

Assessment Beliefs of Mathematical Thinking among Elementary Mathematics Teachers

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Abstract

This study examined the assessment beliefs of public elementary mathematics teachers in Sta. Maria District, Division of Zamboanga City, in terms of assessment forms, assessment benefits, assessment purpose, and students' learning, including differences according to gender and length of service and the relationships among these dimensions. Using a quantitative, descriptive-correlational, and non-experimental design, the study involved 183 mathematics teachers selected through total enumeration. Data were gathered using the 20-item Assessment Beliefs of Mathematical Thinking (ABMT) questionnaire and analyzed through weighted mean, standard deviation, Pearson Product-Moment Correlation, independent-samples t-test, and one-way ANOVA. Findings showed a very high overall level of assessment beliefs in mathematical thinking ($M = 4.58$). Assessment purpose obtained the highest mean ($M = 4.64$), followed by assessment forms ($M = 4.62$), students' learning ($M = 4.58$), and assessment benefits ($M = 4.50$). No significant differences were found according to gender or length of service, while all four assessment-belief dimensions were significantly and positively correlated, with the strongest relationship observed between assessment benefits and assessment purpose ($r = 0.757$, $p = 0.000$). The study concluded that teachers viewed assessment forms, benefits, purposes, and students' learning as interconnected components in supporting mathematical thinking. It recommended sustained professional development, varied and learner-centered assessment approaches, timely feedback, technology-enhanced assessment, and further research across wider populations and contexts. The study supports SDG 4: Quality Education by strengthening teachers' assessment competence and instructional decision-making. Its sustainability impact lies in supporting continuous professional development, improved classroom assessment practices, and sustained mathematics instruction that promotes reasoning, conceptual understanding, and responsiveness to learners' needs.

Keywords: Assessment Beliefs, Assessment Benefits, Assessment Forms, Assessment Purpose, Elementary Mathematics Teachers, Mathematical Thinking, Students' Learning

1. Introduction

Assessment in mathematics has shifted from merely measuring achievement toward supporting reasoning, problem solving, conceptual understanding, and instructional decision-making. Contemporary mathematics assessment emphasizes students' ability to reason, formulate and solve problems, interpret results, and apply mathematical knowledge in meaningful contexts (OECD, 2023). Formative assessment further provides teachers with evidence that can be used to adjust instruction and support learning, with recent reviews showing generally positive effects on K–12 learning outcomes (Sortwell et al., 2024). Teachers' beliefs are important because they influence how assessment is understood and implemented. Evidence among primary mathematics teachers

indicates that assessment conceptions are related to classroom assessment practices (Takele & Melese, 2022). The present study therefore examines the assessment beliefs of public elementary mathematics teachers in Sta. Maria District, Division of Zamboanga City, particularly in terms of assessment forms, assessment benefits, assessment purpose, and students' learning.

Mathematical thinking requires more than obtaining correct answers. It involves reasoning, problem solving, interpretation, representation, and the meaningful use of mathematics. The PISA 2022 mathematics framework places mathematical reasoning at the core of mathematical literacy and emphasizes students' capacity to formulate, employ, interpret, and evaluate mathematics in real-world situations (OECD, 2023). Assessment can support these processes when it encourages explanation, reflection, and feedback. Research with primary learners shows that formative feedback can support mathematical reasoning and students' confidence in explaining mathematical ideas (Smit et al., 2023). Interactive feedback between teachers and learners has likewise been associated with mathematical reasoning and self-efficacy (Smit et al., 2023).

The study considers teachers' assessment beliefs across four interconnected dimensions. Assessment forms concern the use of different methods for determining students' mathematical understanding. These may include written assessments, formative activities, performance tasks, feedback, and other approaches that provide evidence of learning. Recent research indicates that effective formative assessment requires continuous collection and use of evidence rather than assessment being treated only as an end-of-instruction activity (Sortwell et al., 2024). Assessment benefits and purpose relate to how teachers use assessment to identify learning needs, guide instruction, provide feedback, and monitor progress. Teachers' conceptions of assessment are associated with the types of assessment practices they use in mathematics classrooms (Takele & Melese, 2022). At the same time, teachers may perceive assessment as serving both learning improvement and accountability functions (Tóth & Csapó, 2022). Students' learning concerns teachers' beliefs about the capacity of assessment to strengthen mathematical understanding and reasoning. Evidence from recent K–12 research generally supports the contribution of formative assessment to learning, although the magnitude of its effects differs across approaches and contexts (Sortwell et al., 2024).

International evidence demonstrates that teachers' assessment conceptions are related to their classroom practices. In a study of primary mathematics teachers, Takele and Melese (2022) found a positive relationship between teachers' assessment conceptions and their reported assessment practices. Assessment beliefs may also reflect tensions between using assessment to improve learning and meeting accountability requirements (Tóth & Csapó, 2022). In the Philippine context, assessment remains an important component of mathematics teaching. Cruz (2023) examined mathematics teachers' classroom assessment thoughts, skills, and practices in Bulacan and emphasized the continuing need for varied assessment strategies and professional development. Paglomutan et al. (2023) likewise examined mathematics teachers' assessment practices in relation to students' test performance, highlighting the role of classroom assessment in supporting meaningful evaluation and learning. Despite these studies, limited evidence specifically addresses how elementary mathematics teachers in individual districts conceptualize the assessment of mathematical thinking. This limitation is particularly relevant to Sta. Maria District, where understanding teachers' assessment beliefs can provide localized evidence for professional development and instructional improvement.

The study conceptualizes teachers' assessment beliefs as an interconnected system involving assessment forms, benefits, purposes, and students' learning. Contemporary research supports the view that teachers' conceptions of assessment are associated with how assessment is implemented in mathematics classrooms (Takele & Melese, 2022). Assessment beliefs may also include different orientations toward improvement and accountability, which can influence teachers' responses to assessment requirements (Tóth & Csapó, 2022). Within mathematics education, these beliefs are interpreted in relation to mathematical reasoning. Current international standards emphasize assessment that captures reasoning, problem solving, interpretation, and application rather than procedural accuracy alone (OECD, 2023). Thus, the four dimensions are treated as related aspects of a broader assessment belief system. Gender and length of service are considered grouping variables, while assessment forms, assessment benefits, assessment purpose, and students' learning constitute the principal dimensions examined. The findings are intended to inform an intervention program that strengthens teachers' assessment practices for mathematical thinking.

Although assessment research has expanded, much of the literature examines general assessment practices, accountability, or student achievement rather than teachers' multidimensional beliefs about assessing mathematical thinking. Recent international research confirms the relationship between teachers' assessment conceptions and practices (Takele & Melese, 2022), while Philippine studies have investigated teachers' assessment skills and classroom practices (Cruz, 2023; Paglomutan et al., 2023). However, evidence remains limited regarding the combined assessment beliefs of public elementary mathematics teachers within specific Philippine districts. The present study addresses this gap by examining the levels, differences, and interrelationships of assessment forms, assessment benefits, assessment purpose, and students' learning among

elementary mathematics teachers in Sta. Maria District during School Year 2025–2026. It also considers differences according to gender and length of service and uses the findings as the basis for an intervention program.

The study is aligned with SDG 4: Quality Education, particularly its emphasis on improving educational quality and strengthening teachers' professional capacity. UNESCO identifies well-trained and adequately supported teachers as essential to achieving inclusive and equitable quality education (UNESCO & International Task Force on Teachers for Education 2030, 2024). Strengthening teachers' understanding and use of assessment can support this goal by improving instructional decision-making and creating assessment experiences that foster mathematical reasoning and meaningful learning.

The study contributes to educational and institutional sustainability by generating evidence that can guide continuous professional development and improve classroom assessment practices. Recent evidence indicates that formative assessment can contribute positively to sustainable K–12 learning when it is effectively designed and implemented (Sortwell et al., 2024). At the institutional level, the findings may help school leaders and district supervisors identify areas for professional support and develop assessment-focused training or Learning Action Cell activities. Strengthening teachers' assessment competence can help sustain mathematics instruction that promotes reasoning, conceptual understanding, and responsiveness to learners' needs.

2. Material and methods

2.1 Research Design

The study used a quantitative, descriptive-correlational, and non-experimental research design. Quantitative research is appropriate for measuring variables numerically and examining differences and relationships through statistical procedures (Creswell & Creswell, 2023). The descriptive component determined teachers' assessment beliefs in terms of assessment forms, assessment benefits, assessment purpose, and students' learning, while the correlational component examined relationships among these dimensions. Gender and length of service were used as grouping variables.

2.2 Locale of the Study

The study was conducted in Sta. Maria District, Division of Zamboanga City, under the Department of Education Region IX, during School Year 2025–2026. The district consists of twelve public elementary schools serving learners from different socioeconomic and cultural backgrounds. Zamboanga City is a highly urbanized city in Region IX and recorded a population of 1,018,849 in the 2024 Census of Population (Philippine Statistics Authority, 2025). The district provided an appropriate setting for examining elementary mathematics teachers' beliefs regarding assessment.

2.3 Respondents of the Study

The respondents were 183 public elementary teachers actively teaching mathematics in Sta. Maria District during School Year 2025–2026. Of these, 169 or 92.3% were female and 14 or 7.7% were male. In terms of length of service, 129 or 70.5% were veteran teachers, 40 or 21.9% were experienced teachers, and seven or 3.8% each were classified as novice and beginning teachers. Teachers who were not teaching mathematics or were on long-term leave during data collection were excluded.

2.4 Sample and Sampling Procedure

The study targeted qualified public elementary mathematics teachers assigned to the twelve schools in Sta. Maria District. Total enumeration was used among eligible teachers, while the required sample was also determined using the Raosoft Sample Size Calculator with a 95% confidence level, 5% margin of error, and 50% response distribution. The final sample consisted of 183 respondents. Survey research allows researchers to systematically gather standardized responses from a defined population for describing characteristics and examining relationships (Goodfellow, 2023).

2.5 Research Instrument

The study used the Assessment Beliefs of Mathematical Thinking (ABMT) questionnaire developed and validated by Alhunaini et al. (2022). The instrument was specifically designed to assess teachers' beliefs regarding the assessment of mathematical thinking and underwent expert validation, exploratory factor analysis, and confirmatory factor analysis. The original validation involved 537 mathematics teachers and demonstrated acceptable validity and construct reliability (Alhunaini et al., 2022). The ABMT consists of 20 statements distributed across four dimensions: Assessment Forms, Assessment Benefits, Assessment Purpose, and Students' Learning, with five items for each dimension. Responses are measured using a five-point Likert scale ranging from Strongly Disagree to Strongly Agree. The original validation study reported acceptable reliability and satisfactory model-fit results for the instrument (Alhunaini et al., 2022). Participants were given approximately 15 to 20 minutes to complete the questionnaire.

2.6 Data Gathering Procedure

After finalizing the instrument, the researcher secured approval from the Schools Division Office of Zamboanga City, coordinated with the Public Schools District Supervisor of Sta. Maria District, and obtained permission from the participating school heads. Qualified mathematics teachers were then informed about the study and provided with informed consent forms explaining the purpose, procedures, voluntary nature of participation, confidentiality measures, and expected completion time. The questionnaire was administered through Google Forms and distributed through approved communication channels. No personally identifying information was collected, and electronic responses were stored in password-protected files accessible only to the researcher. Data were retained for one year for documentation and verification before deletion. Current National Privacy Commission guidance emphasizes that consent must be informed and freely given and that personal-data processing must be transparent and appropriately safeguarded (National Privacy Commission, 2023).

2.7 Data Analysis Techniques

The data were coded and analyzed using SPSS. Weighted mean and standard deviation were used to describe the levels and variability of teachers' assessment beliefs across the four dimensions. Pearson Product-Moment Correlation was used to determine the strength and direction of relationships among assessment forms, assessment benefits, assessment purpose, and students' learning. An independent-samples t-test was used to examine differences according to gender, while one-way ANOVA was used to determine differences according to length of service. When a significant ANOVA result was obtained, Tukey's Honestly Significant Difference test was used to identify the groups that differed significantly. All inferential tests were evaluated at the 0.05 level of significance. These procedures are consistent with contemporary applications of correlation, t-tests, ANOVA, and SPSS-based quantitative analysis (Field, 2024).

2.8 Ethical Considerations

Participation was voluntary and based on informed consent. Respondents were informed of the study's purpose, procedures, confidentiality provisions, and their right to withdraw without penalty. Necessary administrative approvals were obtained before data collection. Anonymity was maintained by excluding identifying information from the dataset. Electronic information was password-protected, and research data were accessible only to the researcher. Data collection, storage, and disposal followed applicable Philippine privacy requirements and current guidance concerning informed consent and responsible personal-data processing (National Privacy Commission, 2023). The researcher also ensured accurate reporting of findings, proper acknowledgment of sources, and disclosure of potential conflicts of interest.

3. Results and Discussion

3.1 Assessment Beliefs of Mathematical Thinking

3.1.1 Assessment Forms

The respondents demonstrated a very high level of beliefs regarding assessment forms, with a grand mean of 4.62. The highest-rated belief concerned the need to apply various forms of assessment to mathematical thinking ($M = 4.67$), followed by the role of feedback in strengthening students' confidence ($M = 4.64$). Performance evaluation and technology both obtained 4.62, while self-assessment obtained 4.55. These findings indicate strong support for varied approaches to assessing mathematical thinking. The findings suggest that teachers value assessment as part of teaching and learning rather than merely as a measure of achievement. Multiple assessment approaches can provide richer evidence of students' mathematical thinking (Largo & Adanza, 2025; Paglomutan et al., 2023), while formative, peer, and self-assessment support active participation and learning (Palmberg et al., 2024; Maskos et al., 2025). Recent research also demonstrates the importance of formative feedback in supporting mathematical reasoning and self-efficacy (Smit et al., 2023), while broader evidence indicates that formative assessment can positively influence K–12 learning (Sortwell et al., 2024). Technology-supported approaches further provide opportunities for responsive assessment and mathematical learning (Pastor & Pedro, 2023; Rasmini et al., 2023).

3.1.2 Assessment Benefits

Assessment benefits obtained a grand mean of 4.50, interpreted as high. Respondents strongly believed that assessment results can modify methods for developing mathematical thinking ($M = 4.67$), varied assessment tools promote objectivity ($M = 4.66$), assessment measures the quality of student work ($M = 4.55$), and assessment tools improve feedback accuracy ($M = 4.52$). The statement concerning inconsistency between the current assessment system and mathematical-thinking development obtained the lowest mean of 4.09. The findings indicate that teachers regard assessment as valuable for improving instruction, monitoring learning, providing meaningful feedback, and promoting more objective evaluation. This agrees with studies showing that assessment evidence can inform teaching and mathematical achievement (Largo & Adanza, 2025; Paglomutan et al., 2023). Varied formative approaches can support teachers in identifying learning needs and adapting instruction (Palmberg et al., 2024; Maskos et al., 2025). Formative feedback can also contribute to mathematical reasoning and students'

confidence in learning (Smit et al., 2023), while systematic evidence across K–12 education supports the educational contribution of formative assessment (Sortwell et al., 2024).

3.1.3 Assessment Purpose

The respondents demonstrated a very high level of beliefs regarding assessment purpose, with a grand mean of 4.64, the highest among the four dimensions. Identifying students' strengths and weaknesses obtained the highest mean of 4.68, followed by reviewing the logical sequence of teaching objectives at 4.66. Determining instructional starting points and integrating mathematical thinking both obtained 4.63, while enabling students to employ mathematical thinking skills obtained 4.60. These findings show that respondents perceive assessment as serving instructional and developmental purposes beyond measuring achievement. Assessment can guide teaching decisions and identify learning needs (Largo & Adanza, 2025; Paglomutan et al., 2023), while formative assessment can help teachers gather evidence, provide feedback, and adapt instruction according to students' progress (Maskos et al., 2025). Teachers' conceptions of assessment are also related to how they implement assessment practices in mathematics classrooms (Takele & Melese, 2022).

3.1.4 Students' Learning

The respondents reported a very high level of assessment beliefs concerning students' learning, with a grand mean of 4.58. Assessment was most strongly viewed as revealing students' ability to acquire mathematical thinking skills ($M = 4.63$), followed by helping students use mathematical thinking in daily life ($M = 4.62$) and learn new topics ($M = 4.61$). Providing opportunities to acquire new skills obtained 4.54, while connecting mathematics to the surrounding environment obtained 4.50. The results indicate that teachers view assessment as supporting knowledge acquisition, mathematical reasoning, application, and continuous learning. This agrees with evidence that varied and authentic assessment tasks contribute to meaningful mathematical learning (Palmberg et al., 2024; Maskos et al., 2025). Formative feedback has also been linked with mathematical reasoning and self-efficacy among primary learners (Smit et al., 2023), while formative assessment more generally shows positive effects on student achievement across K–12 settings (Sortwell et al., 2024). Technology-enhanced assessment can further support mathematics achievement and responsive learning experiences (Pastor & Pedro, 2023; Rasmini et al., 2023).

3.1.5 Overall Assessment Beliefs

Overall, respondents demonstrated a very high level of assessment beliefs of mathematical thinking, with an overall grand mean of 4.58. Assessment purpose obtained the highest mean of 4.64, followed by assessment forms at 4.62 and students' learning at 4.58. Assessment benefits obtained the lowest mean of 4.50 but remained within the high category. The findings indicate that teachers possess consistently strong beliefs regarding the role of assessment in mathematical thinking. Assessment operates through interconnected forms, purposes, feedback processes, and learning outcomes (Largo & Adanza, 2025; Paglomutan et al., 2023). Recent mathematics assessment research emphasizes formative practices involving teacher assessment, peer assessment, self-assessment, feedback, and computer-based assessment (Maskos et al., 2025). Formative assessment also demonstrates an overall positive contribution to K–12 learning, although its effects depend on implementation and context (Sortwell et al., 2024). Reflective and self-assessment practices can further support student involvement in learning (Panadero et al., 2022; Bellido-García et al., 2024).

3.2 Differences in Assessment Beliefs According to Teacher Profile

The respondents' assessment beliefs did not significantly differ according to gender ($F = 2.543$, $p = 0.113$) or length of service ($F = 0.261$, $p = 0.853$). Both p -values exceeded the 0.05 significance level; therefore, the null hypothesis was not rejected. Although differences in mean scores were observed among the groups, these were not statistically significant, indicating generally similar assessment beliefs across gender and teaching-experience categories. The results suggest that assessment beliefs may reflect shared professional and instructional experiences rather than demographic characteristics alone. Primary mathematics teachers' assessment conceptions have been shown to be associated with their assessment practices (Takele & Melese, 2022). Teachers may also simultaneously hold beliefs concerning improvement and accountability, illustrating how assessment conceptions develop within professional and institutional contexts (Tóth & Csapó, 2022). Contemporary mathematics assessment research further emphasizes common formative practices centered on evidence gathering, feedback, and instructional adaptation (Maskos et al., 2025).

3.3 Interrelationships Among Assessment Belief Dimensions

All four dimensions were significantly and positively interrelated. The strongest relationship was between assessment benefits and assessment purpose ($r = 0.757$, $p = 0.000$), followed by assessment forms and assessment purpose ($r = 0.754$, $p = 0.000$) and assessment forms and assessment benefits ($r = 0.718$, $p = 0.000$). Assessment forms and students' learning were positively correlated at $r = 0.699$, assessment benefits and students' learning at $r = 0.693$, and assessment purpose and students' learning at $r = 0.686$. All relationships were significant at the 0.01 level, resulting in rejection of the null hypothesis for all paired dimensions. These results indicate that teachers perceive assessment forms, benefits, purposes, and students' learning as interconnected rather than

separate components. This supports research showing that teachers' assessment conceptions are positively associated with their classroom assessment practices (Takele & Melese, 2022). Current mathematics assessment literature likewise conceptualizes formative assessment as an integrated process involving evidence collection, feedback, instructional adjustment, peer and self-assessment, and technology-supported assessment (Maskos et al., 2025). Formative feedback and interactive dialogue also contribute to mathematical reasoning processes (Smit et al., 2023), supporting the interconnected role of assessment and learning.

3.4 Results-Based Intervention Implications

The combined findings demonstrate a strong multidimensional system of assessment beliefs. Assessment purpose received the highest rating, while assessment benefits received the lowest but remained high. Gender and length of service did not significantly differentiate assessment beliefs, while all four belief dimensions were significantly and positively correlated. The findings therefore provide a basis for an intervention emphasizing varied assessment methods, purposeful assessment use, meaningful feedback, and strategies that strengthen mathematical thinking. Recent literature supports professional practices that integrate formative evidence, feedback, self- and peer-assessment, and technology into mathematics instruction (Maskos et al., 2025). Research also indicates that teachers' assessment conceptions relate to the practices they employ (Takele & Melese, 2022), while formative assessment can contribute positively to K–12 learning when appropriately implemented (Sortwell et al., 2024).

4. Conclusion & Recommendations

The study concluded that teachers demonstrated a very high level of assessment beliefs in mathematical thinking, reflecting strong recognition of the importance of assessment forms, purposes, benefits, and students' learning in developing mathematical reasoning. No significant differences were found in assessment beliefs when respondents were grouped according to gender and length of service, indicating generally similar beliefs across teacher profiles. Significant positive relationships were also found among assessment forms, assessment benefits, assessment purpose, and students' learning, confirming that these dimensions operate as interconnected components in supporting students' mathematical thinking.

Curriculum planners, district supervisors, and school administrators are encouraged to sustain professional development through training, workshops, Learning Action Cells, mentoring, and classroom coaching that strengthen teachers' assessment competencies. Mathematics teachers should continue using varied, authentic, learner-centered, formative, performance-based, and technology-enhanced assessment approaches, provide timely and meaningful feedback, and use assessment results to improve instruction. Curriculum developers and teacher education institutions may further strengthen assessment-related learning opportunities in pre-service and in-service programs, while students may benefit from assessment practices that develop analytical skills and practical mathematical application. Future researchers may replicate the study in larger populations and other school districts or divisions and employ qualitative or mixed-methods approaches to further examine teachers' assessment beliefs and classroom practices.

5. Compliance with ethical standards

The study was conducted in accordance with established principles of responsible research practice. Appropriate administrative permissions were secured before data collection, participation was voluntary, informed consent was obtained, and respondents' privacy, anonymity, and confidentiality were protected throughout the research process. Data were handled securely, and the researcher ensured accurate reporting, proper acknowledgment of sources, and disclosure of potential conflicts of interest.

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