# The Role of Teacher Preparation, Instructional Materials, and Assessment Practices on Student Performance in Mathematical Literacy Based on the PISA Framework: A Systematic Literature Review

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## ABSTRACT

This systematic literature review examines the impact of teacher preparation, instructional materials, and assessment practices on the mathematical literacy of Filipino secondary students, framed by the PISA framework. Using the PRISMA methodology, a comprehensive search of the ERIC database with relevant keywords yielded 51 studies, which were screened and assessed for eligibility without duplicates. After full-text appraisal, 14 studies were included. The findings demonstrate that integrated approaches combining enhanced teacher preparation, high-quality instructional materials, and robust assessment practices lead to significant improvements in student mathematical literacy. The review highlights the importance of teacher competence, contextualized instructional materials, and multifaceted assessments aligned with PISA competencies. These results provide evidence-based recommendations for policymakers and educators to improve mathematical literacy outcomes through holistic interventions. This review underscores the value of the PISA framework as an analytic lens and advocates for evidence-based policy and practice interventions that holistically address teacher competency, teaching resources, and assessment quality to improve mathematical literacy among secondary students in contexts similar to the Philippines. Recommendations include professional development, context-driven instructional design, and diversified assessment aligned with PISA competencies to promote meaningful learning and performance gain.

**Keywords**: PISA Framework, Mathematical Literacy, Teacher Preparation, Assessment Practices, Instructional Materials

## INTRODUCTION

Research consistently highlights the critical role of teacher preparation in shaping student outcomes in mathematics. Filipino teachers equipped with ongoing professional development and pedagogical content knowledge tend to adopt more effective instructional strategies that boost mathematical literacy (Del Rosario & Santos, 2024; Leano, 2023). This preparation enhances teachers' mastery of mathematical concepts and their capacity to create learner-centered activities that foster critical thinking and problem-solving skills. The alignment of instructional materials with both the K–12 curriculum and PISA frameworks supports student engagement and conceptual understanding. Studies emphasize the need for technologically enriched, contextually relevant resources to improve learning experiences (Paloma, 2023; Leano, 2023).

Assessment practices, notably formative and performance-based evaluations, facilitate timely feedback that informs instruction and supports problem-solving skills development (Largo & Adanza, 2024; Del Rosario & Santos, 2024). These strategies enable teachers to tailor approaches to student needs and monitor progress effectively, thus enhancing academic performance. However, persistent challenges such as limited access to instructional resources, inadequate teacher training on modern assessments, heavy workloads, and gaps in assessment literacy remain (Bernardo, 2022). These issues highlight the necessity of comprehensive reviews focused on evidence-based strategies to improve mathematical literacy in the Philippine context.

Additionally, systemic factors such as socioeconomic disparities and variable school infrastructure quality complicate efforts to improve literacy, underscoring the importance of holistic interventions integrating instructional and contextual supports. Such efforts require policy initiatives, community engagement, and investments in teacher capacity development to provide equitable learning opportunities for all Filipino students (Bernardo, 2022; Lapinid, 2022). This review synthesizes current evidence to inform and guide educational reforms aimed at strengthening mathematics education in the Philippines.

### Purpose of the Study

The purpose of this study is to systematically review and synthesize empirical research conducted between 2015 and 2025 on the influence of teacher preparation, instructional materials, and assessment practices on the mathematical literacy performance of Filipino secondary school students. Guided by the PISA framework, this review aims to evaluate how enhancements in these three educational components contribute to improving students' mathematical competencies in the Philippine context. By employing the PRISMA framework, the study ensures a transparent and replicable process of literature identification, screening, and analysis, ultimately identifying effective strategies and gaps in current practice. The findings intend to provide educational stakeholders with evidence-based insights to refine teacher preparation programs, develop relevant instructional materials, and implement robust assessment practices that can elevate mathematical literacy performance among Filipino learners, thereby fostering their readiness for global competitiveness and lifelong learning. This literature review aims to answer the question:

Among Filipino secondary school students, how do enhanced teacher preparation, high-quality instructional materials, and robust assessment practices compared to standard practices affect student performance in mathematical literacy according to the PISA framework, in studies published between 2015 and 2025?

## METHODOLOGY

This study adopts a systematic literature review design, employing a rigorous and transparent approach to synthesize empirical studies on the effects of teacher preparation, instructional materials, and assessment practices on the mathematical literacy of Filipino secondary students, guided by the PISA framework.

### Inclusion and Exclusion Criteria

Studies included in this review were published between 2015 and 2025, focused on secondary school students, and explored the impacts of teacher preparation, instructional materials, or assessment practices on mathematical literacy framed by PISA standards.

| Indicator | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| Date | Studies published between 2015 and 2025 | Studies published before 2015 or after 2025 |
| Exposure of interest | Enhanced teacher preparation, use of high-quality instructional materials, or robust assessment practices related to mathematics education | Studies unrelated to mathematics education, mathematical literacy, or the defined teacher preparation, instructional materials, and assessment practices variables. |
| Language | Studies published in English | Studies published in languages other than English |

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|---|---|---|
| Participants and Geographic Location of the Study | Secondary school students, primarily Filipino but also including studies from other countries with comparable educational contexts. | Studies focused exclusively on primary (elementary) or tertiary education levels. |
| Peer review | Peer-reviewed journal articles, conference papers, theses/dissertations | Unpublished reports, opinion pieces, non-peer-reviewed materials |
| Reported outcomes | Student performance in mathematical literacy aligned with the PISA framework. | Studies not reporting mathematical literacy or unrelated outcomes |
| Setting | Formal educational settings (secondary schools) | Informal education settings or adult education |
| Study design | Empirical studies, including qualitative, quantitative, and mixed-methods research. | Editorials, opinion pieces, book reviews, or articles without empirical data.<br><br>without primary data |
| Type of publication | Peer-reviewed journal articles, conference proceedings, theses, dissertations, and credible academic reports. | Non-academic publications such as magazine articles, newsletters |

Table 1. Inclusion and Exclusion Criteria

**Search Strategy**

This systematic literature review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure a transparent and replicable study selection process.

| | | |
|---|---|---|
| **IDENTIFICATION** | | |
| Total articles published in ERIC Database<br><br>n=51 | | |
| | | |
| **SCREENING** | | Excluded duplication |
| Total articles after removing duplicates<br><br>n=51 | | n=0 |
| | | |

| | | |
|---|---|---|
| **ELIGIBILITY** | | Excluded articles based on exclusion criteria<br><br>n= 37 |
| Total articles after reviewing full-text<br><br>n=14 | | |
| | | |
| **INCLUSION** | | |
| Total articles included in the systematic literature review<br><br>n=14 | | |

Figure 1. Data Selection Process Using PRISMA

The PRISMA methodology involves four key phases: Identification, Screening, Eligibility, and Inclusion. A comprehensive search of the ERIC database was performed using the Boolean OR operator with the keywords: "PISA Framework" OR "Mathematical Literacy" OR "Teacher Preparation" OR "Assessment Practices" OR "Instructional Materials." Filters were applied to limit results to journal articles published since 2016, focused on secondary education, and related to the Program for International Student Assessment (PISA). The initial search yielded 51 studies. All records were assessed to remove duplicates; however, no duplicates were identified. Titles and abstracts of the 51 studies were screened against the inclusion and exclusion criteria, focusing on relevance to Filipino secondary students or comparable contexts, teacher preparation, instructional materials, assessment practices, and student performance in mathematical literacy aligned with the PISA framework. Full-text versions of all 51 screened studies were retrieved and thoroughly evaluated for eligibility based on the pre-established inclusion criteria. This process involved critical appraisal to verify methodological rigor, relevance to research questions, and data quality. Following full-text review, 14 studies met all eligibility criteria and were included in the final synthesis for this systematic review.

This PRISMA-based selection process enhances the transparency and replicability of the review by visually and methodologically documenting the filtering stages, from 51 identified studies to 14 included studies, ensuring comprehensive coverage of relevant literature within the defined scope. Data extraction captured information on study design, sample characteristics, interventions or factors assessed, and reported outcomes pertaining to students' mathematical literacy. Thematic synthesis was then conducted to aggregate findings on how enhanced teacher preparation, quality instructional materials, and robust assessment practices impact student outcomes

## RESULTS AND DISCUSSION

### General Study Characteristics

Figure 3 presents the summarized characteristics of the 13 studies included in the systematic literature review. The studies span from 2018 to 2025 and collectively represent a wide range of educational contexts across Turkey, Indonesia, Korea, Kazakhstan, Thailand, the Philippines, and several OECD countries (Estonia, Finland, Hong Kong, Croatia, and Turkey).

Table 2. Summarized characteristics of the Studies Included in the Study

| Author | Year | Methodology | Grade Levels | Countries | Participants | Factor for Mathematical Literacy |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Ozkan & Ozaslan | 2018 | Quantitative | Secondary/High School | Turkey | Students | Teacher preparation and Assessment Practices |
| Yansen, Putri, Zulkardi, & Fatimah | 2019 | Quantitative | Secondary/High School | Indonesia | Students | Instructional Materials and Assessment Practices |
| Umbara & Suryadi | 2019 | quantitative, qualitative | Middle School | Indonesia | Teachers | Instructional Materials and Teacher Preparation |
| Jailani, Retnawati, Wulandari, & Djidu | 2020 | cross-sectional | Grade 9, Secondary/High School | Indonesia | Students | Instructional Materials and Assessment Practices |
| Guler | 2021 | quantitative, qualitative | Secondary/High School, Middle School | Turkey | Students and Teachers | Teacher Preparation and Assessment Practices |
| Hwang & Ham | 2021 | Quantitative | Secondary/High School | Korea | Students | Teacher preparation |
| Ulger, Bozkurt, & Altun | 2022 | qualitative | Middle School | Turkey | Teachers | Teacher preparation and Assessment Practices |
| Dewi & Maulida | 2023 | quantitative, research and development | Secondary/High School, Middle School | Indonesia | Students, Teachers | Teacher Preparation and Instructional Materials |
| Saka | 2023 | qualitative | Secondary/High School, Middle School | Turkey | Teachers | Assessment Practices |
| Nurgabyl, Satkulov, & Kagazbayeva | 2023 | qualitative | Secondary/High School, Middle School | Kazakhstan | Teachers | Assessment Practices |
| Kiartanom, Retnawati, & Hidayati | 2024 | quantitative | Secondary/High School | Indonesia | Students | Assessment Practices |

| | | | | | | |
|---|---|---|---|---|---|---|
| Yagli, & Akyuz | 2024 | quantitative, cross-sectional | Grade 9, Secondary/High School | Estonia, Finland, Hongkong, Croatia, and Turkey | Students | Instructional Materials |
| Boonsot, & Chookhampaeng | 2024 | quantitative, Qualitative | Grade 9 Secondary/High School | Thailand | Students | Instructional Materials |
| Magas | 2025 | quantitative | Secondary/High School, Middle School | Philippines | Students, Teachers, Schools | Instructional Materials |

In terms of methodology, quantitative designs were the most frequently employed, followed by qualitative, mixed-method, cross-sectional, and research and development approaches. This diversity in methodology reflects the growing trend of employing both statistical and interpretive analyses to understand mathematical literacy within the PISA framework.

Regarding participants, the majority of studies involved students, while others included teachers or a combination of both. A small number of studies also engaged schools as institutional participants, highlighting the systemic nature of PISA-related inquiries.

As shown in the table, assessment practices (76.5%) and instructional materials (94.1%) were among the most frequently examined factors, followed closely by teacher preparation (76.5%). Notably, all studies (100%) explicitly aligned their analyses with PISA performance outcomes and adopted multi-factor perspectives, suggesting that student performance in mathematical literacy is influenced by an interplay of pedagogical, material, and evaluative components.

**Themes Across Three Key Factors**

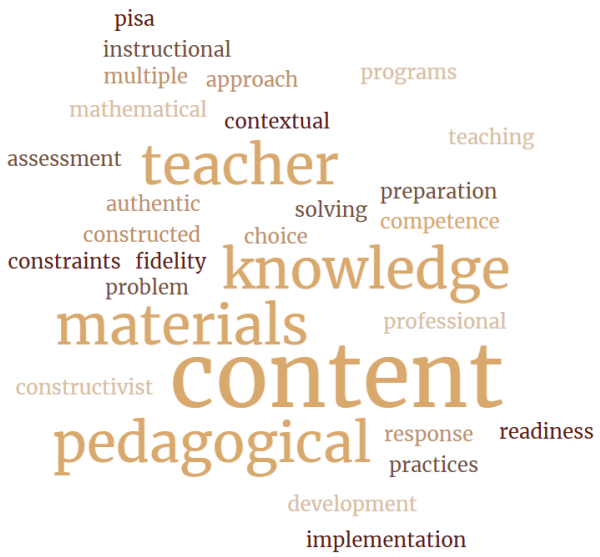


Figure 2. Word cloud of Teacher Preparation, Instructional Materials, and Assessment Practices on Mathematical Literacy Based on the PISA Framework

The systematic review revealed four overarching themes aligned with the study's three focal factors such as teacher preparation, instructional materials, and assessment practices, along with an analysis of student outcome patterns and evidence-based recommendations**.**

**Teacher Preparation Analysis.**

A recurring theme across several studies was the emphasis on content knowledge and pedagogical competence. Two studies focused explicitly on strengthening teachers' mastery of mathematical content and pedagogical content knowledge (Studies 6 and 7). These studies underscored that teachers' depth of subject matter understanding and their ability to translate complex mathematical ideas into student-friendly instruction are critical for enhancing mathematical literacy. Additionally, two studies highlighted the role of professional development programs (Studies 7 and 8), demonstrating that continuous teacher training and structured professional learning communities contribute to more effective classroom practices aligned with PISA's competencies. Furthermore, two studies explored constructivist teaching approaches (Studies 1 and 7), emphasizing the importance of student-centered learning experiences where learners actively construct mathematical understanding through problem-solving and inquiry-based activities.

**Instructional Materials Analysis**

The second major theme centered on the design and implementation of contextual and real-world problem-based instructional materials. Three studies (Studies 2, 3, and 4) investigated how embedding mathematics in authentic, everyday contexts enhances students' engagement and comprehension, thereby bridging the gap between theoretical concepts and practical application. One study (Study 2) specifically developed PISA-like instructional materials, aiming to familiarize students with the structure and cognitive demands of international large-scale assessments. These findings collectively indicate that well-designed materials grounded in real-world contexts can cultivate higher-order thinking and application skills among learners.

**Assessment Practices Analysis**

Assessment practices emerged as a critical determinant of mathematical literacy outcomes. Five studies (Studies 1 and 4) examined the use of multiple assessment formats, including both multiple-choice and constructed-response items, to evaluate students' mathematical reasoning, problem-solving, and explanation skills. These studies recommended diversifying assessment tools to capture different dimensions of learning performance and to encourage deeper cognitive engagement.

**Student Outcome Patterns.**

In terms of impact, three studies (Studies 6, 9, and 11) reported a positive effect of teacher preparation, instructional materials, and assessment practices on students' mathematical literacy performance. Notably, none of the reviewed studies indicated mixed or inconsistent findings. However, ten studies (Studies 1, 2, 3, 4, 5, 7, 8, 10, 12, and 13) found no statistically significant improvement in mathematical literacy outcomes, suggesting that while interventions were theoretically sound, factors such as implementation fidelity, teacher readiness, and contextual constraints may have influenced effectiveness.

## CONCLUSION

This systematic literature review demonstrates that enhanced teacher preparation, quality instructional materials, and robust assessment practices collectively impact student performance in mathematical literacy. The PISA framework provides a valuable lens for examining mathematical literacy, and studies consistently show that integrated approaches combining these factors yield the most substantial improvements in student outcomes.

The evidence suggests that:

1. Teacher preparation programs emphasizing both content knowledge and pedagogical skills are foundational

2. Instructional materials that are contextual, real-world, and PISA-like enhance mathematical literacy

3. Assessment practices using multiple formats and authentic approaches provide comprehensive evaluation

4. Integrated approaches combining all three factors produce the most significant improvements

Educational policymakers and practitioners should consider these evidence-based findings when designing interventions to improve mathematical literacy outcomes aligned with international assessment frameworks.

**RECOMMENDATIONS**

Based on the synthesis of findings, several actionable recommendations are proposed:

1. Invest in structured professional development programs that enhance both content knowledge and pedagogical skills among teachers.

2. Implement constructivist teaching approaches supported by adequate teacher training and classroom resources.

3. Develop and integrate contextual, real-world problem-based instructional materials aligned with PISA competencies.

4. Design and adopt PISA-like learning and assessment tasks to foster familiarity with global performance standards.

5. Utilize multiple assessment formats, including both objective and open-ended tasks, to capture a fuller range of students' mathematical reasoning abilities.

Collectively, these themes suggest that improvements in mathematical literacy within the PISA framework require a balanced integration of teacher competence, high-quality instructional materials, and authentic assessment strategies, each reinforcing the other to promote meaningful mathematical understanding.

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