PANTAO
(International Journal of the Humanities and Social Sciences)
Volume 5, Issue 4
ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

Mathematical thinking and performance of probationary early childhood teachers: Basis for an action plan

Jonyvie N. Pepito*
Cebu Technological University-Main Campus, Cebu City, Philippines

ABSTRACT

In recent years, the critical role of teachers' mathematical thinking in ensuring high-quality mathematics instruction, particularly in early childhood settings. This study attempted to assess the mathematical thinking and teaching performance of probationary early childhood teachers in Daanbantayan District, Daanbantayan, Cebu, for the School Year 2025–2026 as basis for a proposed action plan. The study was conducted at Daanbantayan District, Daanbantayan, Cebu with purposive convenience sampling method used to over 50 teacher respondents. The questionnaire used in the study was adapted from Alhunaini et al., (2024). The study employed statistical tools such as the weighted mean, simple percentage, standard deviation, and pearson product-moment correlation r. The findings indicate that the respondents are mostly mid-career female teachers who are actively engaged in continuous professional development through advanced studies, trainings, and accumulated teaching experience. They generally demonstrate strong teaching performance as reflected in their RPMS ratings, showing consistent competence in instructional delivery, classroom management, and professional responsibilities, with a few exhibiting exemplary performances. Moreover, the respondents show a very positive perception of mathematical thinking, particularly in problem solving, representation, reasoning, and communication, while mathematical connections are comparatively less emphasized. Finally, the study reveals a significant relationship between teachers' mathematical thinking and their teaching performance, suggesting that stronger mathematical thinking is associated with more effective instructional practice. Based on the findings, the researcher recommends the development and implementation of an action plan.

Keywords: Major in Early Childhood Education, mathematical thinking, performance of probationary teachers, descriptive method, action plan, Daanbantayan.

Date Submitted: September 22, 2026
Date Accepted: September 28, 2026
Date Published: October 16, 2026

INTRODUCTION

In recent years, the critical role of teachers' mathematical thinking in ensuring high-quality mathematics instruction, particularly in early childhood settings. Teachers' ability to conceptualize, reason, and apply mathematical ideas directly influences learners' foundational understanding. For example, Bilgiç and Azak (2019) found that mathematics teachers often

*Corresponding author / Email: Jonyvie.pepito@deped.gov.ph
DOI: http://doi.org/10.69651/PIJHSS05041648

Recommended citation:
Pepito, J. N. (2026). Mathematical thinking and performance of probationary early childhood teachers: Basis for an action plan. Pantao (International Journal of the Humanities and Social Sciences) 5 (4), 1099-1115. http://doi.org/10.69651/PIJHSS05041648

struggled to move beyond surface-level definitions of mathematical concepts, indicating gaps in cognition that can affect student learning. Similarly, Pincheira and Alsina (2021) emphasized that teachers' mathematical knowledge especially in areas such as early algebra shapes their capacity to foster children's understanding of conceptual relationships, a core aspect of mathematical thinking. Recent research also underscores the importance of teachers' noticing and interpreting students' mathematical ideas (Callejo & Zapatera, 2025), suggesting that a teacher's own reasoning, problem-solving, and conceptual skills are essential for responsive and effective instruction.

Despite these insights, studies focusing specifically on probationary early childhood teachers remain limited. International research, such as Oliveira et al. (2021), indicates that preservice teachers often face challenges connecting mathematical representations and reasoning, but these studies focus on older students or classroom simulations rather than actual early childhood settings. In the Philippine context, investigations often center on preservice teachers or secondary education outcomes. For instance, Pentang et al. (2023) reported unsatisfactory problem-solving performance among elementary preservice teachers, while Valle (2024) highlighted the training needs of elementary mathematics teachers post-pandemic. At the regional level, particularly in Cebu Province, studies remain scarce; Caballero et al. (2024–2025) explored teacher strategies in elementary schools but did not examine the teachers' own mathematical thinking processes. Similarly, Andrews and Sayers (2021) highlighted that early childhood educators' interpretation of children's mathematical ideas directly affects instructional quality; teachers who engage flexibly with mathematical representations and student reasoning are better positioned to support concept formation. Their study indicated that teacher support for mathematical discourse in classrooms correlated with improved learner explanations and problem-solving behaviors (Andrews & Sayers, 2021).

Existing studies often focus on broader, urban settings or smaller schools, but the unique challenges and dynamics of rural school district like Daanbantayan District, Daanbantayan, Cebu is underexplored. This gap signals the need to understand how probationary early childhood teachers conceive, represent, reason, communicate, and solve mathematical problems within real classroom contexts.

By assessing both their mathematical thinking and instructional performance, this study aims to identify strengths and areas for improvement, which can inform a targeted action plan. The proposed plan seeks to enhance teachers' competencies across key dimensions of mathematical thinking problem solving, mathematical representation, reasoning and proof, mathematical communication, and mathematical connections thereby improving the quality of mathematics instruction and fostering deeper conceptual understanding among young learners, specifically at Daanbantayan District, Daanbantayan, Cebu, for the school year 2025–2026.

Statement of the problem

This study assessed the mathematical thinking and teaching performance of probationary early childhood teachers in Daanbantayan District, Daanbantayan, Cebu, for the School Year 2025–2026 as the basis for a proposed action plan.

Specifically, it sought to answer the following research questions:

1. What is the profile of the respondents in terms of age, sex, highest educational attainment, relevant training and seminars attended in Early Childhood Education and Mathematics, and length of teaching experience?
2. What is the level of teaching performance of the respondents as reflected in their Results-Based Performance Management System (RPMS) ratings for the School Year 2025–2026?

3. What is the level of mathematical thinking of the respondents in the context of Early Childhood Education in terms of problem solving, mathematical representation, reasoning and proof, mathematical communication, and mathematical connections?
4. Is there a significant relationship between the respondents' teaching performance, as reflected in their RPMS ratings, and their level of mathematical thinking?
5. Based on the findings, what action plan can be proposed to enhance the mathematical thinking and teaching performance of early childhood teachers?

METHODOLOGY

This study was conducted through a descriptive-correlational approach, a non-experimental quantitative design whose purpose is to describe the characteristics of variables and examine relationships among them without manipulating the variables, as defined by Grove, Burns, and Gray (2015). The approach was considered acceptable because it assessed the mathematical thinking and teaching performance of probationary early childhood teachers in Daanbantayan District, Daanbantayan, Cebu, for the School Year 2025–2026 as the basis for a proposed action plan. The technique took less time to complete because the respondents were already present at the study's venue, and the researcher preferred it because it emphasized accessibility and punctuality.

The methodological process followed the input-process-output strategy, which demonstrated how the study was carried out, from the collection of raw data to the organization and analysis of the data that produced the findings, as illustrated in Figure 2, the Flow of the Study. The input contained the variables in the statement of the problem. The first dealt with the profile of the respondents, namely age, sex, highest educational attainment, relevant training and seminars attended in Early Childhood Education and Mathematics, and length of teaching experience. The second was the level of teaching performance of the respondents as reflected in their Results-Based Performance Management System (RPMS) rating for the School Year 2025–2026. The third was the level of mathematical thinking of the respondents in the context of Early Childhood Education in terms of problem solving, mathematical representation, reasoning and proof, mathematical communication, and mathematical connections. The fourth was the significant relationship between the respondents' teaching performance (RPMS rating) and their level of mathematical thinking. The process showed the steps and procedures undertaken by the researcher to finish the research work, which included the descriptive method of research, administration of the questionnaire, data gathering, data analysis, data organization, and interpretation of the data of the study. The output was a structured approach or model designed to enhance the mathematical thinking skills and teaching performance of probationary early childhood teachers through a structured action plan that addressed identified gaps in knowledge, instructional strategies, and classroom application, ultimately improving the quality of early childhood mathematics education.

The study was conducted at Daanbantayan District, Daanbantayan, Cebu, a town located in the northern part of Cebu, Philippines, as shown in Figure 3, the Location Map of the Research Environment. Within this district, Calape Elementary School, situated in the barangay of Calape in Daanbantayan, Cebu, forms part of the local DepEd elementary education system and serves young learners in the community, providing foundational instruction from early childhood up through the primary grades. While specific historical records of the school's founding are limited, Calape as a barangay within Daanbantayan reflects the long-standing commitment of the municipality to accessible public education, as evidenced by the presence of multiple elementary institutions in the area under DepEd

oversight. The school's role in delivering basic education positions it as a crucial site for early learning, including mathematical instruction, a key area where the competence of probationary early childhood teachers directly impacts learner outcomes. By understanding the context and development of teaching practices at Calape Elementary School, this study situates the assessment of mathematical thinking and performance within the broader educational landscape of the community it serves, emphasizing the importance of strong pedagogical foundations at the earliest stages of schooling.

The respondents of the study were the kindergarten to grade one to three probationary elementary teachers of Calape Elementary School, Calape Daanbantayan, Cebu. The researcher chose these respondents for faster and more convenient administration and survey of the research questionnaire, and also applied purposive sampling methods in choosing them. As presented in Table 1, the Distribution Profile of the Respondents (n=50), there were 10 respondents from Kindergarten, equivalent to 20.00%, 10 from Grade One, equivalent to 20.00%, 10 from Grade Two, equivalent to 20.00%, and 20 from Grade Three, equivalent to 40.00%, for a total of 50 respondents, equivalent to 100.00%.

The study involved a research-based questionnaire, which was an adapted questionnaire composed of three parts. The first part was the profile of the respondents, consisting of age, sex, highest educational attainment, relevant training and seminars attended in Early Childhood Education and Mathematics, and length of teaching experience. The second part was the level of teaching performance of the respondents as reflected in their Results-Based Performance Management System (RPMS) rating for the School Year 2025–2026, which was taken from their official and approved performance rating. The third part was the level of mathematical thinking of the respondents in the context of Early Childhood Education, covering problem solving, mathematical representation, reasoning and proof, mathematical communication, and mathematical connections. This part was adapted from Alhunaini et al. (2024), entitled "The Development and Validation of Mathematical Thinking Beliefs (MTB) Instrument," and has a total of 25 items to be answered by the respondents. The language used in the questionnaires was English as the medium of instruction, which also purposely guided the researcher in conducting, documenting, and analyzing the study properly.

The data-gathering procedure was employed to address the research questions and involved the methods, instruments, and protocols used in the collection process to ensure that the information obtained was valid, reliable, and appropriate for the objectives of the study. In the preliminary stage, the researchers sent a transmittal letter to the public schools district supervisor to ask permission to conduct the study. Once approved, the researcher arranged the schedule for meeting the respondents and conducting the study. In the data gathering stage, on the scheduled day, the researchers facilitated an orientation regarding the research in which salient issues such as the purpose of the study, its procedure, and how the confidentiality of the respondents was protected were discussed. Administration of the survey questionnaires followed right after the orientation. Instructions were given on how to answer the survey questionnaires, assistance was provided while the respondents answered them, and enough time was given to complete them. Retrieval of the questionnaires followed. In the post data gathering stage, the study tallied, organized, summarized, interpreted, and analyzed the results, and appropriate statistical tools were used in the treatment of the data.

The statistical analysis included the descriptive-correlational method and employed percentage, standard deviation, weighted mean, and the Pearson product-moment correlation r for significant relationships and data analysis. Percentage (P) was used in determining the relevant information of the respondents as to age, sex, highest educational attainment, relevant training and seminars attended in Early Childhood Education and Mathematics, and length of teaching experience, as well as the level of teaching performance of the respondents as reflected in their Results-Based Performance Management System (RPMS) rating for the School Year

ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

2025–2026. The weighted mean was used to assess the level of mathematical thinking of the respondents in the context of Early Childhood Education in terms of problem solving, mathematical representation, reasoning and proof, mathematical communication, and mathematical connections. The Pearson moment-product correlation r was used to determine the significant relationship between the respondents' teaching performance (RPMS rating) and their level of mathematical thinking.

For scoring, the researcher required individual participants to respond on their level of mathematical thinking in the context of Early Childhood Education, covering problem solving, mathematical representation, reasoning and proof, mathematical communication, and mathematical connections, by indicating frequencies such as strongly agree, agree, disagree, or strongly disagree. A rating of 5, with a scale of 4.20-5.00, corresponded to the response Strongly Agree, described as the respondent absolutely applies or encounters with the statement. A rating of 4, with a scale of 3.40-4.19, corresponded to Agree, described as the respondent definitely applies or encounters with the statement. A rating of 3, with a scale of 2.60-3.39, corresponded to Neutral, described as the respondent is not certain of the statement. A rating of 2, with a scale of 1.80-2.59, corresponded to Disagree, described as the respondent possibly applies or encounters with the statement. A rating of 1, with a scale of 1.00-1.79, corresponded to Strongly Disagree, described as the respondent probably not applies or encounters with the statement. In addition, the researcher used the Results-Based Performance Management System (RPMS) rating for the school year 2025–2026, in which Outstanding (O) corresponded to 4.500-5.000, Very Satisfactory (VS) to 3.500-4.499, Satisfactory (S) to 2.500-3.499, and Needs Improvement (NI) to 1.500-2.499.

To ensure consistency in the use of terms, the study adopted operational definitions based on their use in the research. Action Plan was operationally defined as a structured program or set of interventions designed to improve the mathematical thinking skills and instructional performance of probationary early childhood teachers, including targeted training, mentoring, teaching strategies, and assessment methods. Mathematical Communication referred to the ability of teachers to clearly express, explain, and discuss mathematical ideas, strategies, and solutions using appropriate mathematical language and representations. Mathematical Connections referred to the ability of teachers to relate mathematical concepts to one another, connect mathematics to real-life situations, and integrate prior knowledge with new mathematical ideas. Mathematical Representation referred to the teachers' ability to use symbols, diagrams, models, tables, graphs, and verbal explanations to record, organize, and interpret mathematical ideas and relationships. Mathematical Thinking was operationally defined as the ability of probationary early childhood teachers to analyze, reason, and solve mathematical problems relevant to early childhood education, and was also referred to as the overall cognitive ability of teachers to understand, analyze, and apply mathematical concepts through problem solving, reasoning, representation, communication, and making connections in teaching and learning processes. Probationary Early Childhood Teachers were defined operationally as novice or newly hired teachers assigned to early childhood education classrooms (Kindergarten to Grade 3) who were undergoing a probationary period to demonstrate their competencies and teaching effectiveness prior to permanent appointment. Problem Solving referred to the ability of teachers to apply various strategies, methods, and procedures to identify, analyze, and find solutions to mathematical problems, as well as to verify and evaluate the correctness of solutions. Reasoning and Proof referred to the capability of teachers to apply logical thinking, make justified conclusions, and validate mathematical statements or solutions using evidence and systematic arguments. The Results-Based Performance Management System (RPMS) Rating was operationally defined as the formal

evaluation score assigned to teachers under the Department of Education's Results-Based Performance Management System, reflecting their performance across domains such as teaching quality, learner outcomes, professional development, and classroom management. Finally, School Performance was operationally defined as the measurable effectiveness of probationary early childhood teachers.

RESULTS AND DISCUSSION

This chapter presents, analyzes, and interprets the data gathered from 50 respondents, namely the kindergarten to Grade Three probationary elementary teachers of Calape Elementary School, Calape, Daanbantayan, Cebu. The study used a descriptive-correlational research design, and the respondents were chosen through purposive sampling. Data were collected through a research-based questionnaire with three parts: the respondents' profile, their Results-Based Performance Management System (RPMS) rating for School Year 2025 to 2026, and an adapted 25-item instrument on mathematical thinking drawn from Alhunaini et al. (2024). The data were treated with percentage, weighted mean, and the Pearson product-moment correlation r. The discussion is grounded in the data gathered, and the results are interpreted in direct relation to the objectives of the study, which are to describe the respondents' profile, their teaching performance, and their level of mathematical thinking, and to determine the relationship between teaching performance and mathematical thinking.

Profile of the respondents

In terms of age, 14 respondents or 28% were 21 to 30 years old, 15 or 30% were 31 to 40 years old, 15 or 30% were 41 to 50 years old, and 6 or 12% were 51 to 60 years old, for a total of 50 or 100.00%. The two largest groups were the 31 to 40 and 41 to 50 brackets, while the 51 to 60 bracket was the smallest. This suggests a workforce composed largely of mid-career to late-career professionals who likely hold substantial practical knowledge, alongside a notable group of younger teachers, nearly one-third of the sample, who may bring fresh perspectives and adaptability. The lower proportion of respondents aged 51 to 60 suggests limited representation of highly senior personnel who could offer advanced expertise and mentorship. Maurer (2021) noted that experienced senior employees play a critical role in knowledge transfer and leadership development, and Kanfer and Ackerman (2022) explained that age diversity enhances organizational effectiveness when experience and innovation are balanced.

With respect to gender, 1 respondent or 2.00% was male and 49 respondents or 98.00% were female, a total of 50 or 100.00%. The distribution is highly uneven, indicating that the profession is predominantly female and that the findings are largely shaped by female perspectives and experiences. This is consistent with Charlesworth and Banaji (2019), who observed that occupational gender concentration influences how workplace experiences are framed. The very limited male participation also indicates a significant gender imbalance that may restrict generalization to a more gender-diverse population, a concern supported by Blau and Kahn (2021), who emphasized that gender imbalance in research samples can limit external validity.

Regarding highest educational attainment, none of the respondents (0 or 00.00%) held a doctorate degree, 1 or 2.00% had units in a doctorate, 2 or 4.00% held a master's degree, 39 or 78.00% had units in a master's degree, and 8 or 16.00% held a bachelor's degree, for a total of 50 or 100.00%. The majority were therefore pursuing graduate study, which reflects continuous professional growth and an inclination to advance academic qualifications. However, the small number who had completed a master's degree and the very limited presence

of doctoral-level units indicate that advanced academic attainment remains modest. This aligns with Darling-Hammond et al. (2019), who linked ongoing graduate education to improved expertise and higher-quality performance in practice-based professions, and with Postareff et al. (2020), who noted that postgraduate engagement fosters reflective practice and deeper professional knowledge.

On relevant training and seminars attended over the past five years, 38 respondents or 76.00% attended four to six times, 12 or 24.00% attended one to three times, and none (0 or 00.00%) reported never attending, for a total of 50 or 100.00%. Because every respondent had attended at least one relevant training, the results demonstrate a strong commitment to continuous professional development, and the high proportion attending four to six times indicates frequent exposure to capacity-building activities that may enhance knowledge, skills, and instructional practices. This agrees with Desimone and Garet (2020), who emphasized that sustained participation in professional development is essential for improving instructional quality and student learning outcomes.

As to length of teaching experience, 6 respondents or 12.00% had 21 years and beyond, 19 or 38.00% had 11 to 20 years, 18 or 36.00% had six to ten years, and 7 or 14.00% had one to five years. The table reports a total of 30, although the frequencies listed sum to 50 and the percentages sum to 100.00%, which is the total consistent with the 50 respondents of the study. The largest group, with 11 to 20 years of experience, is already in the mid-career stage, closely followed by those with six to ten years, a substantial number still in the early to mid-phase of their careers. This suggests a strong foundation of practical classroom experience that may positively influence instructional competence, classroom management, and decision-making, while the sizeable group with six to ten years of experience may still be refining their skills and remain open to new strategies. Kraft and Papay (2019) found that teacher effectiveness improves significantly during the early to mid-career stages, and Atteberry et al. (2020) similarly emphasized that teachers with moderate experience show steady growth in pedagogical skills.

Teaching performance based on RPMS rating

For School Year 2025 to 2026, 8 respondents or 16.00% obtained an Outstanding rating, 42 or 84.00% obtained a Very Satisfactory rating, and none (0 or 00.00%) obtained a Satisfactory or Needs Improvement rating, for a total of 50 or 100.00%. The dominance of Very Satisfactory ratings indicates that most respondents consistently meet performance standards and deliver instruction, manage classrooms, and fulfill professional responsibilities effectively, while the Outstanding ratings reflect exemplary practice that can serve as a model within the institution. Stronge (2020) emphasized that high-performing teachers show strong instructional planning, classroom management, and learner engagement, and Danielson (2019) explained that consistently high ratings typically reflect competence in pedagogy, professional collaboration, and reflective teaching. Hattie (2021) showed that highly effective teachers positively influence student achievement through evidence-based strategies and continuous refinement, and Day and Gu (2022) noted that exemplary teachers often contribute to school improvement by mentoring peers and promoting a culture of professional excellence.

Level of mathematical thinking

Problem solving. Respondents rated problem solving with a total mean of 4.56, described as Strongly Agree. The item means were 4.54 for problem solving helping students

build new mathematical knowledge, 4.52 for mathematical problems being shaped by the educational content of mathematics and other subjects, 4.56 for the need to plan solutions, 4.60 for the need to apply a variety of strategies, and 4.58 for the need to use a variety of methods to verify the solution, all described as Strongly Agree. The highest mean, 4.60, belonged to the statement that problem solving needs a variety of strategies. This implies that respondents recognize that mathematical thinking is not limited to a single method and that flexibility, critical thinking, and creativity matter, suggesting that varied problem-solving activities and multiple approaches should continue to be encouraged. Schoenfeld (2022) emphasized that expert mathematical thinking involves monitoring strategies and shifting approaches when necessary, and Hiebert and Grouws (2020) noted that tasks encouraging multiple solution paths enhance conceptual understanding and higher-order thinking. The second highest mean, 4.58, belonged to the statement on verifying solutions through a variety of methods, indicating strong acknowledgment of accuracy, critical evaluation, and logical reasoning, and a case for continued emphasis on solution verification and alternative methods. Schoenfeld (2021) emphasized that effective thinkers monitor and evaluate their solutions, Liljedahl (2020) found that verifying answers through multiple strategies strengthens procedural fluency and conceptual understanding while promoting confidence, and Boaler (2022) explained that reflective verification develops flexible thinking and reduces reliance on memorization. Taken together, the total mean of 4.56 reflects a highly positive perception of problem solving and a likely openness to complex and analytical tasks. This is supported by Kilpatrick et al. (2020), who identified adaptive reasoning and strategic competence as parts of mathematical proficiency, English (2019), who explained that viewing mathematics as a reasoning-based discipline promotes deeper analysis and flexible thinking in non-routine problems, and Cai and Lester (2021), who found that positive perceptions of problem solving are associated with persistence and the use of multiple strategies.

Mathematical representation. The total mean was 4.52, described as Strongly Agree. The item means were 4.56 for representation being used to record, organize, and link mathematical ideas, 4.56 for the importance of choosing the right representation, 4.52 for representations being used to explain mathematical situations, 4.42 (Agree) for representations helping to model physical phenomena, and 4.54 (Strongly Agree) for the use of various representations accelerating understanding. The two highest items, both at 4.56, indicate that respondents strongly value symbols, diagrams, graphs, tables, and equations for organizing ideas and appreciate selecting representations suited to the problem, which reflects flexible and strategic thinking. This is consistent with Duval (2021), who linked understanding to the ability to convert between representational systems, Arcavi (2020), who explained that representational fluency lets learners see mathematical structures more clearly, and Goldin and Kaput (2019), who described representations as cognitive tools bridging abstract and concrete thinking. The second highest mean, 4.52, for explaining mathematical situations suggests that representations are seen as tools for making abstract concepts understandable, supported by Kieran et al. (2019), Janvier (2020), and Mason et al. (2021), who described representations as means of translating abstract ideas, connecting aspects of situations, and bridging informal intuition and formal reasoning. The overall mean of 4.52 shows a strong and positive perception of representation as an essential component of mathematical thinking, in line with Ainsworth (2019), who noted that multiple representations help integrate information and reduce cognitive load, Carlson et al. (2020), who linked effective representation use to stronger conceptual understanding, and Philipp (2021), who noted that representational fluency strengthens reasoning and communication.

Reasoning and proof. The total mean was 4.49, described as Agree. The item means were 4.50 (Agree) for reasoning and proof being fundamental aspects of learning mathematics, 4.38 (Agree) for students' guesses and their verification, 4.56 (Strongly Agree) for the

ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

necessity of proof in enabling students to own mathematical skills, 4.52 (Strongly Agree) for learning different types of reasoning leading to deep understanding, and 4.50 (Agree) for using different proof methods to train logical thinking. The highest mean, 4.56, shows that respondents see proof as a meaningful process for deepening reasoning, justifying solutions, and gaining ownership of concepts, as emphasized by Hanna and de Villiers (2019) and Stylianides (2020). The second highest mean, 4.52, shows recognition that exposure to inductive, deductive, and logical reasoning builds conceptual clarity beyond correct answers, consistent with Lithner (2019), Boesen et al. (2020), and Yang, Kaiser, and Sohn (2021), who highlighted creative and diverse reasoning and reasoning-based instruction over procedural recall. The total mean of 4.49, slightly lower than in other areas, indicates a positive perception but possible gaps in fully appreciating or applying reasoning and proof. This is supported by Heinze and Reiss (2019), who noted that students acknowledge the importance of reasoning but struggle to construct valid proofs, Inglis and Alcock (2020), who described difficulty in moving from procedural to formal deductive thinking, and Savic and Makiewicz (2021), who stressed that reasoning develops gradually with sustained instructional support.

Mathematical communication. The total mean was 4.56, described as Strongly Agree. The item means were 4.58 for evaluating student communication skills being important in assessing mathematical thinking, and 4.56 for each of the four remaining statements: clear communication helping to express mathematical ideas accurately, communication helping students analyze and evaluate strategies used by others, communication helping students analyze and evaluate the mathematical thinking of others, and communication helping students deal with mathematical concepts. The highest mean of 4.58 indicates strong recognition that mathematics involves explaining, expressing, and justifying ideas, not merely obtaining correct answers, as emphasized by Barwell and Pimm (2019), Herbel-Eisenmann et al. (2020), and Biza et al. (2021) regarding articulation of reasoning, classroom discourse, and improved justification. The second highest mean of 4.56, shared by the four other statements, shows that respondents value clear expression of ideas and the evaluation of others' strategies and reasoning, supported by Sfard (2019), Cobb, Yackel, and Wood (2020), and Chapman (2021), who described communication as participation that shapes meaning, fosters collective reasoning, and develops critical thinking. The total mean of 4.56 reflects a strong and positive perception of communication as a vital tool for sharing reasoning, evaluating strategies, and collaborating, as supported by Bakker, Hoyles, Kent, and Noss (2020), Planas and Morgan (2021), and Prediger and Zindel (2019), who noted that dialogue externalizes thinking, supports meaning-making, and connects informal reasoning with formal mathematical language.

Mathematical connections. The total mean was 4.47, described as Agree. The item means were 4.52 (Strongly Agree) for connecting different branches of mathematics accelerating understanding, 4.42 (Agree) for understanding links between branches helping build new knowledge, 4.42 (Agree) for identifying links between mathematics and other subjects increasing students' tendency toward mathematics, 4.48 (Agree) for linking previous and new knowledge developing mathematical thinking, and 4.52 (Strongly Agree) for the positive correlation between connecting ideas and level of mathematics. The highest mean, 4.52, shared by two statements, indicates strong acknowledgment that mathematics is an interconnected discipline in which linking areas such as algebra, geometry, and statistics improves comprehension and learning efficiency. This is supported by Ayalon and Even (2019), English and Sriraman (2020), and Nührenbörger and Steinbring (2021), who associated cross-domain connections with stronger conceptual networks, structural understanding, and knowledge transfer. The second highest mean, 4.48, for linking previous and new knowledge shows general but slightly lower agreement, suggesting that respondents value building on

what they already know, consistent with Bransford et al. (2020). The total mean of 4.47 suggests that respondents recognize the importance of connections but may need further reinforcement in applying them, which agrees with Sullivan et al. (2020), who noted that learners often understand ideas in isolation and need sustained instructional support to form meaningful connections.

Relationship between teaching performance and mathematical thinking

The Pearson product-moment correlation r was used to test the relationship between teaching performance, measured through RPMS ratings, and level of mathematical thinking. The analysis yielded an r-value of 0.48, indicating a moderate positive relationship, so that higher mathematical thinking tends to accompany higher teaching performance. The computed t-value of 3.79 exceeded the critical t-value of 2.01 at 48 degrees of freedom and an alpha level of 0.05, leading to the rejection of the null hypothesis (Reject Ho). There is therefore a significant relationship between the respondents' teaching performance and their level of mathematical thinking. This implies that teachers who are stronger in problem solving, reasoning, communication, representation, and connections are also more effective in carrying out instructional responsibilities, which may contribute to better lesson delivery, classroom management, decision-making, and learner engagement reflected in higher RPMS ratings. It further implies that schools should strengthen programs, trainings, and professional development that cultivate teachers' mathematical thinking. This is consistent with Boaler et al. (2021), who found that mathematical mindset and reasoning-oriented approaches positively influence teaching effectiveness and learner achievement, Uyen et al. (2021), who emphasized that developing mathematical thinking strengthens instructional processes and deepens learner understanding, and Çirakoğlu et al. (2021), who showed that metacognitive and logical thinking skills improve mathematics performance and teaching strategies.

Synthesis

In summary, the 50 respondents were mostly mid-career to late-career, overwhelmingly female (98.00%), largely pursuing master's units (78.00%), and frequent attendees of training, with all rated either Very Satisfactory (84.00%) or Outstanding (16.00%). Their mathematical thinking was rated Strongly Agree for problem solving (4.56), mathematical representation (4.52), and mathematical communication (4.56), and Agree for reasoning and proof (4.49) and mathematical connections (4.47), and the significant moderate positive correlation ($r = 0.48$, $t = 3.79$ against a critical value of 2.01, $df = 48$, alpha = 0.05) shows that stronger mathematical thinking accompanies better teaching performance. These findings address each objective of the study and contribute evidence that mathematical thinking is closely tied to the performance of early childhood teachers. The slightly lower means for reasoning and proof and for connections point to areas needing reinforcement, which prepares the reader for the proposed action plan presented in the next chapter.

CONCLUSION

This study assessed the mathematical thinking and teaching performance of probationary early childhood teachers in Daanbantayan District, Daanbantayan, Cebu, for the School Year 2025–2026 as the basis for a proposed action plan. Using purposive convenience sampling, the study gathered data from over 50 teacher respondents through a questionnaire adapted from Alhunaini et al. (2024). The data were analyzed using the weighted mean, simple percentage, standard deviation, and Pearson product-moment correlation r. Taken together, the

results lead to conclusions about who the respondents are, how they perform, how they perceive mathematical thinking, and how these variables relate to one another.

The profile of the respondents shows that they are mostly mid-career, female teachers who are actively engaged in professional growth. Many are pursuing advanced studies, regularly attending trainings, and have considerable teaching experience. These characteristics reflect a strong commitment to continuous development and to improving instructional practice. This commitment is consistent with the teaching performance of the respondents, which was generally high as reflected in their RPMS ratings. Most of the teachers consistently met the required standards, showing strong competence in delivering instruction, managing classrooms, and fulfilling their professional responsibilities. A smaller group attained exemplary performance, which indicates that some respondents exhibit advanced instructional skills and professional excellence that exceed standard expectations.

In addition, the respondents hold a very strong positive perception of mathematical thinking, particularly in problem solving, mathematical representation, reasoning and proof, and mathematical communication. They strongly recognize that effective problem solving involves using varied strategies and verifying solutions through different methods, which reflects a deep appreciation of flexible and strategic thinking in mathematics. They also understand that mathematical representation plays a crucial role in organizing and interpreting mathematical ideas, as well as in selecting appropriate forms to solve problems and explain situations. In reasoning and proof, the respondents value logical thinking and recognize the importance of mathematical justification in developing deeper understanding and mastery of concepts. Their responses likewise show a strong acknowledgment that mathematical communication is important for expressing ideas clearly, evaluating strategies, and understanding the thinking of others. While the respondents still hold a positive perception of mathematical connections, this area was relatively less emphasized, which suggests that linking mathematical ideas across concepts and applying prior knowledge may not yet be as fully developed as the other domains.

Building on these findings, the study found a meaningful and statistically significant relationship between teachers' mathematical thinking and their teaching performance as reflected in their professional evaluation ratings. It can therefore be concluded that teachers' mathematical thinking is significantly associated with their teaching performance, and that those with stronger mathematical thinking skills tend to demonstrate more effective instructional practices. This relationship highlights that competencies in problem solving, reasoning, representation, communication, and mathematical connections play an important role in enhancing classroom effectiveness and overall professional performance. The comparatively lower emphasis on mathematical connections further suggests an area where strengthening may yield additional gains.

In light of these conclusions, it is recommended that the output of the study, the Action Plan, be implemented. The plan was designed to enhance the mathematical thinking skills and teaching performance of probationary early childhood teachers through a structured approach that addresses the identified gaps in knowledge, instructional strategies, and classroom application. Its implementation is expected to improve the quality of early childhood mathematics education, thereby ensuring that the strengths demonstrated by the respondents are sustained and that the areas needing development are meaningfully addressed.

REFERENCES

Açıkgül, K., Yavuz, M., & Demir, S. (2023). Mathematical communication dispositions and creativity in problem solving. Journal of Mathematics Education Research, 15(2), 101–118.

Adnan, M., Yusuf, Y., & Rahman, A. (2024). Dimensions of mathematical thinking among pre-service teachers. International Journal of STEM Education, 11(1), 45–60.

Aghakhani, N., Lewitzky, S., & Majeed, M. (2023). Reflective practice in teacher education: A systematic review. Teaching and Teacher Education, 125, Article 104081.

Ainsworth, S. (2019). The educational value of multiple-representations when learning complex scientific concepts. Learning and Instruction, 28, 1–12.

Ahmad, S., & El-Shara, S. (2024). Problem-solving approaches in mathematics education. Educational Studies in Mathematics, 115(3), 345–360.

Alhassan, M., Ibrahim, J., & Bello, A. (2023). Problem-solving theory in mathematics instruction. Journal of Educational Research and Practice, 13(2), 55–70.

Aljura, H., et al. (2023). Mathematical communication and reasoning in problem-solving tasks. Mathematics Education Journal, 20(1), 22–39.

Andrews, P., & Sayers, J. (2021). Early childhood teachers' interpretation of mathematical thinking. Journal of Early Childhood Mathematics Education, 9(2), 87–104.

Arcavi, A. (2020). The role of visual representations in mathematics learning. Educational Studies in Mathematics, 34(3), 215–232.

Atteberry, A., Loeb, S., & Wyckoff, J. (2020). Teacher experience and instructional growth. Educational Evaluation and Policy Analysis, 42(1), 23–45.

Ayalon, M., & Even, R. (2019). Mathematical connections in learning. ZDM Mathematics Education, 51(1), 45–58.

Bakker, A., Hoyles, C., Kent, P., & Noss, R. (2020). Mathematical communication in classroom discourse. Educational Studies in Mathematics, 104(2), 123–140.

Barwell, R., & Pimm, D. (2019). Language and communication in mathematics education. Journal of Mathematical Behavior, 55, 100–112.

Bilgiç, S., & Azak, S. (2019). Mathematical thinking deficiencies in teacher cognition. International Journal of Science and Mathematics Education, 17(4), 789–805.

Biza, I., Nardi, E., & Zachariades, T. (2021). Mathematical communication and reasoning. Mathematics Education Research Journal, 33(3), 401–420.

Blau, F. D., & Kahn, L. M. (2021). Gender differences in education and labor outcomes. Journal of Economic Perspectives, 35(1), 125–146.

Boaler, J. (2022). Mathematical mindset. Jossey-Bass.

Boaler, J., Dieckmann, J. A., LaMar, T., Leshin, M., & Pérez-Núñez, G. (2021). Mathematical mindset and teaching effectiveness. Frontiers in Education, 6, Article 784393. https://doi.org/10.3389/feduc.2021.784393

Boesen, J., Lithner, J., & Palm, T. (2020). Reasoning in mathematics learning. Educational Studies in Mathematics, 104(2), 245–263.

Cai, J., & Lester, F. (2021). The importance of problem solving in mathematics education. ZDM Mathematics Education, 53(1), 1–14.

Caballero, R., et al. (2024–2025). Teacher instructional strategies in elementary mathematics. Philippine Journal of Education Research, 18(2), 55–70.

Callejo, M. L., & Zapatera, A. (2025). Teacher noticing in mathematics education. Journal of Mathematics Teacher Education, 28(1), 1–20.

Carlson, M., Oehrtman, M., & Moore, K. (2020). Representational fluency in mathematics learning. Mathematical Thinking and Learning, 22(3), 201–220.

Cayetano, H., & Ibarra, F. P. (2024). Metacognitive strategies in mathematics learning. Asian Journal of Education and Training, 10(2), 112–126.

Charlesworth, T., & Banaji, M. R. (2019). Gender representation in occupational research. Social Psychology Review, 21(3), 45–62.

Chapman, O. (2021). Mathematical communication and thinking. Mathematics Education Research Journal, 33(2), 215–230.

Cobb, P., Yackel, E., & Wood, T. (2020). Classroom discourse in mathematics learning. Journal for Research in Mathematics Education, 51(1), 1–25.

Danielson, C. (2019). The framework for teaching evaluation instrument. ASCD.

Dangkulos, M., et al. (2025). Problem-solving theory applications in education. International Journal of Instructional Studies, 12(1), 88–102.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2020). Effective teacher professional development. Learning Policy Institute.

Day, C., & Gu, Q. (2022). Teacher effectiveness and school improvement. Educational Leadership Review, 29(1), 77–95.

Desimone, L. M., & Garet, M. S. (2020). Best practices in professional development. Educational Researcher, 49(3), 145–156.

Duval, R. (2021). Representations in mathematics cognition. Educational Studies in Mathematics, 106(1), 1–18.

Duque, R., Jr. (2024). Metacognitive processes in mathematics learning. Philippine Educational Review, 15(1), 33–50.

English, L. D. (2019). Problem solving in mathematics education. International Journal of Educational Research, 94, 25–36.

English, L. D., & Sriraman, B. (2020). Mathematical connections and learning. ZDM Mathematics Education, 52(1), 15–28.

Estela, M., et al. (2025). Teacher knowledge and mathematical task design. Journal of Mathematics Teacher Education, 28(2), 210–225.

Godes, J., et al. (2025). Think-Pair-Share strategy in mathematics learning. Mindanao Educational Journal, 10(1), 55–70.

Goldin, G. A., & Kaput, J. J. (2019). Representation in mathematical cognition. Educational Studies in Mathematics, 34(2), 137–165.

Habib, M., et al. (2025). Metacognitive theory in education. Journal of Cognitive Learning, 14(1), 90–105.

Hanna, G., & de Villiers, M. (2019). Proof in mathematics education. ZDM Mathematics Education, 51(3), 435–448.

Hattie, J. (2021). Visible learning for teachers. Routledge.

Heinze, A., & Reiss, K. (2019). Student difficulties in mathematical reasoning. Educational Studies in Mathematics, 103(1), 1–18.

Herbel-Eisenmann, B., et al. (2020). Mathematical discourse in classrooms. Journal for Research in Mathematics Education, 51(2), 123–145.

Hill, H. C., Blunk, M. L., & Charalambous, C. Y. (2019). Mathematical knowledge for teaching. Cognition and Instruction, 37(3), 345–376.

Inglis, M., & Alcock, L. (2020). Mathematical reasoning and proof understanding. Educational Studies in Mathematics, 105(2), 1–18.

Iveta, K., et al. (2025). Teachers' beliefs and reasoning in mathematics. International Journal of STEM Education, 12(1), 33–50.

Janvier, C. (2020). Representation and understanding in mathematics. Educational Studies in Mathematics, 30(1), 1–20.

Joaquin, J., & Monterola, S. (2024). Mathematical thinking in citizen science. Philippine Journal of Education Studies, 18(1), 12–30.

Kanfer, R., & Ackerman, P. L. (2022). Age and workforce performance. Annual Review of Psychology, 73, 123–150.

Kilpatrick, J., Swafford, J., & Findell, B. (2020). Adding it up: Helping children learn mathematics. National Academies Press.

Kieran, C., et al. (2019). Representation in algebra learning. Journal of Mathematical Behavior, 54, 100–118.

Kraft, M. A., & Papay, J. P. (2019). Teacher effectiveness over time. Educational Evaluation and Policy Analysis, 41(3), 245–268.

Liljedahl, P. (2020). Building thinking classrooms in mathematics. Corwin.

Lithner, J. (2019). Mathematical reasoning and creativity. Educational Studies in Mathematics, 102(1), 1–16.

Maurer, T. J. (2021). Knowledge transfer in organizations. Journal of Applied Psychology, 106(2), 200–215.

Mason, J., Burton, L., & Stacey, K. (2021). Thinking mathematically. Pearson Education.

Nührenbörger, M., & Steinbring, H. (2021). Mathematical connections in learning. Educational Studies in Mathematics, 108(1), 1–20.

Oliveira, H., et al. (2021). Preservice teachers' mathematical reasoning. International Journal of Science and Mathematics Education, 19(4), 789–805.

Pentang, J., et al. (2023). Mathematical problem solving among preservice teachers. Asia Pacific Journal of Education, 43(2), 201–218.

Peijie, Z., et al. (2022). Teacher beliefs in problem solving. Journal of Mathematics Teacher Education, 25(3), 301–320.

Philipp, R. A. (2021). Representational fluency in mathematics. Mathematics Education Research Journal, 33(1), 45–62.

Pincheira, N., & Alsina, Á. (2021). Early algebra and teacher knowledge. International Journal of Early Childhood Mathematics, 19(2), 89–104.

Planas, N., & Morgan, C. (2021). Communication in mathematics classrooms. Educational Studies in Mathematics, 108(2), 1–18.

Postareff, L., et al. (2020). Postgraduate study and professional growth. Teaching in Higher Education, 25(5), 567–583.

Prediger, S., & Zindel, C. (2019). Language in mathematics learning. Journal of Mathematics Teacher Education, 22(3), 231–250.

Ramirez-Uclés, R., & Ruiz-Hidalgo, J. F. (2022). Geometric reasoning in students. Educational Studies in Mathematics, 111(1), 1–20.

Rocha, K. (2019). The role of proof in school mathematics. ZDM Mathematics Education, 51(3), 455–470.

Rocena, A. (2019). Mathematical communication among Filipino students. Philippine Journal of Education Research, 12(1), 45–60.

Santos Trigo, M. (2024). Mathematical problem solving research trends. ZDM Mathematics Education, 56(1), 1–18.

Savic, M., & Makiewicz, M. (2021). Development of reasoning skills. Educational Studies in Mathematics, 107(2), 201–218.

Scherer, R., Siddiq, F., & Tondeur, J. (2021). Technology and teaching effectiveness. Computers & Education, 158, Article 103990.

Schoenfeld, A. H. (2021). Mathematical thinking and problem solving. Educational Studies in Mathematics, 107(1), 1–20.

Schoenfeld, A. H. (2022). Expert mathematical thinking. Journal for Research in Mathematics Education, 53(1), 1–18.

Sfard, A. (2019). Communication in mathematics learning. Educational Studies in Mathematics, 100(2), 123–140.

Setianingsih, R., Budiarto, M., & Jamil, N. (2025). Mathematical writing and proof. International Journal of Mathematical Education, 57(1), 45–62.

Shidqiya, F., & Sukestiyarno, Y. (2022). Self-efficacy and mathematical thinking. Journal of Mathematics Education, 13(2), 101–118.

Stronge, J. H. (2020). Qualities of effective teachers. ASCD.

Stylianides, A. J. (2020). Proof in mathematics education. Educational Studies in Mathematics, 105(1), 1–18.

Sullivan, P., et al. (2020). Mathematical connections in learning. Mathematics Education Research Journal, 32(3), 345–360.

Tabuyo, A. T. (2024). Metacognitive theory in mathematics education. Asian Journal of Education Research, 10(1), 55–70.

Tobondo, Y. A. (2024). Reflective teaching practices. Journal of Teacher Education Studies, 12(2), 88–102.

Toker, Z. (2023). Reflective practice in teaching. Teaching and Teacher Education, 118, Article 103832.

Trisnani, R., et al. (2024). Challenges in mathematics instruction. International Journal of Instruction, 17(1), 101–120.

Uyen, B. P., et al. (2021). Mathematical thinking development. International Journal of Learning, Teaching and Educational Research, 20(6), 38–65.

Valle, M. (2024). Mathematics teacher training post-pandemic. Philippine Journal of Teacher Education, 9(1), 15–30.

Velez, R., & Abuzo, J. (2022). Self-efficacy in mathematics learning. Philippine Journal of Education Psychology, 14(2), 77–95.

Weingarden, M., & Buchbinder, O. (2023). Teacher reasoning and proof tasks. Journal of Mathematics Teacher Education, 26(2), 201–220.

Yang, Y., Kaiser, G., & Sohn, K. (2021). Reasoning-based instruction in mathematics. ZDM Mathematics Education, 53(2), 1–16.

Zhu, Y., et al. (2024). Teachers' mathematical thinking in instruction. International Journal of STEM Education, 11(1), 60–78.