesia, this study offers relevant insights for other developing countries facing similar pedagogical challenges, thereby enriching the global discourse on teaching and developing mathematical literacy across diverse cultural contexts and education systems.

Theoretical and Empirical Background

Conceptualising Mathematical Literacy and Related Constructs

The concept of Mathematical literacy (ML) has shifted from a focus on procedural mastery to the ability to use mathematics reflectively in real-life situations. The OECD (2023b) defines mathematical literacy as an individual's capacity to reason mathematically, formulate, use, and interpret mathematics to solve problems in real contexts. Within this framework, mathematics is no longer viewed as a collection of abstract knowledge, but as a practical tool for thinking that is relevant to social, economic, and technological life (Ernest, 2002).

Conceptually, mathematical literacy needs to be distinguished from mathematics as a discipline. While mathematics focuses on formal structures, logical consistency, and abstract deduction (Khan, 2015), mathematical literacy has an emphasis on the application and interpretation in contextual situations (Burkhardt, 2007). In other words, mathematical literacy represents the "functional face" of mathematics—that is, the ability to use quantitative knowledge to understand, evaluate, and make decisions in modern society (OECD, 2023a).

To clarify these conceptual boundaries, it is important to review the terms numeracy and quantitative literacy, which are often used interchangeably with mathematical literacy. Numeracy first became popular in the United Kingdom through the 1959 Crowther Report as an elitist concept for sixth graders to develop scientific and quantitative thinking skills (Brinkworth, 1985). This term later came to be understood as the ability to use basic mathematics in everyday life. As it developed, numeracy came to be defined more broadly as the ability to competently use numbers, tables, and graphs (Parsons & Bynner, 2006). Meanwhile, quantitative literacy emerged in North America in the late 20th century as a response to the growing need for numerical and statistical skills in modern society (Scheaffer, 1990), with an emphasis on the ability to interpret data and quantitative arguments in professional and civic settings (Steen, 2001).

From the OECD perspective, mathematical literacy combines elements of numeracy and quantitative literacy within a broader competency framework—namely, the ability to formulate, apply, and interpret mathematics reflectively. De Lange (2003) illustrated the relationship between these three terms (Figure 1), showing that mathematical literacy encompasses cognitive, affective, and contextual dimensions that intersect with the other two concepts. It should be noted, however, that this expansion is not hierarchical. Numeracy, quantitative literacy, and mathematical literacy arose from different social and policy contexts—each reflecting the needs of society and educational traditions in their respective regions (Gal, 2002; Geiger, Goos, et al., 2015). Therefore, the OECD version of mathematical literacy is better understood as the result of conceptual synthesis in the context of the globalisation of educational assessment, rather than as the "highest level" of the other two terms. In this study, the term mathematical literacy was chosen because it best represents the integration of cognitive, affective, and contextual aspects that are the focus of the study. Additionally, it is relevant to the reflective needs of prospective teachers as they face the complexities of life and mathematics learning in the modern era.

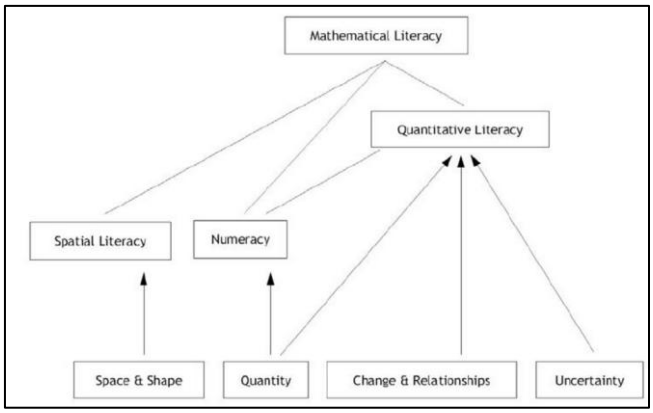

Figure 1. Mathematical literacy structure by De Lange (2003).

Curriculum and Teacher Education Context

The approach to integrating mathematical literacy into the curriculum varies across countries and is typically influenced by educational philosophies and views on the relationship between mathematics and real-world application. In Australia, for example, mathematical literacy—or better known as numeracy—is regarded as a general skill that must be developed across subjects. Therefore, all teachers have a responsibility to foster it, not just mathematics teachers (Forgasz et al., 2017; Geiger et al., 2015). This model places mathematical literacy as a contextual competency that must be present in all domains of learning. South Africa has chosen a different path by making mathematical literacy a separate subject at the secondary level (Pillai et al., 2017). The goal is not merely to teach mathematical concepts, but to develop the ability to use mathematics to understand social, economic, and civic issues (Venkat & Graven, 2008). In the Finnish context, mathematical literacy is not only viewed as a cognitive ability, but also as part of transversal competences that involve critical, creative, and collaborative thinking across different disciplines (Finnish National Board of Education, 2014). To develop these cross-disciplinary competencies, mathematics learning is approached through methods that emphasise authenticity and contextual relevance. This can be done, for example, through pedagogical entrepreneurship (Haara, 2018), where context-based problem-solving activities are used to foster reflective and applied applications of mathematical literacy.

Global trends indicate a move towards more reflective and practical approaches to mathematics learning, where understanding concepts is strongly connected to real-life situations. As stated by Bolstad and Goodchild (2025), the direction of international curriculum development now emphasises pedagogy that bridges academic mathematics with learners' social and professional experiences. This

shift in paradigm calls for innovation in learning design and cross-disciplinary collaboration, both within schools and in teacher education programs that prepare future teachers to facilitate mathematical literacy across diverse contexts.

In the Indonesian context, the commonly used term is numeracy literacy, which is defined in the Merdeka Curriculum as the ability to apply mathematical knowledge to explain phenomena, solve problems, and make decisions in everyday life (Kementerian Pendidikan dan Kebudayaan, 2017). The effort to strengthen numeracy literacy in Indonesia is mainly implemented through the National Assessment (NA), which generally assesses students' ability to reason using data, numbers, and quantitative concepts in real-life contexts (Kemendikbud, 2021). The NA results, however, show that most students still have difficulty interpreting and using quantitative information meaningfully, which indicates the need to shift from procedural learning to reasoning and context-based learning. Furthermore, Indonesia's participation in international assessments such as PISA highlights this trend, as Indonesian students consistently score poorly in mathematical reasoning and in applying concepts to real-world contexts. (OECD, 2023c).

This situation has direct implications for teacher education. Teacher Training Institutions—Lembaga Pendidikan Tenaga Kependidikan (LPTK)[1] in Indonesia—are still oriented towards mastery of mathematical content and general pedagogy, while reflective, contextual, and social aspects are not yet the main emphasis (Yustitia et al., 2020). This leads prospective teachers to interpret mathematical literacy narrowly, limited to the ability to calculate or solve contextual problems without understanding its critical and applicative dimensions (Istiandaru et al., 2021). Given teachers' central role in connecting formal mathematical representations with the real-world contexts, the development of mathematical literacy should, therefore, be an integral part of teacher education (Geiger et al., 2015).

To overcome reductionist tendencies in teacher education, the numeracy across the curriculum approach offers a relevant conceptual direction (Forgasz et al., 2017). This approach emphasises that the development of mathematical literacy is the collective responsibility of all teachers, not just mathematics teachers. Mathematics teachers play a role in fostering mathematical reasoning and thinking structures, but teachers from other fields help contextualise these aspects through diverse social, economic, and professional situations. Such a cross-disciplinary approach remains rarely implemented in Indonesian teacher education, despite its potential to expand understanding of mathematical literacy as a vital life skill that connects different domains of knowledge and real-world contexts.

Gaps and Rationale of the Study

Although mathematical literacy has been a global concern for more than two decades, research exploring the development of mathematical literacy in Indonesia remains relatively limited, especially in the context of teacher education. Most studies have focused on school students and curriculum development (Rum & Juandi, 2022; Wijaya, 2017), and studies examining teachers' and prospective teachers' understanding and perceptions of mathematical literacy are rare. Existing research generally focused on describing mathematical literacy abilities (Suharta & Suarjana, 2018) and exploring the role of teachers or prospective teachers in designing learning that integrates mathematical literacy (Lestari et al., 2019). These studies, however, have not revealed much insight into how prospective teachers interpret and conceptualise mathematical literacy as part of their professional competence. In fact, as emphasised by Forgasz et al. (2017), without reflective understanding among prospective teachers, the integration of mathematical literacy into the national curriculum risks being mechanistic—merely following the assessment format without a fundamental pedagogical transformation.

In addition to these empirical limitations, a conceptual gap also exists in the Indonesian literature. The terms mathematical literacy, numeracy, and problem-solving skills are often used interchangeably without clear theoretical definitions. This ambiguity contrasts with international studies that explicitly

[1] LPTK (Lembaga Pendidikan Tenaga Kependidikan) refers to accredited teacher training institutions in Indonesia.

differentiate between numeracy and a critical literacy framework (Geiger et al., 2015) and understand statistical/quantitative literacy as a critical part of an information society (Gal, 2002). This conceptual gap has led to inconsistencies in the development of instruments, pedagogical designs, and literacy-focused education policies in Indonesia.

Given these empirical and conceptual gaps, this study aims to explore teachers' and prospective teachers' perceptions of mathematical literacy in the Indonesian context. This study seeks to understand how teachers and prospective teachers conceptualise the role and importance of mathematical literacy, the factors shaping these perceptions, and their implications for the development of teacher education curricula. By placing the Indonesian context in dialogue with international literature, this study is expected to offer a conceptual contribution to clarifying the meaning of mathematical literacy in the context of developing countries, while providing an empirical basis for teacher education designs that foster reflective, contextual, and mathematically literate thinking.

Method

Research Design

This study uses a qualitative descriptive design to explore the perceptions of pre-service and in-service teachers regarding mathematical literacy. This approach allows for an in-depth exploration of the participants' understanding, views, and meanings of mathematical literacy, both in terms of concepts and their application in teaching practice. This research is grounded in the interpretivist paradigm, which focuses on understanding individual experiences and perceptions in their social context (Alharahsheh & Pius, 2020). The paradigm is relevant to this study because teachers' perceptions of mathematical literacy are subjective, evolving, and shaped by their experiences and educational backgrounds. Using an interpretive approach, researchers can capture the complexity and variation of individual experiences, leading to a more comprehensive understanding of participants' perceptions of mathematical literacy. Additionally, it allows for the identification of factors that influence participants' perceptions, such as teaching experience, educational background, and knowledge of mathematical literacy, as well as the exploration of differences in perceptions between pre-service and in-service teachers. This design is suitable for exploring how teachers and prospective teachers understand, apply, and prepare for mathematical literacy, given its emphasis on participants' subjective meanings.

Data Collection Instruments

The data collection instrument employed in this study is an online questionnaire featuring open-ended questions, designed to explore participants' perspectives in depth. The questionnaire is comprised of two sections. The first section starts with demographic questions, such as questions on education level, teaching experience, province, and field of study. The second section contains five core questions related to perceptions of mathematical literacy[2]: (1) What do you think mathematical literacy is? (2) Do you think mathematical literacy is important for you as a pre-service or in-service teacher? Why? (3) As a pre-service or in-service teacher, when do you think is the right time to develop mathematical literacy for yourself as a teacher who will later have to integrate mathematical literacy in learning? (4) What efforts have you made to improve mathematical literacy? and (5) What efforts will you make in the future to improve mathematical literacy? The third question about the timing of mathematics literacy development aims to explore participants' perspectives on its ongoing growth, rather than viewing it as a fixed skill that one either possesses or lacks. The goal is to assess whether pre-service and in-service teachers are motivated to begin developing mathematical literacy skills as early as possible, so they can

[2] The survey items were originally administered in Indonesian and translated into English for clarity in reporting. The translation aimed to preserve semantic equivalence with the original wording.

effectively integrate mathematical literacy into their teaching practices, both for personal and professional development. All questions in this questionnaire are discussed in this paper, ensuring that the entire instrument is covered in the analysis.

Prior to distribution, the questionnaire underwent expert validation to ensure the questions were relevant, clear, and accurate in measuring participants' perceptions of mathematical literacy. This process involved three experts: two in mathematics education and one in language education. Each expert assessed each item based on three criteria: relevance (whether the question reflected the mathematical literacy concept being studied), clarity of language (whether the question was easy to understand and free of ambiguity), and contextual appropriateness (whether the question was relevant to the experiences of teachers and prospective teachers in Indonesia). Each criterion was rated on a scale of 1–4 (1 = not appropriate, 2 = less appropriate, 3 = appropriate, 4 = very appropriate). The experts' average score was used to determine which items needed revision. The validation results showed that all main items in the questionnaire had an average score of ≥ 3 (3.47), which means they met the standards according to the three criteria. Some questions, however, needed minor revisions to clarify the language or add specific context, such as placing an emphasis on the continuous development of mathematical literacy for prospective teachers and active teachers. Table 1 shows a sample of items that were revised through this process.

Table 1
Evaluation Process of the Instrument (Sample Items)

Before	Feedback	After
As a pre-service or in-service teacher, when do you think is the right time to develop mathematical literacy?	Developed for what purpose? Is it for their personal growth or in their role as pre-service or in-service teachers?	As a pre-service or in-service teacher, when do you think is the right time to develop mathematical literacy for yourself as a teacher who will later have to integrate mathematical literacy in learning?
What efforts will you make in the future to improve mathematical literacy?	It is also necessary to ask about the efforts they have made so far.	An additional question was added before this one: What efforts have you made to improve mathematical literacy?

The questionnaire, compiled in Microsoft Forms, was distributed via professional networks, educational institutions, and social media over a 1-month period. Participation was voluntary, and responses were collected anonymously to protect participants' identities. No proportional allocation by region or province was applied. To increase the response rate, reminders were sent periodically to potential participants. The data collection process was conducted online via an easy-to-access survey platform to ensure broad, diverse participation.

Research Participants

The research participants included both pre-service and in-service teachers chosen through volunteer sampling based on their willingness to participate. Pre-service teachers were students majoring in education, both in mathematics and other fields. The in-service teachers had teaching experience at various levels of education, ranging from elementary to high school, and had taught various subjects, including, but not limited to, mathematics. The selection of participants using this approach aimed to obtain diverse and representative insights into perceptions of mathematical literacy in various learning contexts. Although this method allowed participation from diverse backgrounds, experiences, and geographic areas, it was more pragmatic and thus did not fully represent the population statistically. A total of 163 pre-service teachers and 82 in-service teachers participated in this study. The demographics for each of the respondents are listed in Table A1: Pre-service teachers and Table A2: In-service teachers (see the Appendix).

Data Analysis

The data collected were analysed using a combination of qualitative and descriptive quantitative analysis approaches. In the qualitative analysis stage, researchers used thematic coding to identify patterns and main themes in participants' perceptions of mathematical literacy. The coding process was conducted independently by three researchers to minimise subjective bias; each researcher generated initial codes from participants' responses without influencing each other. After that, the three researchers compared, reviewed, and discussed the codes they generated to reach a consensus on the final themes. Some key themes identified included: (1) understanding of mathematical literacy concepts, (2) factors supporting the development of mathematical literacy, (3) factors hindering the development of mathematical literacy, (4) cross-subject perspectives, and (5) time and strategies for developing mathematical literacy. These themes were then used to group and interpret the qualitative data, thereby providing a deeper understanding of the participants' perceptions.

To validate the findings, data triangulation was conducted by comparing responses from the two participant groups (prospective teachers and active teachers), as well as between open-ended responses and demographic data, to ensure consistency in the patterns that emerged. Descriptive quantitative analysis was performed on demographic data and response distribution using simple statistics such as frequency and percentage, assisted by MS Excel software. This quantitative analysis provides a complementary picture of differences in perceptions between prospective teachers and active teachers, as well as a more comprehensive understanding of both theme exploration and the distribution of perceptions related to mathematical literacy.

Result

Based on the questionnaire data analysis, the discussion will focus on the main points pertinent to the research questions. Each point will be elaborated in detail to identify important findings, emerging patterns, and implications for the study. Each response will be placed into STEM and non-STEM categories: pre-service teachers STEM (n = 58, 35.58%) and non-STEM (n = 105, 64.42%), and in-service teachers STEM (n = 43, 53.66%) and non-STEM (n = 38, 46.34%).

Understanding the Definition of Mathematical Literacy

To obtain an initial sense of how participants perceived the concept of mathematical literacy, they were asked to respond to open-ended questions about their definition mathematical literacy. Participants' responses were analysed using a qualitative approach with thematic coding techniques to identify the main themes that emerged from the written responses. The coding process was conducted independently by three researchers, and the results were then compared and discussed to reach consensus on the themes. The coding results revealed themes that captured the meaning of mathematical literacy, ranging from its application in everyday life to critical thinking and problem-solving. The frequency distribution for each theme, by participant group (preservice teachers and in-service teachers), is presented in the following table (Table 4).

Table 4
Distribution of Mathematical Literacy Definitions Based on Participant Groups

Theme	Description	Pre-service (n = 163)		In-service (n = 82)	
		STEM	Non-STEM	STEM	Non-STEM
Mathematics for everyday life	Describes the understanding that mathematical literacy is related to the ability to use or apply mathematical concepts and skills in various real-life contexts.	33 (20.25%)	26 (15.95%)	21 (25.61%)	18 (21.95%)
Counting and numbers	Shows the perception that mathematical literacy is synonymous with counting, using numbers, and basic arithmetic operations in solving mathematical problems.	10 (6.13%)	39 (23.93%)	8 (9.76%)	12 (14.63%)
Reading and understanding word problems	Reflects the view that mathematical literacy is the ability to understand texts or word-based problems that contain mathematical elements before solving them.	8 (4.91%)	21 (12.88%)	6 (7.32%)	11 (13.41%)
Critical and logical thinking	Refers to the understanding that mathematical literacy includes the ability to think logically, analyse information, and think critically.	10 (6.13%)	11 (6.75%)	9 10.98%)	5 (6.10%)
Problem-solving and mathematical reasoning	Describes the understanding that mathematical literacy is related to the ability to solve problems and draw conclusions rationally and structurally.	10 (6.13%)	8 (4.91%)	4 (4.88%)	3 (3.66%)
Basic mathematical skills	Indicates the perception that mathematical literacy is related to mastery of basic mathematical skills.	9 (5.52%)	17 (10.43)	2 (2.44%)	6 (7.32%)
Understanding mathematical concepts	Describes the view that mathematical literacy is related to the ability to understand concepts in mathematics, not just the application of calculation procedures.	5 (3.07%)	7 (4.29%)	7 (8.54%)	3 (3.66%)

Conversely, many prospective teachers, especially those from non-STEM fields (23.93%), interpreted mathematical literacy narrowly as arithmetic and the use of numbers. This suggests that some of the prospective teachers still viewed mathematical literacy as a procedural skill and had not yet recognised it as a complex thinking process. Another recurring theme was critical and logical thinking, as well as problem-solving and mathematical reasoning, which indicated an awareness of the cognitive and reflective aspects of mathematical literacy, although the percentages were relatively low.

Additionally, themes of reading and understanding word problems, as well as basic mathematics skills, emerged, highlighting an emphasis on fundamental and technical abilities in solving mathematical problems. A small number of respondents in both groups did not define mathematical literacy or provided unclear answers. Overall, these results suggest that prospective teachers' understanding of mathematical literacy tends to be mechanical and somewhat conceptual, whereas teachers generally have a more contextual and applied perspective.

Perception of the Importance of Mathematical Literacy for Pre-service and In-service Teachers

This section presents the results of a comparison of perceptions between pre-service and in-service teachers regarding the importance of mathematical literacy. The question asked was: "Is mathematical

literacy important to you as a pre-service or in-service teacher?" Table 5 shows the percentage of responses from both groups, indicating how relevant mathematical literacy is and its importance in shaping their roles. To be more specific, it provides an overview of each group's awareness of mathematical literacy.

Table 5
Comparison of The Understanding of Pre-service and In-service Teachers Related to the Importance of Mathematical Literacy

Response related to the importance of mathematical literacy	Pre-service (*n* = 163)		In-service (*n* = 82)	
	STEM	Non-STEM	STEM	Non-STEM
Yes, it is important	162 (99.39%)	0 (0.00%)	80 (97.56%)	0 (0.00%)
No, it is not important	0 (0.00%)	1 (0.61%)	0 (0.00%)	2 (2.44%)

Most participants, both prospective teachers and practicing teachers, stated that mathematical literacy is an important skill that individuals need to master, especially in the context of mathematics education. As shown in Table 5, over 97% of participants in both groups responded that developing mathematical literacy is vital, with only 1 or 2 participants stating otherwise. This finding indicated a general awareness of the value and urgency of mathematical literacy, although the level of understanding and the reasons behind this view varied.

To explore the reasons behind these views in greater depth, a thematic analysis of participants' open-ended responses was conducted. Table 6 shows that the main reasons reasons given were the relevance of mathematical literacy in the real world, its role in developing critical and logical thinking skills, and its significance for the teaching profession and for mathematics learning in schools.

Table 6
Distribution of Combined Themes of Perceptions about the Importance of Mathematical Literacy

Theme	Description	Pre-service (*n* = 162)		In-service (*n* = 80)	
		STEM	Non-STEM	STEM	Non-STEM
Contextual problem solving	Mathematical literacy is considered important because it helps individuals understand and solve real-world problems through the application of mathematical concepts.	12 (7.36%)	10 (6.13%)	8 (9.76%)	6 (7.32%)
Development of logical and critical thinking	Mathematical literacy is seen as a means of fostering rational, analytical, and reflective thinking.	9 (5.52%)	14 (8.59%)	11 (13.41%)	6 (7.32%)
Relevance in everyday life	Mathematical literacy is considered important for dealing intelligently with life, economic, and social situations.	17 (10.43%)	18 (11.04%)	16 (19.51%)	12 (14.63%)
Significance for the teaching profession and the world of education	Mathematical literacy is considered a basic competency for teachers to be able to teach, assess, and develop meaningful learning for students.	30 (18.40%)	55 (33.74%)	15 (18.29%)	10 (12.20%)
Context of assessment and education policy	Mathematical literacy is the focus of international assessments such as PISA and education policy.	0 (0.00%)	0 (0.00%)	2 (2.44%)	1 (1.22%)

In general, both prospective teachers and teachers showed relatively similar perceptions regarding the importance of mathematical literacy. The most prominent theme in both groups was its importance for the teaching profession and education in general, reflecting the idea that mathematical literacy is an essential competency for educators to design meaningful learning, thoroughly assess students' abilities, and promote mathematical thinking skills. Interestingly, a higher proportion of pre-service teachers

emphasised this aspect compared to in-service teachers, indicating academic idealism and early awareness of their future professional roles.

Additionally, themes relevant to everyday life and decision-making appeared frequently, especially among STEM teacher candidates, who highlighted the link between mathematics and practical situations. Meanwhile, in-service teachers highlighted the role of mathematical literacy in developing logical and critical thinking and contextual problem-solving, indicating a reflective orientation based on real-world experience in the field. A small number of participants associated mathematical literacy with the context of global education policy, such as PISA, which indicates an awareness of the direction of modern educational assessment policies. Overall, these findings reinforced the position of mathematical literacy not only as a cognitive skill but also as a professional and social foundation for today's educators.

Complementing these findings, it is also interesting to examine the responses of the minority of respondents who stated that mathematical literacy is not important. Although the numbers were very small (0.61% of pre-service teachers and 2.44% of in-service teachers), these differing views offered a contrasting perspective that deepens understanding of how well prospective teachers and in-service teachers grasp the concept of mathematical literacy. Among prospective teachers, the reason "not important" reflected a procedural perspective on mathematics. Respondents viewed mathematical literacy primarily as a foundation for calculation or as a routine computational skill that did not require special emphasis. This pattern shows a reductionist tendency, in which mathematics is understood in isolation from the contexts of reasoning, interpretation, and real-life application. In other words, mathematical literacy is limited to mechanical calculation skills, rather than reflective abilities to use and interpret mathematics meaningfully. Meanwhile, in-service teachers who gave the same "not important" response tended to frame their reasoning in terms of curricular alignment, focusing on whether mathematical literacy falls within the scope of the subjects and learning objectives for which they were responsible. The in-service teachers in this group saw mathematical literacy as irrelevant because it was either not part of the subjects they taught or not explicitly mentioned in curriculum outcomes. This perspective shows a separation between mathematical literacy and the broader curriculum context—as if literacy is the sole responsibility of mathematics, rather than a cross-disciplinary competency that can enrich students' logical and analytical thinking across fields.

When viewed as a whole, the two groups showed different but complementary conceptual gaps. The prospective teachers often interpreted mathematical literacy predominantly within a procedural framework, whereas in-service teachers tended to perceive it as excessively disconnected from the practical relevance of their subject area. This pattern emphasised the need to strengthen conceptual understanding of mathematical literacy in both teacher education and teacher professional development. Mathematical literacy should be seen not just as the skill to calculate, but as a reflective and contextual ability that involves interpreting, analysing, and applying mathematics in meaningful ways across different real-life scenarios.

Perception of the Best Time for Self-development of Mathematical Literacy

Time spent on developing mathematical literacy is an important aspect in preparing competent teachers. The following table (Table 7) presents a comparison of perceptions between pre-service and in-service teachers regarding the most ideal moments to improve mathematical literacy, both during the lecture period and after they become professional educators.

Table 7
Perception of Pre-service and In-service Teachers Regarding the Best Time for the Self-development of Mathematical Literacy

Best Time in Developing Mathematical Literacy	Pre-service (*n* =163)		In-service (*n* = 82)	
	STEM (*n* = 58)	Non-STEM (*n* = 105)	STEM (*n* = 44)	Non-STEM (*n* = 38)
During study (lectures)	58 (100%)	104 (99.05%)	38 (86.36%)	29 (65.91%)
When you are already a teacher	0 (0.00%)	1 (0.95%)	6 (13.64%)	9 (20.45%)

Table 7 shows that both prospective teachers and teachers generally viewed their college years as the most appropriate time to develop mathematical literacy. Almost all prospective teachers from both STEM (100%) and non-STEM (99.05%) programs stated that mathematical literacy should be developed during college. A similar pattern was also observed among in-service teachers, though with slightly lower proportions—86.36% for STEM teachers and 65.91% for non-STEM teachers. In contrast, only a small proportion of teachers, especially from the non-STEM group (20.45%), believed that mathematical literacy should be developed after they entered the workforce as teachers. Furthermore, prospective teachers' responses regarding the best time to develop mathematical literacy indicated that 84.66% responded during the first year of college, 9.82% during the second year, 1.23% during the third year, and 3.68% during the fourth year. This suggests that these participants considered mathematical literacy important from the outset of higher education, possibly because of its direct link to foundational mathematics learning.

These findings revealed differences in perceptions between prospective teachers and in-service teachers. Prospective teachers viewed the development of mathematical literacy as an integral part of professionalism that should begin early in their education. In contrast, experienced teachers understand that mathematical literacy does not end with the lecture but continues to grow through hands-on classroom experience. Nevertheless, the dominant view that places college as the ideal phase for developing mathematical literacy highlighted the importance of teacher education institutions in providing a conceptual and contextual foundation for mathematical literacy from the outset. Teacher education is a crucial stage for developing a mathematically literate mindset, which will later shape how pre-service teachers integrate literacy into their teaching practices. Systematic efforts to strengthen mathematical literacy during teacher education will improve their professional preparedness and ensure their suitability for 21st-century learning demands that emphasise reflective, contextual, and mathematical reasoning skills.

Responses Regarding Efforts to Improve Mathematical Literacy

The following table (Table 8) shows responses from pre-service and in-service teachers regarding various efforts to support the development of mathematical literacy in educational practice. Table 8 shows that the most dominant effort made by both prospective teachers and teachers in improving mathematical literacy was independent learning and practice. Most prospective teachers, especially those from non-STEM programs (36.20%), reported regularly engaging in activities such as practicing questions, reading articles, watching educational videos, or managing their study time as ways to strengthen their literacy. A similar pattern was also observed among teachers, with 35.37% of the STEM group and 21.95% of the non-STEM group emphasising the importance of independent learning. These findings showed that both prospective teachers and teachers viewed the development of mathematical literacy as a personal responsibility rooted in individual initiative, rather than as part of a structured professional development system.

Table 8
Distribution of Efforts Made to Improve Mathematical Literacy

Theme	Description	Pre-service (n = 162)		In-service (n = 80)	
		STEM	Non-STEM	STEM	Non-STEM
Independent learning and practice	Practice mathematical literacy through independent learning, practicing problems (including creating problems for teachers), watching videos, reading articles, and managing study time consistently.	40 (24.54%)	59 (36.20%)	29 (35.37%)	18 (21.95%)
Applying mathematics in daily life and learning activities.	Relating mathematical concepts to real-life contexts and, for teachers, applying them in learning activities or contextual teaching design.	15 (9.20%)	5 (3.07%)	11 (13.41%)	14 (17.07)
Participating in mathematical literacy training activities	Attending classes, tutorials, training sessions, or seminars focused on strengthening mathematical literacy.	9 (5.52%)	19 (11.66%)	0 (0.00%)	4 (4.88%)
Collaborating or asking colleagues	Learning, discussing, or sharing experiences with colleagues or teacher communities to deepen understanding and practice of mathematical literacy.	2 (1.23%)	4 (2.45%)	2 (2.44%)	1 (1.22%)

Another effort noted was applying mathematics to everyday life and learning activities. Teachers were more prominent in this category, especially among the non-STEM group (17%), which showed that practical teaching experience offers opportunities for these teachers to integrate mathematical literacy in authentic learning contexts. This contrasts with the prospective teachers, who were limited to the conceptual reflection stage and had not yet reached application in real educational settings. Participation in mathematical literacy training also emerged, though at a relatively low level. Only pre-service teachers reported participation in activities such as seminars or training, especially from the non-STEM group (12%), whereas none of the STEM teachers reported the same. This indicated potentially limited access or opportunities for the teachers to receive formal training in mathematical literacy, which is ironic because such training is necessary to enhance their pedagogical skills.

In addition, a significant proportion of the non-STEM teacher candidate group (14%) reported not having made any specific efforts. This indicated a potential gap in understanding of the meaning and concrete forms of mathematical literacy development outside of routine academic activities. Overall, this pattern illustrated that although awareness of the importance of mathematical literacy is quite high, its development strategies remained primarily based on individual approaches and had not been supported by systematic institutional or collaborative mechanisms.

Response Concerning Future Efforts to Enhance Mathematical Literacy

It is essential to understand how pre-service and in-service teachers plan their next steps to improve their mathematical literacy, as this provides a clear view of each group's readiness and commitment to further developing their skills. Analysis of prospective teachers' and teachers' responses regarding efforts to improve mathematical literacy shows that both groups placed independent learning or practice as their main strategy. Most of the prospective teachers, especially those from non-STEM groups (52%) and STEM groups (34%), strived to strengthen their mathematical literacy through independent learning, practice questions, and the use of digital media (Table 9). This pattern indicated that the development of mathematical literacy was primarily driven by individual efforts and had not been fully incorporated into a continuous professional development system.

Table 9
Distribution of Combined Themes of Response to Efforts to Improve Mathematical Literacy in the Future

Theme	Description	Pre-service (*n* = 162)		In-service (*n* = 80)	
		STEM	Non-STEM	STEM	Non-STEM
Independent Learning and Practice	Develop mathematical literacy skills through independent learning, regular practice, reading literature, and utilising digital media as additional learning resources.	52 (31.90%)	85 (52.15%)	28 (34.15%)	19 (23.17%)
Attending Training, Seminars, or Academic Activities and Collaborating	Participating in seminars, webinars, workshops, or other academic activities related to mathematical literacy and mathematics learning, as well as collaborating with peers, tutors, or lecturers to share ideas and discuss.	7 (4.29%)	5 (3.07)	5 (6.10%)	6 (7.32%)
Relating Literacy to Real Life (Contextual Approach)	Applying mathematical literacy concepts in everyday situations and in learning activities based on real contexts.	7 (4.29%)	4 (2.45%)	12 (14.36%)	8 (9.76%)
Fostering a Positive Attitude and Interest in Mathematics	Building a positive attitude, curiosity, and interest in mathematics as a basis for developing mathematical literacy.	2 (1.23%)	4 (2.45%)	1 (1.22%)	2 (2.44%)

Additionally, both prospective teachers and in-service teachers expressed interest in academic collaboration and participation in training or seminars to broaden their knowledge of literacy-oriented mathematics learning. Teachers seemed to emphasise the application of mathematical literacy in real learning contexts, while pre-service teachers stressed the application of a contextual approach to relate mathematical concepts to everyday life. This difference reflects each professional's stage of development: prospective teachers focus more on building their skills and preparing for teaching, while teachers place more emphasis on application and innovation in learning practices.

These findings align with previous research that emphasises the importance of continuous professional development in mathematical literacy (Laitochová et al., 2021). The prospective teachers focused on learning theory and on developing future teaching strategies, such as using technology or learning videos to deepen their understanding of concepts. In contrast, the experienced teachers integrated mathematical literacy more into their daily teaching practices, for example, through problem-based learning, contextual mathematics games, or small research projects to enrich teaching materials. Thus, although both groups shared a similar commitment to improving mathematical literacy, the difference lies in the level of practical application and the orientation of their experience.

Discussion

The results of this study show that both prospective teachers and teachers have diverse understandings of mathematical literacy. Most interpret it within a framework focused on procedural skills and numeracy, while others begin to relate it to the application of mathematics in everyday life. These findings are consistent with previous studies (Burkhardt, 2007; Genc & Erbas, 2019), which showed that understanding of mathematical literacy is often limited to the functional level and does not yet fully cover the reflective and socio-cultural dimensions as emphasised in the PISA framework (OECD, 2023a).

Although the differences between teachers and prospective teachers are not significant, there is a tendency for teachers with more experience to demonstrate a deeper contextual understanding than prospective teachers. Prospective teachers tend to view mathematical literacy as a theoretical and fundamental preparation for future teaching. This aligns with previous research, which found that prospective teachers view mathematical literacy primarily from a theoretical perspective, emphasising

critical thinking and logical reasoning (Zeljić & Dabić Boričić, 2020). In contrast, experienced teachers view mathematical literacy more comprehensively, highlighting its use in everyday life settings and interdisciplinary contexts (Mbekwa, 2006). In-service teachers also see mathematical literacy as a skill related to global and national assessment, recognising that mathematics is an important foundation for various forms of assessment and educational standards (Umbara & Suryadi, 2019; Uygur Kabael & Ata Baran, 2023). These differences demonstrate how practical experience shapes teachers' perspectives on mathematical literacy and how theories learned during formal education relate to their application in the field.

These differences in perception appear to be relatively consistent across academic backgrounds, both STEM and non-STEM. This indicates that learning and teaching experiences have a stronger influence on shaping the understanding of mathematical literacy than the field of study. Therefore, practical experience in the real world is a key factor that distinguishes teachers' views on mathematical literacy from those of prospective teachers still in the theoretical conceptualisation stage. Despite these differences in context and background, both groups share a fundamental similarity in their view of the importance of mathematical literacy as the key to developing critical thinking and problem-solving skills (Afifah et al., 2018; Laitochová et al., 2021). These findings reflect a growing awareness of the central role of mathematical literacy in education (Pillai et al., 2017), which extends beyond mathematics to various disciplines.

Based on these findings, there is a great opportunity to develop teacher education and training programs that integrate theoretical and practical approaches to improve mathematical literacy competencies (Dofková & Chudý, 2019; Laitochová et al., 2021). In the context of teacher education, universities can offer additional courses or interdisciplinary modules focusing on mathematical literacy and encourage collaboration among course lecturers in designing context-based assignments. If implementing structural changes is challenging, an alternative could be offering tutorial programs or mathematical literacy clinics outside of lectures. These forms of training have the potential to bridge the gap between prospective teachers' theoretical knowledge and teachers' practical application in the field. For in-service teachers, the results of this study can inform the design of continuing professional development programs that emphasise the application of mathematical literacy in real learning practices. Examples include cross-subject lesson studies, authentic case-based workshops, and professional learning communities (PLCs) that encourage teachers to explore collaboratively ways to integrate mathematical literacy into teaching. This approach not only enhances pedagogical skills but also promotes teachers' reflective awareness of how mathematics plays a role in understanding and decision-making in real life.

In terms of training time, the early stages of lectures—especially in the first year—are a strategic period for developing mathematical literacy foundations. Previous studies have shown that new students often lack basic mathematical skills, especially in terms of spatial abilities (Er, 2017; Padernal & Tupas, 2024). Evaluating mathematical literacy in the early stages of lectures can help identify areas that need to be strengthened (Breen et al., 2009). At this stage of their education, it is vital to equip prospective teachers with a strong theoretical understanding that can later be translated into teaching practice.

In addition to the early stages of pre-service teacher education, ongoing training after teachers enter the workforce is also important. Direct experience in the field can enrich teachers' understanding and competence in teaching mathematical literacy (Ningtiyas & Jailani, 2018). Therefore, the teacher training curriculum would benefit from being reviewed so that active teachers can develop new skills and obtain higher qualifications (Bansilal et al., 2015). Targeted and continuous training programs have been proven effective in improving teachers' pedagogical skills and their understanding of mathematical literacy (Riyadi et al., 2022), as well as preparing students to face the demands of multidisciplinary skills in the era of the Industrial Revolution 4.0 (Ahmad et al., 2019).

Overall, this study confirms that differences between prospective and active teachers reflect not only variations in career stages but also the trajectory of teachers' professional growth. Prospective teachers develop a conceptual foundation and reflective disposition toward mathematical literacy, while in-service teachers enrich this understanding through practice and learning innovation. Thus, effective

teacher education must be viewed as a continuum of teacher learning—beginning with pre-service education that develops theoretical understanding and progressing to in-service training that enhances the ability to apply mathematical literacy in context and adaptively.

Conclusion

This study explored pre-service and in-service teachers' perceptions of mathematical literacy within the Indonesian context, with particular attention to how these perceptions are shaped by professional stage and experience. The study showed a significant difference in perceptions of mathematical literacy between prospective and in-service teachers. Prospective teachers tend to understand mathematical literacy in a theoretical and conceptual way, while active teachers have a more comprehensive and applicable understanding view. These differences suggest that professional experience plays a significant role in shaping teachers' interpretations of mathematical literacy, moving from conceptual abstraction toward contextual integration.

Despite these differences, both groups share the view that mathematical literacy is an essential skill in the development of critical thinking and problem-solving skills. This shared perspective provides a strategic starting point for designing teacher training programs that balance theoretical and practical aspects. This pattern highlights a critical need for institutional support mechanisms within both teacher education programs and continuing professional development frameworks. Teacher education institutions are advised to offer opportunities for prospective teachers to engage in context-based activities, such as problem-based learning, lesson simulation, or interdisciplinary collaboration. For in-service teachers, continuing education needs to be strengthened with a focus on the application of mathematical literacy in interdisciplinary and contextual learning. By bridging the gap between theory and practice, teacher education institutions and policymakers can foster a more coherent and transformative approach to mathematical literacy—one that moves beyond procedural competence toward reflective, contextual, and socially responsive mathematical thinking.

To expand the contribution of this research, further studies with a qualitative approach and a broader sample are needed. In-depth research can help identify how local cultures, educational policies, and practices influence the understanding of mathematical literacy. Such studies can provide concrete guidance for the development of education policies and learning practices that are relevant globally.

Although the study offers valuable insights, its limitations should be acknowledged for future research. Data collection methods relying only on questionnaires are limited to participants' explicit understanding and may not fully capture the complexity of their perception of mathematical literacy. Questionnaires, while useful for collecting broad data, cannot explore the nuances or deeper shifts in perception that may emerge in open discussions or in-depth interviews (Mason et al., 2023). Additionally, the small participant pool and focus on pre-service and in-service teachers limit the extent to which the findings can be generalised to other educational stakeholders. Therefore, future research should include a larger sample that encompasses diverse educational levels, institutional backgrounds, and geographic regions. This will enable a more comprehensive and representative view. Qualitative methods, such as in-depth interviews and observations, are highly recommended to gain a deeper understanding of how mathematical literacy is practiced in real educational settings.

Furthermore, these findings highlight that enhancing mathematical literacy in Indonesia is not just about improving assessment scores like PISA, but about developing meaningful mathematical thinking skills for life. Mathematical literacy should be understood as the reflective ability to interpret real-world phenomena, make rational decisions, and actively participate in an information-based society. By establishing mathematical literacy as the foundation of interdisciplinary learning, the education system can contribute to the development of teachers and students who are not only academically competent but also capable of critical, adaptive, and responsible thinking in addressing the challenges of 21st-century life (Szabo et al., 2020; Tytler et al., 2021).

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Ethical approval

This study followed the research ethics procedures of Universitas Pendidikan Indonesia. Formal ethical approval was not required for this type of minimal-risk survey research involving adult participants and non-sensitive topics. Participation in the study was voluntary. Participants provided informed consent before participating, and the confidentiality and anonymity of their data is guaranteed. The results of the research are only used for academic purposes.

Competing interests

The authors declare there are no competing interests.

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Appendix

Table A1

Pre-service Teacher Respondent Demographics

		N	%
Educational Level	Freshmen (1st year)	57	34.97
	Sophomores (2nd year)	36	22.09
	Juniors (3rd year)	50	30.67
	Seniors (4th year)	10	6.13
	More than 4 years	10	6.13
Study Program	Christian Education	17	10.43
	Indonesian Language Education	41	25.15
	Biology Education	1	0.61
	Economic Education	10	6.13
	Primary Teacher Education	4	2.45
	Social Science Education	33	20.25
	Mathematics Education	57	34.97
Province	Bali	1	0.61
	Bangka Belitung	1	0.61
	Banten	6	3.68
	Bengkulu	2	1.23
	Special Capital Region of Jakarta	4	2.45
	West Java	7	4.29
	Central Java	6	3.68
	East Java	7	4.29
	West Kalimantan	5	3.07
	Central Kalimantan	2	1.23
	East Kalimantan	1	0.61
	North Kalimantan	1	0.61
	Lampung	9	5.52
	Maluku	3	1.84
	West Nusa Tenggara	1	0.61
	East Nusa Tenggara	14	8.59
	Papua	5	3.07
	Riau	6	3.68
	West Sulawesi	1	0.61
	South Sulawesi	6	3.68
	Central Sulawesi	3	1.84
	North Sulawesi	13	7.98
	South Sumatera	3	1.84
	North Sumatera	56	34.36

Table A2
In-service Teacher Respondent Demographics

		N	%
Teaching Level	Kindergarten	2	2.44
	Elementary School	13	15.85
	Junior High School	28	34.15
	High School	39	47.56
Teaching Duration	< 5 years	28	34.15
	5–10 years	10	12.20
	11–20 years	22	26.83
	> 20 years	22	26.83
Subjects Taught	All subjects (Kindergarten)	2	2.44
	All subjects (Elementary School)	4	4.88
	Religious Education (Islam, Hinduism, Christianity)	5	6.10
	Language (Indonesian, English)	7	8.54
	Counselling and Guidance	4	4.88
	Biology	3	3.66
	Fashion Product Design	1	1.22
	Economics or Accounting	2	2.44
	Estimated Construction Costs	2	2.44
	Physics	2	2.44
	Informatics and visual communication design	2	2.44
	Science	2	2.44
	Integrated Science and Social Studies	2	2.44
	Social Studies	2	2.44
	Woodcraft Vocational Skills	1	1.22
	Chemistry	1	1.22
	Computer Science	1	1.22
	Mathematics	17	20.73
	Mathematics & Integrated Science and Social Studies	1	1.22
	Mathematics & Physics	3	3.66
	Basic Programming	1	1.22
	Physical Education	6	7.32
	Civics Education	1	1.22
	Creative Products and Entrepreneurship	6	7.32
	Sociology	1	1.22
	Art and Culture	3	3.66
Province of School	Bangka Belitung	1	1.22
	Banten	6	7.32
	Jambi	2	2.44
	Special Capital Region of Jakarta	4	4.88
	West Java	9	10.98
	Central Java	2	2.44
	East Java	3	3.66
	West Kalimantan	2	2.44
	Lampung	13	15.85
	Maluku	3	3.66
	North Maluku	2	2.44
	East Nusa Tenggara	7	8.54
	Papua	3	3.66
	South Papua	1	1.22
	Riau	3	3.66
	South Sulawesi	3	3.66
	Central Sulawesi	2	2.44
	Southeast Sulawesi	2	2.44
	North Sulawesi	5	6.10
	West Sumatera	2	2.44
	South Sumatera	2	2.44
	North Sumatera	5	6.10