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Immersion into Mathematics Instruction: An Ethnography on the Development of Problem-Solving Skills by Homogenized Grade 10 Learners

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Abstract

This study examined the development of mathematical problem-solving skills among homogenized Grade 10 learners of Ramon Magsaysay Cubao High School through immersion in mathematics instruction, considering both teacher and learner perspectives. Anchored on theories related to classroom management, social cognitive learning, self-regulated learning, cognitive load, constructive alignment, and educational effectiveness, the study employed a qualitative ethnographic research design. Data were gathered through classroom observations, semi-structured interviews with four Grade 10 mathematics teachers, focused group discussions with twenty selected learners, lesson plan analysis, and field notes involving approximately 150 learners from four homogenized classes. The findings revealed that mathematics instruction was generally structured, MELC-aligned, and supported by step-by-step explanations, guided practice, questioning, peer interaction, and teacher modeling. However, problem-solving development was limited by fast pacing, formula confusion, anxiety, time pressure, mental blocking, and dependence on teacher or peer support. Learners commonly used strategies such as rereading problems, consulting examples, asking classmates or teachers, using trial-and-error, and seeking digital support. Across immersion cycles, clinical supervision helped teachers improve questioning, pacing, differentiation, conceptual integration, and classroom support, resulting in better learner engagement and gradual improvement in problem-solving participation. The study concludes that strengthening problem-solving skills requires a balance between procedural clarity, conceptual reasoning, emotional support, differentiated instruction, and sufficient thinking time. The study supports SDG 4, Quality Education, by focusing on improved mathematics instruction and learning outcomes, and SDG 10, Reduced Inequalities, by examining learning opportunities across homogenized class groupings. Its sustainability impact lies in promoting educational, institutional, and equity-oriented improvements through responsive teaching, instructional supervision, and inclusive mathematics support.

Keywords: Adaptive Teaching, Clinical Supervision, Ethnographic Research, Grade 10 Learners, Homogenized Classes, Mathematics Instruction, Problem-Solving Skills, Qualitative Research, Self-Regulated Learning

1. Introduction

Mathematics develops logical reasoning, analytical thinking, and problem-solving skills needed in school and daily life (Kilpatrick, Swafford, & Findell, 2001). In 21st-century education, problem solving is considered a critical competency because it allows learners to apply knowledge in meaningful and varied contexts (Trilling & Fadel, 2009). It involves understanding a problem, planning and testing strategies, and evaluating solutions (Polya, 1945), while also requiring flexible thinking, reflection, and adaptation to unfamiliar situations (Schoenfeld, 2013). Despite its importance, Filipino learners continue to face difficulties in mathematical problem solving, as shown in international and national assessments (OECD, 2019, 2022; SEAMEO INNOTECH, 2019). This study examined the development of problem-solving skills among homogenized Grade 10 learners of Ramon Magsaysay Cubao High School through immersion in mathematics instruction, considering both teacher and learner perspectives.

1.1 Development of Problem-Solving Skills in Grade 10 Mathematics Instruction

Problem solving is central to mathematics education because it requires learners to analyze situations, generate strategies, justify solutions, and reflect on their reasoning (Polya, 1945; Schoenfeld, 2013). In Grade 10 Mathematics, learners are expected to interpret word problems, translate real-life situations into mathematical expressions, apply appropriate strategies, verify solutions, and explain their reasoning. These skills reflect both procedural fluency and conceptual understanding. However, many learners struggle with unfamiliar, non-routine, and multi-step problems. Although they may follow guided procedures and recall formulas, they often experience difficulty interpreting complex tasks, choosing strategies independently, and sustaining reasoning. These challenges may be connected to formula-based instruction (Boaler, 2016), memorization habits (Baroody, 2003), and classroom factors such as curriculum demands, class size, and diverse learner needs. At Ramon Magsaysay Cubao High School, Grade 10 learners are grouped into homogenized sections based on performance levels, making it important to explore how problem-solving skills develop within this specific classroom arrangement.

1.2 Teaching Practices, Learner Strategies, and Classroom Interactions in Mathematical Problem Solving

Related literature shows that teaching practices strongly influence learners' problem-solving development. Polya's (1945) model and Schoenfeld's (2013) metacognitive framework describe problem solving as a process of understanding, planning, executing, and reflecting. Boaler (2016) emphasizes inquiry-driven instruction, while Lester (2013) highlights teacher modeling as a way to help learners develop strategies. Darling-Hammond et al. (2017) also stress the importance of professional learning in sustaining effective pedagogy. International studies show that higher-order reasoning remains a challenge in mathematics education (OECD, 2019, 2022). Curriculum and assessment misalignment may contribute to this problem (Hopfenbeck et al., 2020), while overemphasis on procedures may limit transfer of learning (Hiebert & Grouws, 2007). In the Philippine context, teachers may lack preparation for problem-solving instruction (Ogena et al., 2020), and assessment-driven practices may limit authentic reasoning (Clores & Reganit, 2020). However, contextualized and metacognitive strategies have been shown to improve learner outcomes (Dinglasan et al., 2023; Presto & Menorca, 2023). Classroom interaction also shapes mathematical understanding. Discourse allows learners to explain reasoning, justify answers, and construct meaning through interaction. Meaningful questioning and discussion support conceptual understanding, while teacher-centered recitation may limit learner participation (Clores & Reganit, 2020). Learners' strategies, confidence, motivation, and emotions also affect problem solving. Self-efficacy, persistence, mindset, and metacognition influence how learners approach challenging tasks (Pajares & Miller, 1994; Schoenfeld, 2013; Bernardo, 2021).

1.3 Mathematics Problem-Solving Instruction in the Local, National, and Global Contexts

Globally, mathematics education has shifted toward reasoning, inquiry, and real-world application. Mathematical literacy requires learners to formulate, use, and interpret mathematics in meaningful contexts (OECD, 2023). This direction supports the need to move beyond procedural instruction toward reasoning-oriented learning (Boaler, 2016; Hiebert & Grouws, 2007; OECD, 2023). Nationally, the Philippine curriculum emphasizes problem-solving competencies through the Most Essential Learning Competencies. In Grade 10 Mathematics, learners are expected to interpret word problems, represent situations mathematically, select strategies, and verify solutions (Department of Education, 2020). However, studies show that implementation may remain procedural because of time constraints, curriculum demands, and limited training in conceptual teaching strategies (Ogena et al., 2020; Espinosa et al., 2023). Recent reforms, including the MELCs and the MATATAG Curriculum, reflect a shift toward competency depth and reasoning-oriented learning (Department of Education, 2020, 2024). Locally, this study focused on Ramon Magsaysay Cubao High School, where Grade 10 learners are grouped into advanced, proficient, developing, and beginning sections. Homogenized grouping may support instructional pacing but may also reinforce achievement gaps when not supported by adaptive teaching (Luschei & Jeong, 2021; Bernardo et al., 2022). This context makes it necessary to examine how teachers adapt instruction and how learners experience problem solving across performance-based groupings.

1.4 Theoretical and Conceptual Basis for Immersion-Based Mathematics Instruction

This study was anchored in theories that explain the relationship among instruction, classroom management, learner behavior, and mathematical problem solving. Frederic Jones' Theory of Positive Classroom Management emphasizes structured routines, clear expectations, student accountability, and efficient use of instructional time. These principles support a learning environment where students can participate actively and take responsibility for learning. Social Cognitive Theory explains that learning occurs through interaction among personal factors, behavior, and environment. In this study, it supports the role of teacher modeling, peer interaction, and classroom engagement in developing problem-solving skills. Self-Regulated Learning Theory explains how learners plan, monitor, and evaluate their learning, while Cognitive Load Theory explains the need for clear pacing, scaffolding, and guided examples to prevent cognitive overload. Constructive Alignment Theory emphasizes the alignment of objectives, teaching strategies, and assessment, while the Dynamic Model of Educational Effectiveness highlights adaptive teaching based on learner needs and classroom context. The conceptual framework was thematic and ethnographic. It focused on the instructional environment, learner interaction, immersion with homogenized learners, and emerging themes from classroom observations, interviews, focus group discussions, and field notes. This framework allowed the study to interpret how learners' problem-solving skills developed within authentic Grade 10 mathematics classrooms.

1.5 Research Gaps and Rationale in Homogenized Grade 10 Mathematics Classrooms

Existing studies show that mathematical problem-solving development is shaped by instructional practices, learner dispositions, classroom interaction, curriculum alignment, and feedback. Effective instruction requires a shift from procedural teaching toward conceptual understanding, reasoning, and inquiry-based learning (Boaler, 2016; Hiebert & Grouws, 2007; OECD, 2023). However, many classrooms still provide limited opportunities for explanation, justification, and flexible strategy use (Ogena et al., 2020; Espinosa et al., 2023). Although previous studies have examined teaching practices, learner strategies, and curriculum implementation, few have explored how these elements interact in actual homogenized Grade 10 mathematics classrooms. There is also limited qualitative research documenting how instructional practices evolve across repeated classroom immersion and clinical supervision. This study addressed these gaps by using an ethnographic approach to examine teaching practices, classroom interactions, learner experiences, and instructional adaptations across three immersion sessions involving four mathematics teachers, four Grade 10 classes, and approximately 150 learners.

1.6 Alignment with Relevant Sustainable Development Goals in Mathematics Education

This study aligns with SDG 4 – Quality Education because it focuses on improving mathematics instruction, strengthening problem-solving competencies, and supporting meaningful learning among Grade 10 learners. Its emphasis on MELC-based instruction, teacher reflection, classroom interaction, and learner engagement supports efforts to improve instructional quality and learning outcomes in Philippine basic education. The study also relates to SDG 10 – Reduced Inequalities because it examines homogenized class groupings and the differences in learning opportunities among advanced, proficient, developing, and beginning learners. Since such grouping may reinforce achievement gaps if not supported by adaptive and inclusive instruction (Luschei & Jeong, 2021; Bernardo et al., 2022), the study may inform more equitable mathematics teaching practices.

1.7 Importance of the Study to Educational, Institutional, and Equity-Oriented Sustainability

The study contributes to educational sustainability by providing insights that may help teachers improve lesson planning, instructional delivery, classroom management, scaffolding, questioning, and assessment. By strengthening mathematical reasoning, confidence, persistence, and independent problem solving, the study supports learners' long-term academic development. It also contributes to institutional sustainability by giving school administrators evidence that may guide professional development, instructional supervision, and school-based programs for improving mathematics achievement. Its focus on homogenized Grade 10 classrooms also supports equity-oriented sustainability by helping teachers, parents, and future researchers understand learners' actual problem-solving challenges and develop more responsive instructional support.

2. Material and methods

2.1 Research Design

This study employed a qualitative ethnographic research design to explore how instructional practices influenced the development of mathematical problem-solving skills among homogenized Grade 10 learners. Ethnography focuses on understanding social interactions, behaviors, and perceptions within natural settings. This design was appropriate because it allowed the researcher to immerse in actual Grade 10 mathematics classrooms and observe teaching and learning processes as they occurred in real time. The study used multiple qualitative methods, including semi-structured interviews, focused group discussions, and classroom observations, which are commonly used in ethnographic research to gather rich and contextualized data. Each selected class underwent three immersion visits composed of one announced and two unannounced observations. This repeated observation supported prolonged engagement, which enhances the credibility of qualitative findings. The study also applied triangulation by combining teacher perspectives, learner experiences, classroom observations, and lesson plan analysis to strengthen the validity of the findings.

2.2 Locale of the Study

The study was conducted at Ramon Magsaysay Cubao High School, a public secondary school in District 4, Quezon City, Philippines. The school caters to learners from diverse socioeconomic backgrounds and implements the K to 12 Basic Education Curriculum prescribed by the Department of Education. Its mathematics instruction is guided by the Most Essential Learning Competencies (MELCs), which serve as the basis for lesson planning and instructional delivery. The school was selected because it represents an urban public secondary school context where large class sizes, varied learner abilities, and resource limitations are commonly experienced. It also reflects broader challenges in mathematics instruction observed in national and international assessments. Conducting the study in this setting provided contextually grounded insights into the teaching and learning of mathematical problem solving in Philippine public schools.

2.3 Respondents of the Study

The participants consisted of four Grade 10 mathematics teachers and approximately one hundred fifty (150) Grade 10 learners from four homogenized classes at Ramon Magsaysay Cubao High School. Each teacher handled one selected class, referred to as Class A, Class B, Class C, and Class D. These classes represented different performance groupings, including advanced, proficient, developing, and beginning learners. The teachers participated through individual semi-structured interviews, where they shared their instructional practices, challenges, and strategies in teaching mathematical problem solving. The learners participated through focused group discussions. Five learners from each class were selected for the FGDs, resulting in a total of twenty learner participants. This structure allowed the study to include both teacher and learner perspectives in understanding how problem-solving skills were taught, learned, and experienced in Grade 10 mathematics classrooms.

2.4 Sample and Sampling Procedure

The study used purposive sampling to select participants who could provide in-depth and meaningful insights. At the class level, four Grade 10 sections were selected, with one representative section from each homogenized performance grouping. This ensured that different learner abilities and classroom contexts were represented while keeping the study manageable. Within each selected class, five learners were chosen in consultation with their teachers. The inclusion criteria were willingness to participate voluntarily, representation of different performance levels, consistent attendance in mathematics classes, and ability to communicate learning experiences during discussions. Learners were assigned codes such as A1–A5, B1–B5, C1–C5, and D1–D5 to preserve confidentiality. This sampling procedure aligned with the qualitative ethnographic design because the goal was not statistical representativeness but the collection of rich, varied, and meaningful data.

2.5 Research Instrument

The study used three main instruments: a semi-structured interview guide, a focused group discussion guide, and an observation checklist. The semi-structured interview guide was used with the four Grade 10 mathematics teachers and focused on their instructional practices, challenges, and strategies in teaching problem solving. The FGD guide was used with the twenty selected learners and included prompts about their experiences in mathematics instruction, problem-solving strategies, and classroom interactions. The observation checklist was used during classroom immersion to record teacher instructional practices, learner participation, peer collaboration, and problem-solving approaches. It was supplemented by field notes to capture contextual details and classroom dynamics. The instruments were aligned with the research questions and the qualitative ethnographic approach. The instruments were validated by four experts: one Guidance Counselor, one Language Expert, and two Master Teachers in Mathematics. They evaluated the tools in terms of content validity, appropriateness of questions, clarity of language, and alignment with the study's focus on mathematical problem solving. Revisions were made based on their comments, particularly on question wording, sequencing, clarity, and alignment with the study objectives. The instruments were also pilot-tested in a non-participating class before formal data collection.

2.6 Data Gathering Procedure

Data collection was conducted during a three-week classroom immersion in the Grade 10 mathematics classes of Ramon Magsaysay Cubao High School. Before the immersion, permission was secured from the school principal and participating teachers, and informed consent was obtained from the learners and their parents or guardians. Each of the four homogenized classes was observed three times following the natural instructional schedule. The first immersion was an announced observation that established baseline instructional practices. The second and third immersions were unannounced observations that documented regular classroom instruction, monitored instructional strategies, and validated observed teaching practices. Observations focused on problem-solving lessons, learner engagement, classroom interaction, and the instructional and cognitive strategies used by teachers and learners. After the observation phase, individual interviews were conducted with the four mathematics teachers at convenient schedules. Focused group discussions were then conducted with five selected learners from each class. These discussions were facilitated using a prepared protocol and were audio-recorded with participants' consent to ensure accuracy.

2.7 Data Analysis Techniques

The study applied ethnographic thematic analysis. Each homogenized Grade 10 classroom was treated as a distinct cultural case with its own instructional routines, interaction patterns, and shared meanings. Interviews, FGDs, and observation notes were organized by class, and audio recordings were transcribed verbatim and translated when necessary. The researcher repeatedly read the transcripts and field notes to gain a holistic understanding of each classroom context. Coding was conducted within each class dataset to identify recurring phrases, behaviors, and interaction patterns related to problem-solving instruction. These codes were grouped into categories and refined into class-specific themes describing teaching practices, learner strategies, emotional responses, and classroom interactions. After class-level themes were established, a cross-class synthesis was conducted to identify shared patterns across the four classrooms. The purpose was not to statistically compare classes but to understand how similar instructional structures operated in different classroom cultures. Trustworthiness was ensured through member checking, peer debriefing with the adviser, and an audit trail documenting coding decisions.

2.8 Ethical Considerations

The study followed ethical standards in educational research. Approval was sought from the appropriate authorities, including the school principal and the Division Office of Quezon City. Written informed consent was obtained from the participating teachers, learners, and the parents or guardians of minor participants. The consent forms explained the purpose of the study, the nature of participation, and the voluntary right to withdraw at any time without penalty. Confidentiality was maintained by assigning codes to all participants, such as Teacher T1–T4 and Learners A1–D5. Audio recordings, transcripts, and observation notes were stored in password-protected digital files accessible only to the researcher, while hard copies were kept securely. The study upheld beneficence, respect for persons, and justice by ensuring that participation did not expose respondents to harm or risk. The research also complied with the ethical guidelines of the Department of Education and the Data Privacy Act of 2012 (Republic Act 10173).

3. Results and Discussion

3.1 Teaching Practices and Classroom Interactions in Problem-Solving Instruction

3.1.1 Step-by-Step Teaching and Guided Practice

The findings showed that Grade 10 mathematics teachers commonly used step-by-step explanations, board examples, worked examples, and guided practice when teaching problem-solving tasks. Learners also confirmed that their teachers usually explained the process first, gave examples, and then allowed them to practice independently. Visual aids, PowerPoint presentations, repeated explanations, and gradual movement from easy to difficult examples were also observed. However, some learners reported that fast pacing made it difficult for them to follow the lesson, especially when complex solutions were presented quickly. These findings show that problem-solving instruction was largely structured and procedural. The use of guided examples and gradual practice supported learners in understanding solution steps and reflected Polya's (1945) problem-solving framework, particularly the stages of understanding and planning. The use of scaffolding was also consistent with Vygotsky's concept of guided support, while visual and verbal representations supported Paivio's Dual Coding Theory. Repetition supported Bloom's Mastery Learning framework, but concerns about pacing aligned with Cognitive Load Theory, which explains that excessive instructional speed may overwhelm learners' working memory.

3.1.2 Classroom Interaction and Collaborative Problem Solving

The results showed that teachers encouraged classroom interaction through questioning, board recitation, peer discussion, hints, and collective checking of answers. Learners described classroom interaction as active and supportive, with students asking questions, teachers re-explaining unclear steps, classmates helping one another, and teachers moving around to check notebooks and give clues. However, uneven participation was also observed, as some learners remained quiet because of shyness, fear of mistakes, or lack of understanding. These findings indicate that classroom interaction supported learners' mathematical engagement but remained partly teacher-directed. Questioning, board work, and peer collaboration promoted mathematical discourse and shared reasoning, which is consistent with Walshaw and Anthony (2008). Peer support reflected cooperative learning dynamics, while teacher hints supported Vygotsky's Zone of Proximal Development and Schoenfeld's (2013) emphasis on reflective problem solving. However, the persistence of quiet or hesitant learners suggests that affective factors influenced participation, showing the need for a classroom climate that normalizes mistakes and encourages equitable learner voice.

3.1.3 Procedural Instruction, MELC Alignment, and Problem-Solving Opportunities

The findings revealed that teachers generally balanced procedural teaching with problem-solving tasks by modeling procedures first and then allowing learners to attempt exercises. Teachers reported that lesson plans and task selections were aligned with the Most Essential Learning Competencies. Classroom observations confirmed that problem-solving tasks were introduced clearly and that questioning was used to guide reasoning. However, in some lessons, procedural instruction was more dominant, resulting in fewer open-ended opportunities for learners to reason independently. These findings suggest that MELC alignment was present, but deeper problem-solving development required stronger balance between procedural fluency and conceptual reasoning. Structured modeling helped learners follow solutions, but excessive dependence on procedures may limit independent mathematical thinking. In homogenized classes, this balance is especially important because instructional pacing and task design affect the class collectively. The findings therefore indicate that teachers must maintain procedural clarity while gradually increasing opportunities for reasoning, explanation, and independent solution attempts.

3.2 Cognitive, Emotional, and Behavioral Patterns in Problem-Solving Engagement

3.2.1 Anxiety, Confusion, and Mental Blocking

The findings showed that learners experienced anxiety, nervousness, pressure, fear of failure, confusion in selecting formulas, and mental blocking during mathematical problem-solving tasks. Teachers observed that learners often struggled to understand what the problem asked, recall appropriate formulas, and sustain reasoning during multi-step solutions. Learners confirmed these difficulties, noting that they often felt pressured, forgot equations, mixed up rules, or became overwhelmed by long word problems and mathematical terminologies. These results show that mathematical problem solving was both a cognitive and emotional experience for learners. Anxiety interfered with attention and working memory, which is consistent with Ashcraft (2002). Difficulties in interpreting word problems reflected challenges in problem representation, as explained by Mayer (2002). Confusion in formula selection and mental blocking were also consistent with Cognitive Load Theory (Sweller, 1988) and working memory models. These findings suggest that learners need not only procedural instruction but also emotional support and explicit guidance in understanding, representing, and planning solutions.

3.2.2 Time Pressure, Incomplete Work, and Learner Confidence

The results revealed that time pressure was a common difficulty among learners. Many reported that they ran out of time during long problem-solving tasks and sometimes submitted incomplete answers. Learners also described memorable experiences of both success and failure, such as correctly solving a problem on the board or experiencing a blank mind during tests. These experiences shaped their confidence and willingness to participate in future problem-solving activities. These findings suggest that time pressure intensified learners' anxiety and reduced processing efficiency. This supports Eysenck & Calvo (1992), who explained that anxiety affects performance under pressure. Success and failure experiences also influenced learners' self-efficacy, which is consistent with Bandura (1997). Since learners in homogenized classes shared similar emotional experiences, their anxiety and confidence appeared to operate at a group level. Instruction should therefore provide sufficient thinking time, repeated explanation, and supportive feedback to strengthen confidence and persistence.

3.2.3 Observed Engagement and Problem-Solving Behavior

Observation data showed that learners generally paid attention, followed instructions, attempted to solve independently, asked questions, used formulas and rules, and persisted when given hints or examples. However, conceptual reasoning appeared more often among confident learners, while self-checking occurred mainly when prompted by the teacher. Learners were frequently observed copying solution steps, waiting for cues, and revisiting answers after teacher feedback. These findings indicate that learners demonstrated behavioral engagement but were still developing independent metacognitive skills. Visible attention and task participation reflected behavioral engagement. Attempts to solve before asking for help suggested emerging self-regulation, while continued effort after hints reflected the importance of scaffolding. The dominance of formulas and modeled steps reflected procedural learning (Anderson, 1982), while limited conceptual explanation showed the need to strengthen deeper understanding (Hiebert & Lefevre, 1986). Self-checking with teacher prompts aligned with metacognitive monitoring.

3.3 Learner Strategies in Responding to Challenging Mathematical Tasks

3.3.1 Rereading, Consulting Notes, and Seeking Help

The findings showed that learners used several common strategies when they could not solve a problem immediately. These included rereading the problem, identifying given information, consulting notes or board examples, asking classmates for help, and asking the teacher to repeat the solution step-by-step. Teachers also observed that learners often asked seatmates first, then sought teacher guidance when their strategies were ineffective. These strategies show that learners were actively trying to cope with difficult tasks rather than avoiding them. Rereading and analyzing the problem reflected heuristic problem-solving behavior and aligned with Polya (1957). Consulting examples reflected cognitive apprenticeship, where learners rely on modeled procedures to guide their own attempts. Peer consultation reflected cooperative learning and shared reasoning, while teacher re-explanation and hints reflected instructional scaffolding (Wood et al., 1976). However, frequent dependence on teacher and peer support suggests the need to develop stronger independent strategy selection.

3.3.2 Trial-and-Error, Digital Support, and Self-Regulation

Learners also used trial-and-error, tried different formulas, watched YouTube tutorials, used online resources when allowed, and skipped difficult items to return to them later. These strategies appeared across classes and showed that learners used both classroom-based and independent resources to manage difficult tasks. Skipping difficult items and returning later also showed attempts to regulate time and emotions during problem solving. These findings indicate that learners had a shared strategy culture shaped by their classroom experiences and performance grouping. Trial-and-error reflected exploratory reasoning and heuristic experimentation (Polya, 1957), though it may also suggest uncertainty in conceptual understanding. Returning to basic concepts reflected spiral instructional design. The use of online tutorials demonstrated self-directed learning behavior, while skipping and returning to items reflected self-regulated learning processes. These results suggest that teachers should explicitly teach learners how to choose strategies, check solutions, and manage confusion independently.

3.4 Instructional Improvements for Homogenized Grade 10 Mathematics Classes

3.4.1 Teacher-Identified Instructional Needs

Teachers identified several ways to strengthen learners' problem-solving skills, including more real-life and contextualized problems, visual aids, manipulatives, diagrams, digital tools, updated modules, well-constructed problem sets, and more training on problem-solving models and strategies. Teachers also emphasized the need for manageable class sizes, enough time for thinking, collaborative planning, and sharing of best practices among teachers. These findings show that improving problem-solving instruction requires support in pedagogy, resources, and school systems. Contextualized problems support situated learning because authentic tasks help deepen understanding. Visual aids and diagrams support cognitive processing through dual coding (Paivio, 1986). Digital tools align with technology-enhanced pedagogy. Professional development and collaborative planning support sustained teacher learning (DuFour, 2004), while updated materials and systematic task design relate to curriculum alignment. Adequate time for thinking also supports cognitive processing and wait time.

3.4.2 Learner-Identified Instructional Needs

Learners suggested slower step-by-step explanations, more practice problems with feedback, clearer explanations of formulas and when to use them, more real-life and visual problem situations, more opportunities to ask questions without embarrassment, and the use of videos or technology to demonstrate solutions. Across classes, learners emphasized that they understood better when teachers repeated examples, explained gradually, checked their work, and clarified mistakes. These findings indicate that learners need instruction that is clear, scaffolded, supportive, and responsive to their emotional needs. Slower pacing and wait time help reduce anxiety and improve cognitive processing. Practice with corrective feedback strengthens learning and accuracy. Clear explanation of formulas supports conceptual development and spiral learning (Bruner, 1960). Real-life and visual situations support situated learning, while safe questioning reflects the social nature of learning. Interest in videos and digital demonstrations also supports technology-enhanced instruction (Mishra & Koehler, 2006).

3.4.3 Shared Instructional Priorities Across Classes

The synthesis of teacher and learner responses showed shared priorities in instructional pacing, practice and feedback, conceptual explanation, contextual learning, classroom climate, and technology integration. All classes needed more guided practice, while slower pacing was most emphasized in lower-confidence groups. Clear formula explanation was strongly needed in mid-performing groups, real-life contexts were most emphasized in Class C, safe questioning was prominent in Class A, and technology support emerged across Classes B to D. These findings suggest that homogenized classes share common instructional needs but also differ in emphasis. The convergence between teacher and learner perspectives shows that instructional improvement should not be treated as isolated preference but as a coordinated response to cognitive and emotional learner needs. This supports Darling-Hammond et al. (2017), who emphasize responsive instruction, and Boaler (2016), who highlights the role of positive classroom relationships and psychological safety in mathematical engagement.

3.5 Instructional Development Across Immersion Cycles

3.5.1 Class A: From Procedural Modeling to Emerging Conceptual Reasoning

The three immersion cycles in Class A showed a gradual shift from strong procedural control toward emerging conceptual reasoning. During the first immersion, the teacher demonstrated effective classroom management, high participation, MELC-aligned planning, and step-by-step modeling. Learners were attentive and described the instruction as clear and systematic, but responses were mostly short and formula-driven. After clinical supervision, the teacher increased conceptual questioning, cross-curricular integration, and reflective prompts. By the third immersion, learners showed greater confidence and more willingness to explain solution processes. This development suggests that procedural clarity served as a foundation for later conceptual growth. The initial emphasis on solution steps aligned with Polya's (1945) procedural problem-solving framework, but the limited reasoning showed the need for metacognitive extension. Clinical supervision guided the teacher toward deeper content integration and higher-order questioning. The improvement in learner reasoning suggests that homogenized learners respond positively when structured modeling is maintained while conceptual questioning is gradually strengthened.

3.5.2 Class B: Strengthening Affective Engagement and Reflection

The findings in Class B showed that instruction began with structured procedural activities and guided group work, but learner reflection and affective engagement were initially limited. Learners reported feeling pressured by long problem-solving tasks and often waited for teacher validation before proceeding. After clinical supervision, reflective questioning and affective check-ins were introduced. By the third immersion, learners showed reduced hesitation, increased participation, and stronger peer consultation. These findings indicate that emotional regulation and reflective questioning are important in problem-solving development. The initial dependence on teacher validation reflected procedural emphasis consistent with Polya (1945), but limited metacognitive engagement. Clinical supervision encouraged reflective prompts and affective support. The later improvement aligned with Vygotsky's (1978) concept of scaffolding, where structured support helps learners move toward greater independence.

3.5.3 Class C: From Recall-Based Questioning to Higher-Order Thinking

Class C showed a clear movement from recall-based questioning to differentiated and higher-order instruction. During the first immersion, the teacher used structured objectives and organized tasks, but most questions required recall or direct application. Learners were attentive but gave brief, formula-driven answers. After supervision, the teacher incorporated higher-order questions, differentiated tasks, tiered activities, and flexible grouping. By the third immersion, learners showed more reasoning, justification, and participation across ability levels. This progression shows that learners benefited when instruction moved beyond recall and direct application. The initial pattern reflected the lower levels of Bloom's taxonomy, focusing on remembering and applying rather than analyzing or evaluating. Clinical supervision encouraged higher-order thinking, differentiated tasks, and conceptual integration (Cogan, 1973; Goldhammer, 1969). The resulting improvement suggests that homogenized learners can engage in deeper reasoning when tasks are intentionally designed to require explanation and application.

3.5.4 Class D: Refining Differentiated Instruction and Conceptual Participation

Class D initially showed supportive classroom practices, guided seatwork, teacher hints, and some differentiated instruction. Learners described the teacher as encouraging and helpful, but many still relied on teacher confirmation before proceeding. During the second immersion, activities remained mostly uniform and higher-order questioning was limited. By the third immersion, the teacher introduced more structured differentiated tasks, tiered questioning, and reasoning prompts, leading to improved participation and greater willingness among learners to attempt solutions independently. These findings indicate that differentiation must be intentionally structured to support conceptual engagement. Teacher hints reflected scaffolded assistance within the Zone of Proximal Development (Vygotsky, 1978), but the early emphasis remained on guided correction rather than independent reasoning. The later use of tiered questioning and reasoning prompts reflected a move toward metacognitive engagement in mathematical problem solving (Schoenfeld, 2013). Clinical supervision helped transform loosely applied differentiation into purposeful instructional practice (Cogan, 1973; Goldhammer, 1969).

3.6 Synthesis of Problem-Solving Development Among Homogenized Learners

The overall findings showed that the development of problem-solving skills among homogenized Grade 10 learners was shaped by the interaction of instructional clarity, pacing, classroom interaction, emotional experiences, strategy use, and instructional support. Learners responded positively to clear step-by-step modeling, repeated examples, visual supports, contextualized tasks, guided practice, and safe opportunities to ask questions. However, fast pacing, formula confusion, anxiety, time pressure, and dependence on teacher guidance limited independent problem-solving development. These findings suggest that homogenized grouping affects not only academic pacing but also shared cognitive and emotional experiences. When instruction was clear, appropriately paced, and emotionally supportive, learners showed greater engagement, persistence, and willingness to explain their thinking. When these conditions were lacking, confusion and anxiety emerged collectively. This supports Hiebert and Grouws' (2007) view that effective mathematics instruction requires time for sense-making, and it aligns with research on mathematics anxiety and performance (Pajares & Miller, 1994). It also supports Luschei and Jeong (2021), who argue that homogenized grouping can intensify shared learning experiences depending on instructional support.

3.7 Overall Discussion

The study revealed that problem-solving instruction in homogenized Grade 10 mathematics classes was generally organized, MELC-aligned, and supported by teacher modeling, questioning, guided practice, and peer interaction. Learners were engaged and used several strategies such as rereading, consulting examples, asking peers, seeking teacher guidance, and trying alternative solution paths. However, their problem-solving development was constrained by anxiety, limited formula understanding, time pressure, and dependence on external support. Overall, the findings suggest that effective problem-solving instruction for homogenized learners requires a balanced approach that combines procedural clarity with conceptual reasoning, emotional support, strategic instruction, differentiated tasks, and sufficient thinking time. Learners need to be taught not only how to solve mathematical problems but also how to select strategies, monitor understanding, manage difficulty, and explain reasoning. Clinical supervision across the immersion cycles showed that instructional practices improved when teachers received feedback and adjusted their questioning, pacing, differentiation, and conceptual integration. Thus, strengthening problem-solving skills in homogenized Grade 10 mathematics classrooms requires sustained, responsive, and reflective teaching practices.

4. Conclusion & Recommendations

The study concluded that the development of mathematical problem-solving skills among homogenized Grade 10 learners was shaped by the interaction of instructional practices, learner behavior, classroom engagement, emotional factors, and adaptive teaching strategies. Teaching across the observed classes was mostly procedural, teacher-guided, and focused on step-by-step explanation and guided practice, which supported procedural accuracy but limited deeper conceptual understanding and independent problem solving. Learners experienced cognitive and emotional barriers such as difficulty interpreting problems, selecting formulas, sustaining reasoning, anxiety, confusion, and mental blocking. They also relied on support-dependent strategies, including rereading problems, consulting examples, asking peers or teachers, and using trial-and-error. However, the immersion process and clinical supervision showed that instructional practices improved when teachers adjusted questioning, pacing, differentiation, and classroom support, leading to better engagement and gradual improvement in problem-solving performance.

Mathematics teachers should balance procedural instruction with conceptual and inquiry-based strategies by using clear explanations, higher-order questioning, real-life problem contexts, guided discovery, reflective tasks, and learner-centered problem-solving activities. Learners should strengthen self-regulated learning by attempting solutions independently, checking their work, reflecting on errors, using supplementary learning resources, and collaborating with peers responsibly. School heads and instructional leaders should support regular clinical supervision, professional development, collaborative lesson planning, and monitoring of classroom instruction aligned with higher-order thinking competencies. Curriculum planners and DepEd officials should provide instructional materials and assessment frameworks that emphasize conceptual understanding, real-life applications, and problem-solving competencies. A supportive classroom climate should also be maintained by encouraging questions, normalizing mistakes, providing sufficient thinking time, promoting inclusive participation, and strengthening respectful collaboration.

The study was limited to homogenized Grade 10 mathematics classes in one school context; therefore, its findings were mainly descriptive, contextual, and based on the experiences of the selected teachers and learners. Since the study used a qualitative ethnographic approach, the results were not intended for broad statistical generalization across all schools or learner groups. Future studies may expand the scope to multiple schools or regions, use mixed-method approaches, examine the long-term impact of conceptual teaching strategies, explore technology integration in mathematical problem solving, and compare experiences between heterogeneous and homogenized classrooms.

Compliance with ethical standards

The study followed ethical standards in educational research and complied with the ethical guidelines of the Department of Education and the Data Privacy Act of 2012 (Republic Act 10173). Confidentiality was maintained by assigning codes to all participants, such as Teacher T1–T4 and Learners A1–D5. Audio recordings, transcripts, and observation notes were stored in password-protected digital files accessible only to the researcher, while hard copies were kept securely. The study upheld beneficence, respect for persons, and justice by ensuring that participation did not expose respondents to harm or risk.

REFERENCES

Anderson, J. R. (1982). Acquisition of cognitive skill. Psychological Review, 89(4), 369–406. https://doi.org/10.1037/0033-295X.89.4.369

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. Current Directions in Psychological Science, 11(5), 181–185. https://doi.org/10.1111/1467-8721.00196

Bandura, A. (1997). Self-efficacy: The exercise of control. W. H. Freeman. https://books.google.com/books/about/Self_Efficacy.html?id=eJ-PN9g_o-EC

Baroody, A. J. (2003). The development of adaptive expertise and flexibility: The integration of conceptual and procedural knowledge. Educational Psychologist, 38(3), 175–193. https://doi.org/10.1207/S15326985EP3803_3

Bernardo, A. B. I. (2021). Mindsets matter: How student beliefs shape mathematics learning in the Philippines. Asia Pacific Education Review, 22(2), 237–249. https://doi.org/10.1007/s12564-020-09665-9

Bernardo, A. B. I., Tan, J., & Ocampo, D. (2022). Rote memorization and problem-solving: Persistent practices in Philippine classrooms. Philippine Journal of Psychology, 55(1), 65–84.

Boaler, J. (2016). Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages, and innovative teaching. Jossey-Bass.

Bruner, J. S. (1960). The process of education. Harvard University Press. https://archive.org/details/processofeducati0000brun

Clores, M. A., & Reganit, M. F. (2020). Assessment practices and student learning in mathematics: Insights from Philippine classrooms. Asia Pacific Social Science Review, 20(2), 1–14.

Cogan, M. L. (1973). Clinical supervision. Houghton Mifflin. https://books.google.com/books/about/Clinical_Supervision.html?id=YlKdAAAAMAAJ

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Learning Policy Institute.

Department of Education. (2020). Most Essential Learning Competencies (MELCs) with guidelines on the use of MELCs. Department of Education.

Department of Education. (2024). Policy guidelines on the implementation of the MATATAG Curriculum (DepEd Order No. 010, s. 2024). https://www.deped.gov.ph/2024/07/23/july-23-2024-do-010-s-2024-policy-guidelines-on-the-implementation-of-the-matatag-curriculum/

Dinglasan, J. A., Ramos, R. J., & Villanueva, M. C. (2023). Realistic mathematics education in Philippine classrooms: Effects on students' problem-solving skills. Philippine Journal of Education Studies, 95(1), 45–62.

DuFour, R. (2004). What is a "professional learning community"? Educational Leadership, 61(8), 6–11. https://www.ascd.org/el/articles/what-is-a-professional-learning-community

Espinosa, A. A., Bernarte, R. P., & Reyes, M. J. (2023). Pre-service mathematics teachers' readiness in teaching problem solving: Challenges and opportunities. Philippine Normal University Research Journal, 18(2), 77–95.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. Cognition and Emotion, 6(6), 409–434. https://doi.org/10.1080/02699939208409696

Goldhammer, R. (1969). Clinical supervision: Special methods for the supervision of teachers. Holt, Rinehart and Winston. https://books.google.com/books/about/Clinical_Supervision.html?id=2jVSAQAAIAAJ

Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. In F. K. Lester, Jr. (Ed.), Second handbook of research on mathematics teaching and learning (pp. 371–404). Information Age Publishing.

Hiebert, J., & Lefevre, P. (1986). Conceptual and procedural knowledge in mathematics: An introductory analysis. In J. Hiebert (Ed.), Conceptual and procedural knowledge: The case of mathematics (pp. 1–27). Lawrence Erlbaum Associates. https://doi.org/10.4324/9780203063538-1

Hopfenbeck, T. N., Lenkeit, J., El Masri, Y., Cantrell, K., Ryan, J., & Baird, J. (2020). Lessons learned from PISA: A systematic review of peer-reviewed articles on the Programme for International Student Assessment. Scandinavian Journal of Educational Research, 64(3), 333–353.

Kilpatrick, J., Swafford, J., & Findell, B. (2001). Adding it up: Helping children learn mathematics. National Academy Press.

Lester, F. K. (2013). Thoughts about research on mathematical problem-solving instruction. The Mathematics Enthusiast, 10(1/2), 245–278.

Luschei, T. F., & Jeong, D. W. (2021). The impact of ability grouping on equity in education: Global perspectives. Compare: A Journal of Comparative and International Education, 51(2), 196–214. https://doi.org/10.1080/03057925.2019.1633500

Mayer, R. E. (2002). Mathematical problem solving [ERIC record ED474730]. ERIC. https://eric.ed.gov/?id=ED474730

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

OECD. (2019). PISA 2018 results: What students know and can do. OECD Publishing. https://doi.org/10.1787/5f07c754-en

OECD. (2022). PISA 2022 results: Creative problem solving and mathematical reasoning. OECD Publishing. https://doi.org/10.1787/8a8ef40e-en

OECD. (2023). PISA 2022 results (Volume I): The state of learning and equity in education. OECD Publishing. https://doi.org/10.1787/53f23881-en

Ogena, E. B., Tan, J., & Magno, C. (2020). Preparing teachers for global competence in mathematics education: The Philippine case. Journal of Teacher Education, 71(5), 518–530. https://doi.org/10.1177/0022487120939303

Paivio, A. (1986). Mental representations: A dual coding approach. Oxford University Press. https://archive.org/details/mentalrepresenta0000paiv

Pajares, F., & Miller, M. D. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. Journal of Educational Psychology, 86(2), 193–203. https://doi.org/10.1037/0022-0663.86.2.193

Polya, G. (1945). How to solve it: A new aspect of mathematical method. Princeton University Press.

Polya, G. (1957). How to solve it: A new aspect of mathematical method (2nd ed.). Princeton University Press. https://openlibrary.org/works/OL4569830W/How_to_solve_it

Presto, A. G., & Menorca, R. T. (2023). Metacognitive strategy instruction in blended mathematics classrooms. Philippine Journal of Learning and Teaching, 9(2), 101–118.

Republic Act No. 10173, Data Privacy Act of 2012. (2012). Official Gazette of the Republic of the Philippines. https://www.officialgazette.gov.ph/2012/08/15/republic-act-no-10173/

Schoenfeld, A. H. (2013). Reflections on problem solving theory and practice. The Mathematics Enthusiast, 10(1/2), 9–34.

SEAMEO INNOTECH. (2019). Regional research on student learning outcomes in Southeast Asia. SEAMEO INNOTECH.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive Science, 12(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4

Trilling, B., & Fadel, C. (2009). 21st century skills: Learning for life in our times. Jossey-Bass.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press. https://books.google.com/books/about/Mind_in_Society.html?id=RxjjUefze_oC

Walshaw, M., & Anthony, G. (2008). The teacher's role in classroom discourse: A review of recent research into mathematics classrooms. Review of Educational Research, 78(3), 516–551. https://doi.org/10.3102/0034654308320292

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. Journal of Child Psychology and Psychiatry, 17(2), 89–100.