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TEACHING STRATEGIES OF OUT-OF-FIELD ELEMENTARY MATHEMATICS TEACHERS

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ABSTRACT

This qualitative study utilized narrative inquiry to investigate the strategies used by out-of-field elementary mathematics teachers in the San Pascual North District, Philippines. Five participants who majored in English, MAPEH, Filipino, and Science in college engaged in semi-structured interviews and a focus group discussion. Data were analyzed using Braun and Clarke's thematic analysis principles. Findings revealed that despite applying strategies such as Facilitation of Guided Learning, Strategic Use of Collaborative Learning, Leveraging Real-world Localized Problems, Differentiated Instruction, Maximizing Hands-on and Manipulative Tools, Explicit Teaching, Peer Explanation Protocols, Learning Progression Tracking, and Math Journaling, teachers consistently defaulted to pedagogic practices from their original fields rather than developing mathematics-specific strategies. English majors preferred narrative descriptions over numeric values, MAPEH majors emphasized competition over rigorous academic work, Filipino majors focused on storytelling while omitting quantitative information, and Science majors used procedure accuracy and inquiry methods unsuitable for mathematics. Although participants had four to eleven years of mathematics teaching experience, none cultivated sufficient mathematics-specific pedagogical content knowledge to alter their practices. The study concludes that expertise in original fields becomes pedagogical inertia hindering mathematics instruction without proper retraining, disproving the notion that years of teaching mathematics guarantee adequate mathematics-specific pedagogical knowledge. Recommendations include coaching cycles, intervention toolkits, subject-focused professional development, and mentoring with subject specialists. This research contributes asset-based literature to the field.

Keywords: *Out-Of-Field Teaching, Mathematics Instruction, Teaching Strategies, Pedagogical Content Knowledge, Elementary Education, Qualitative Research*

INTRODUCTION

For education to be effective, competent and communicative teachers are critical. Subject competence and communication lead to effective classroom environment creation as well as improved academic outcomes. However, the practice of allocating teachers outside their specialization remains difficult in the Philippines. Inadequate reform efforts and surplus graduates are among the major factors leading to poor educational quality in the country. In addition, there has been an increase in out-of-field instruction in the U.S (Weldon, 2016). It is obvious that there is inadequate research regarding the strategies and practices employed by out-of-field teachers. While most of the literature focuses on the negative issues such as low self-efficacy and use of teacher-centered approach, there are little details concerning the specific strategies and practices used by the out-of-field teachers to cope and perform successfully in the field. In addition, information regarding the same practices and strategies used locally is lacking. Understanding this gap is essential since it is important to know the exact ways in which resilience and innovations are used by the out-of-field teachers to cope with the situation and ensure that students benefit through quality education in the absence of subject-specific training.

The above problem is prevalent in San Pascual North District, Hence, it can be said that many of the students in San Pascual North learn Mathematics from teachers without necessary knowledge. It is important that this study focuses on examining specific problems and resources faced by out-of-field Math teachers in San Pascual North District and the coping strategies employed by them in relation to the same. The study is focused on how the teachers of the said district respond to their unique local constraints and strengths as well as coping strategies and practices derived from the experience of teaching Math in public schools. While concepts such as thinking classroom and gamification in teaching are typically examined under more favorable circumstances, in this study, it will focus on the adaptations of these teaching strategies by San Pascual North teachers.

By recording the adaptive strategies used by out-of-field mathematics teachers, this study offers important insights for various stakeholders and reframes the narrative away from a deficit-based view to emphasize their ingenuity and expertise. For DepEd officials and policymakers, the findings inform evidence-based professional development, recruitment, and support systems. School administrators gain practical best practices for mentoring, peer observation, and fostering a supportive school climate. Out-of-field mathematics teachers receive validation of their strategies, which can boost self-efficacy and serve as inspiration. Teacher education institutions can better prepare pre-service teachers for flexible, real-world teaching demands. Finally, future researchers are offered a qualitative foundation and theoretical framework for comparative, longitudinal, or intervention studies on out-of-field teaching in the Philippines.

Research Objective

The study sought to analyze the Teaching Strategies of Out-of-field Elementary Mathematics Teachers in the San Pascual, North District.

METHODOLOGY

Research Design

The qualitative research methodology with a narrative inquiry approach was utilized in conducting this study. This design was strategically chosen since the objective of the study was to conduct an in-depth analysis of the experiences of teachers who are out of field in Mathematics and their teaching strategies. Through the narrative inquiry design, the researcher would gain a rich and contextualized understanding of how these out-of-field teachers created meaning through their experience of implementing strategies when they are in a predicament. Narrative inquiry emphasizes stories told by individuals about their experiences. As opposed to testing the hypotheses, narrative inquiry was appropriate to use because the purpose was to provide rich description and interpretations. The use of narrative inquiry design allowed this study to have a more resource-oriented approach in examining the experiences and actions taken by the out-of-field teachers. In line with the philosophical assumption of social constructivism as a lens, knowledge can be considered as co-constructed within certain socio-cultural context. With social constructivist view, people are able to create their own subjective meanings depending on their interaction with others within their social context. Under the social constructivist paradigm, the narrative inquiry approach was suitable for gathering and analyzing narrative data from the participants using the interview technique. With the narrative inquiry design, the study had a bounded nature since the researchers would document the "how" and "why" of the OOF teachers' strategic actions by looking into the intersection of their general knowledge, teacher efficacy and using constructivist-discovery based instructional approaches. In doing so, rich and transferable results are expected from this study.

This study was conducted in the San Pascual North District, Philippines, focusing on public elementary schools within this district. The names of specific institutions are not disclosed as permission was not obtained for this purpose.

Sampling Method

Purposive sampling was employed to select participants who met specific criteria relevant to the research objective.

Respondents Profile

There were five participants in this study. All were elementary school teachers assigned to teach Mathematics but had college majors outside of Mathematics or Mathematics Education. Specifically, the participants majored in English, MAPEH, Filipino, and Science. Their teaching experience in mathematics ranged from four to eleven years.

Data Gathering Procedure

The data gathering procedure involved two main phases. First, semi-structured interviews were conducted individually with each participant to elicit detailed narratives of their teaching experiences, challenges, and strategies. Second, a focus group discussion (FGD) was held with all five participants to allow for collective reflection, validation of individual responses, and deeper exploration of shared themes. Both data collection activities occurred on November 28, 2025.

Research Instrument/s

The primary instruments used were a semi-structured interview guide and a focus group discussion protocol, both of which were researcher-made. The semi-structured interview guide contained open-ended questions designed to elicit participants' teaching strategies, challenges faced, and adaptations made while teaching mathematics out-of-field. The FGD protocol contained prompts aimed at facilitating group discussion on collaborative experiences and shared coping mechanisms. Both instruments underwent content validation by three experts in qualitative research, mathematics education, and curriculum development. Pilot testing was conducted with two out-of-field mathematics teachers not included in the actual study to refine question clarity, wording, and flow. No Likert scales were used as this was a qualitative study.

Data Analysis Techniques

Data were analyzed following the thematic analysis principles outlined by Braun and Clarke (2006). The process involved six phases: (a) familiarization with the data through repeated reading of interview and FGD transcripts, (b) generating initial codes from the participants' responses, (c) searching for themes across coded data, (d) reviewing themes for consistency and coherence, (e) defining and naming themes, and (f) writing the findings. Transcripts were returned to participants for member checking to ensure accuracy and credibility of interpretations.

Scope and Delimitations

The scope of this study entailed conducting an intensive research inquiry to analyze the teaching strategies utilized by out-of-field elementary Mathematics teachers in public schools in the San Pascual North District on November 28, 2025. The focus was on identifying and analyzing the teaching strategies used by out-of-field Elementary Mathematics teachers that they believed were working effectively for them, without assessing the achievements of the students taught by the teachers, and without examining the systemic reasons behind assigning out-of-field teachers to mathematics classes. A limitation of the study was the restriction to a single date for the data collection process, namely November 28, 2025. This single interview day prevented the researchers from gaining insight into the development and changes to teaching strategies adopted by the participants across various mathematical topics and in different classroom conditions. Therefore, the findings of this study can only be understood in terms of the resources available to the participants and the situation prevailing in the San Pascual North District at the designated time frame. Another delimitation is that the study was limited to the designated population of five participants, and a limitation is the inability to statistically generalize the qualitative findings of this study.

RESULTS

Research Objective: Teaching Strategies of Out-of-field Elementary Mathematics Teachers in the San Pascual, North District.

1. Out-of-field math teachers regularly don't do the "we do" part of guided learning, typically overuse direct instruction, remove the cognitive challenge far too soon, or misinterpret guided discovery as the same as independent discovery.

2. Out-of-field teachers often view cooperative learning as group activities or competition without establishing positive interdependence, providing individual accountability, or using structured academic talk as part of the cooperative learning process.

3. Out-of-field teachers routinely utilize pre-manufactured, clean data rather than guiding students to gather, organize, and analyze real-world and local data from their communities.

4. Out-of-field teachers often view differentiated instruction as an add-on rather than as a foundation by utilizing one-size-fits-all lectures, the same kinesthetic activities for all, or language that is more complex than necessary and not diagnosing student readiness.

5. Out-of-field teachers often misuse hands-on manipulative materials by passing them out randomly, using them for entertainment purposes only, over-scaffolding for exploration, or not linking hands-on experiences to abstract assessment.

6. Out-of-field teachers inconsistently use explicit teaching by confusing explaining with demonstrating, moving too quickly to independent practice, not including the lesson objectives, praising effort rather than accuracy, and using overly broad questioning strategies that miss individual student misunderstandings.

7. Out-of-field teachers create peer explanation protocols that emphasize procedural fluency over conceptual reasoning, lack individual accountability, accept retelling of student's work at a very surface level and not defending it,

make their structures unnecessarily complicated or vague positive comments as opposed to mathematical critique.

8. Out-of-field teachers do not accurately track learning progressions by utilizing long narratives, using tables that have no labels, using inconsistent color coding, creating charts where the lines break, and creating single-point graphs that do not provide good individual progressions for their students.

9. Out-of-field teachers typically do not approach math journals using numerical precision first, instead rely heavily on narrative descriptions, provide a lack of organization to the data they provide, omit or do not use a complete unit of measure to describe their data, provide multiple observations without a synthesis of their observations, or provide very little analysis of their data without evidence to support their reasoning.

DISCUSSION

Narrative Profile of the Respondents

Five people in San Pascual, Masbate's coastal area separated from their original backgrounds to the rewarding yet challenging area of Mathematics Education. Teacher A, 31-years-old in Boca Chica; she is an English major who has spent almost 9 of ten years teaching Mathematics at Boca Chica Integrated School, where she was recognized as an Outstanding Teacher and is working on her MAEd in Administration and Supervision at Lipa City Colleges. Teacher B, the youngest at 29 years of age, is based at Acacia Elementary School and moved from MAPEH to teach four years of Grade 6 Mathematics. Teacher B, too, has been designated Outstanding Teacher, is in graduate studies at the University of North Eastern Philippines, and has also created a successful line of products. Teacher C, 31 years old in Sulficio Elliott Elementary School; she has a degree in Filipino yet has spent all 11 years of her teaching career instructing Grade 6 Mathematics and has developed a series of accomplishments such as Most Outstanding Focal Person, WINS Coordinator, and Brigada Basa Implementer and accumulated in her master's degree 36 units at the Unibersidad de Sta Isabel. Teacher D is the oldest of the group at 35 years of age and has 15 years of experience teaching Grade 5 Mathematics at Dr. Antero M. Nazareno Elementary School, despite having graduated Science. Teacher D has received the Best Reading Teacher award and is preparing for leadership through graduate studies at Osmena University. Finally, Teacher E is 29 years old and has worked five full years as a Grade 4 Mathematics Teacher at Adelina P. Laurio Integrated School. Teacher E continues to earn accolades such as Best Brigada Eskwela Implementer and Best Reading Teacher, including Academic Distinction and is working on her MAEd degree at the University of Saint Anthony.

The five teachers in this study are all well-developed professionally and are known for their great sense of adaptation and pursuit of excellence throughout the San Pascual Schools. They come from diverse backgrounds, having been trained in organizations ranging from the fields of English to Music, Art and Physical Education (MAPEH) to Filipino (the National Language of the Philippines) to Science, but have since embraced (and excelled in) Mathematics as their primary teaching responsibilities and have received numerous accolades in the field of Mathematics including Distinguished Teacher Awards; District Excellence Awards; Best Reading Teacher; Best Brigada Implementer; Program Coordination Roles; and a high level of independent contributions on the part of their students. All five are currently pursuing a Master's degree in Educational Administration and Supervision (though they are each attending different graduate schools) with the overall goal of attaining leadership positions outside the classroom in their respective school districts. No dramatic changes have taken place for the five; however, they will continue to show their strong commitment to their learners and to the community by meeting the needs of their learners through the instruction of necessary academic subjects; by striving for excellence in the areas they chose to work in; and by preparing for future service through continuing education at the graduate level.

The OOF teachers working at public schools in San Pascual, Masbate are part of the coastal, rural area of Bochica as well. The five public elementary schools—Boca Chica Integrated School, Acacia Elementary School, Sulficio Elliot Elementary School, Dr. Antero M. Nazareno Elementary School, and Adelina P. Laurio Integrated School—provide community ties for the region, but also share commonalities with the teachers regarding inadequate resources, the challenges that come from serving in multiple grades, and the expectation of balancing many additional responsibilities besides being a subject matter expert in their subject area. Each of the five teachers has also experienced a major change since graduating from their degrees in either English, MAPEH, Filipino, or Science, and then becoming just as proficient in their respective field of Mathematics. Teacher A has worked in mathematics for nine out of the last ten years; Teacher B has worked in mathematics for four out of the last six years; Teacher C has worked in mathematics for the past eleven years; Teacher D has worked in mathematics for the last ten years; and Teacher E has worked in mathematics for five full years. Thus, each teacher has gone from having a background in one area of study to being highly effective in teaching and demonstrating their proficiency to others, and therefore becoming versatile educators. Each of the teachers have received multiple awards throughout their careers (i.e., Outstanding Teacher; Best Reading Teacher; Most Outstanding Focal Person; Best Brigada Implementer; and Academic Distinction), which serve as proof of their adaptability and support the idea of evolution as they now pursue their master's degrees in Administration and Supervision at different universities. Furthermore, all five teachers hope to assume leadership positions as principals, supervisors, or program coordinators in the near future so that they will have the opportunity to shape policies instead of merely implementing them. Socially and personally, the connections they have built with their peers, administrators, school leaders, and parents have had a profound impact on their journeys to becoming leaders; for example, Teacher C serves as a WINS Coordinator and Brigada Basa Implementer and therefore collaborates frequently with parents and local government officials; Teacher D has been recognized as a Best Reading Teacher and therefore serves as a mentor to younger colleagues; Teacher E has received numerous awards for her performance and is highly respected by her school; and all five teachers are also driven by a goal of obtaining their graduate degree and are likely to share knowledge and motivation with one another regardless of their school locations. In addition to the school-based relationships mentioned, all five teachers have family connections in Boca-Chica, San Pascual, Bolod, Busing or Blood that tie them to the community. Additionally, the relationships they built with the children they teach who need a Math intervention, the colleagues they help coordinate programs, and the administrators and/or leaders at their school who recognize their excellence continue to influence the formation of their professional identity. Ultimately, these five public school teachers in San Pascual, Masbate are not isolated individuals, but rather are interconnected members of a social structure characterized by social expectations, institutional demands, and personal aspirations, all of which are shifting from a deficit of subject-matter expertise to a desire for systemic leadership, while remaining firmly rooted in the unique, resourceful, and community-based reality of public elementary education in Masbate.

They went through an epiphany about the nature of teaching that began in a small way, in a year-by-year development, as each teacher began to realize that (whatever he/she was trained to teach in college – English, MAPEH, Filipino math, Science) was not an anchor; but a beginning point on a journey. Their epiphany occurred when they came to recognize that although they held the transcript label “English Teacher” or “Science Teacher”, in actuality they were Mathematics Teachers in rural Masbate, and that designation was made every morning; and that adaptability is in no way a diminishing of one's identity but an increasing of it; and that the act of providing instruction that is based on the needs presented to them rather than on the content studied in college, and therefore not a lack of specialization, is a higher level of professionalism. Furthermore, over the course of their journey, they became aware through the awards they had received – Outstanding Teacher Award, Best Reading Teacher Award, Most Outstanding Focal Person, Best Brigada Implementer, Academic Distinction – that both their professional accolades and the respective titles, were not simply an acknowledgement of their accomplishments as professionals, but rather an objective affirmation of a subjective truth; namely that excellence in teaching cannot be defined by the subject one teaches. The most powerful epiphany for the five teachers challenged by the realization that they had all obtained Master Degrees in Administration and Supervision, was recognizing this achievement as much more than an avenue for career advancement, rather an understated affirmation that; they were no longer satisfied with merely surviving the demands of the system; they wanted to assume leadership roles within the system. They clearly came to realize that in some cases, their changes from English to Mathematics, from MAPEH to the 6th grade, from Filipino to math, were necessary training for the ultimate change of the present day, which is, to go from being followers of village high school rules and procedures to shapers. The greatest epiphany for the five teachers was as follows: that even with limited resources, their classrooms at San Pascual did not diminish them as teachers; rather, they were formed by their classrooms in San Pascual; that there was not a problem to be solved regarding the mismatch of degrees and professional development; rather it was a blessing to be seized; that the greatest specialist does not remain within his/her designated lane; rather, he/she creates new lanes for children.

The accounts of Teachers A, B, C, D, and E are not figments of the imagination; rather, they are accurate reflections of a reality that exists within the Philippine Department of Education, most notably in the remote and impoverished island municipality of San Pascual, Masbate. All have completed a degree in English (Teacher A), MAPEH (Teacher B), Filipino (Teacher C), or Science (Teacher D), yet have spent a majority of their teaching careers instructing students in Mathematics—a phenomenon experienced by teachers throughout the nation, whereby placement depends on the needs of the school and the availability of positions and does not consider the area of concentration obtained by the teacher at the education institution. While this reality is present throughout the entire country, it is more acute in rural/remote coastal areas of the Philippines, where it is often cost-prohibitive or logistically impossible to hire teachers who are unique to their fields of study. For example, although Teacher A earned her degree in English, she has taught Math for the past nine (9) years; Teacher C has been teaching Math for eleven (11) years, even though she graduated with a degree in Filipino; and Teacher D has spent ten (10) years teaching Math while graduating with a degree in Science. In addition, data from DepEd reflects that more than sixty percent of elementary teachers in Masbate province are assigned subjects that are outside their field of study. Their recognized accomplishments, such as Outstanding Teacher, Best Reading Teacher, Most Outstanding Focal Person, Best Brigada Eskwela Implementer, and Academic Distinction, are verifiable awards granted by DepEd Divisions, as well as by members of the School Community, and are not fabricated accolades. Their pursuit of an MAEd in Administration and supervision at schools such as Lipa City Colleges, University of North Eastern Philippines, Unibersidad de Sta. Isabel, Osmeña University, and University of Saint Anthony demonstrates a legitimate trend of Professional growth and development of mid-level public school teachers in Bicol Region, where graduate education is sought for the purpose of obtaining the necessary educational qualifications to be promoted and, ultimately, to assume an administrative position in the school (i.e., principal, supervisor). Finally, all of the schools identified (e.g., Boca Chica Integrated School, Acacia Elementary, Sulficio Elliot Elementary, Dr. Antero M. Nazareno Elementary, Adelina P. Laurio Integrated School) have been recognized by the DepEd as schools serving coastal barangays in San Pascual, Masbate. The demographic characteristics of these teachers, such as their ages ranging from 29 to 35 years and their years of teaching service ranging from 5 to 15 years, as well as their community of residence (e.g., Boca-Chica, San Pascual, Bolod, Busing, Blood) illustrate that these teachers live within their respective communities and, in most cases, either walk or commute short distances to school; hence, they are also community members who support many of the communities they live in by serving as teachers and, in several cases, have established close relationships with students who are now older than they are. In conclusion, the profiles described above provide an accurate and verifiable image of real public school teachers working in rural Masbate, Philippines, who are managing the challenges associated with providing quality instruction in multiple subject areas, multiple programs, and multiple grade levels—as is the case for public school teachers in San Pascual and numerous other peripheral communities in the Philippines. Teachers in these communities manage to complete their degree programs by attending classes after their regular school hours; in San Pascual, as well as in multiple other peripheral communities in the country, this exemplifies what it means to be a teacher.

This story tells the story of 5 teachers by painstakingly building a story that works in such a way that it goes from the "specific" to the “general” and back-to-the “specific”, starting from the specific data regarding Teachers A-E (i.e., teacher age, home community, school, original area of specialty, length of time that each has taught mathematics, awards received, advanced degrees pursued, etc.) and describing the lives of the teachers. Next, it synthesizes these specific elements of the teachers’ lives into a collective pattern of adaptability and quiet success that shows their shared experience while illustrating the differences in schools and backgrounds of each. Then the narrative moves to an analysis applying an analytic framework to the teachers as a function of their environment (coastal, resource-poor communities in San Pascual, et cetera), demonstrating their turning points throughout their careers, and social contextualization around their peers, families, and local officials. Finally, there is a “revelatory” paragraph in which the external view disappears and gives way to an internal view of the teachers’ collective realization of the fact that their majors were not anchors, adaptability increases identity rather than diminishes it, and pursuing graduate work in leadership is an assertion of a desire to develop educational policy rather than merely to follow it. The overall structure of the narrative then is as follows: = (1) Data to Narrative, (2) Synthesis to Analysis, (3) Contextualization to Observation, and (4) Relational Purchasing to Realization; i.e., data in a DepEd personnel file to knowledge of shared experience (struggle) to the lived reality of the teachers working in rural schools, and finally to the internal realization of the transformation of their necessity into vocation. The meta-narrative truth is that the narrative does not simply document teacher epiphany but also serves as an illustration of teacher epiphanies, thus leading the reader to experience the same distinct layers of noticing, connecting, situating, and realizing that the teachers experienced over time as professional educators. Therefore, it replicates that reflective layered thinking which is necessary when conducting educational research: not reducing teachers to disaggregated data points, but honouring the expansive nature of each teacher's story of their respective professional journeys and the slow, accumulative, and ultimately enlightening growth of their practice.

The essence of these five teachers' stories lies not in the subjects they were trained to teach, but in the quiet, daily choice to become what their community needs. Teacher A, Teacher B, Teacher C, Teacher D, and Teacher E each embody a fundamental truth about education in the Philippine periphery: that a teacher's worth is measured not by alignment with a college transcript, but by responsiveness to a child's reality. Their recognition of being an Outstanding Teacher, Best Reading Teacher, Most Outstanding Focal Person, Best Brigada Implementer, and Academic Distinction should not be viewed as merely a series of fortunate events but a result of committing themselves and truly giving their time and efforts into teaching outside their initial area of specialty will create mastery rather than mediocrity. Their pursuit of an Administration and Supervision Master's degree at the same time reinforces this concept. They are a group of educators who are not simply accepting systemic requirements as passive recipients. They are using their mismatched degree to teach as a training opportunity for future leadership, proving through years of teaching Mathematics without a Math degree that real expertise is achieved through practice and cannot be awarded via an educational credential. The heart of each of their stories revolves around the fact that the best teacher in the coastal, limited-resource classrooms of San Pascual, Masbate is not the teacher who remained in their lane but rather the teacher who created another path for their students when the original path was blocked. They teach Mathematics, not because they are Math teachers but because the students needed someone to teach them; that is at the core of their vocation and goes much further than any award or graduate degree they may possess.

This report seeks to present qualitative results regarding the work of five teachers in the San Pascual North District's mathematics Out-Of-Field (OOF) program. All five of the participating teachers specialize in teaching a different subject area: one is an English teacher, one a M.A.P.E.H. teacher, one a Filipino teacher and two are Science teachers. Each of the five teachers has four or more years of teaching experience; some have as many as 15 years. They all reported struggles implementing one or more of the eight core mathematics instructional strategies (facilitation of guided learning, strategic collaboration, integration of real-world problems, differentiated instruction, use of hands-on manipulatives, explicit instruction, peer explanation protocols, tracking student learning progressions, and the use of mathematics journals) due to their previously established strong pedagogical credence in content areas other than mathematics. The factors causing this struggle with the eight core mathematics instructional strategies were not caused by poor classroom management or commitment to doing their best; however, the two factors established a strong impact and created many conflicting pedagogical habits in their non-mathematical disciplines that have made it difficult for them to be successful in developing and implementing content-specific pedagogical content knowledge (PCK) for teaching mathematics in their respective classrooms. The themes that developed as a result of this research are based upon each of the strategies introduced above and provide significant evidence of the immediate necessity for long-term professional development to assist OOF mathematics teachers to acquire content-specific PCK in mathematics that relates specifically to these strategies that are discussed in this report.

Instructional Strategies of OOF Teachers in Teaching Mathematics

There are several core instructional strategies among the practices employed by the five mathematics OOF teachers. The first instructional strategy, referred to as facilitation of guided learning, focused on whether the teachers were competent in implementing the "we do" phase of instruction. This strategy focused on ensuring that students could transition smoothly into independent practice after modeling through proper scaffolding. The second strategy looked at the teachers' abilities to promote and facilitate strategic collaboration. Specifically, the strategy focused on how well the teachers promoted interdependence among students and allowed them to build and share knowledge. In addition, the strategy aimed at determining whether the teachers encouraged students to have meaningful conversations about mathematics. Utilizing Real World, Local Problems is the third strategy considered in analyzing the effectiveness of OOF mathematics teachers. This strategy focused on whether the teachers were able to relate the math curriculum to real world experiences and problems encountered within the community. Differentiation was the forth strategy used, which aimed at examining how the teachers were able to diagnostically identify student readiness levels and then plan and implement tiered tasks. Maximize Hands-On and Manipulative Tools is the fifth strategy used. It entailed determining whether the teachers were able to use manipulatives to develop abstract understanding from concrete manipulation. Explicit

Table 1

Summary Results of the Core Strategies of the OOF Teachers in Teaching Mathematics

Core Strategy	Teacher Examples & Specialization-Informed Variations	Primary Adaptive Function / Mechanism
Facilitation of Guided Learning	Teacher A (English): Relied on direct teaching when students strayed from the topic, emphasizing coherence over exploration. Teacher B (MAPEH): Stressed procedure-based memorization, assuming that following steps was equivalent to comprehension. Teacher C (Filipino): Did not heed indicators of preparedness, proceeding even while students were confused in order to maintain pace. Teacher D (Science): Mistook guided learning for discovery learning, pulling out before necessary. Teacher E (English): Answered questions prematurely, alleviating cognitive burden and preventing critical thinking growth.	Responsive scaffolds aligned to students' zone of proximal development, balancing structure and autonomy in the "we do" stage of teaching.
Strategic Use of Collaborative Learning	Teacher A (English): Employed individual worksheets that were done in groups, confusing physical closeness for interdependence. Teacher B (MAPEH): Employed competitive games between teams instead of using collaborative problem solving among students. Teacher C (Filipino): Faled to develop group rules and responsibilities, resulting in students engaging in other activities not related to their task. Teacher D (Science): Used group activity in answer checking instead of investigation.	Positive interdependence, individual accountability, and structured academic talk to ensure that collaborative work becomes meaningful knowledge construction.

	Teacher E (English): Faled to monitor group activity while collaborating.	
Leveraging Real-world, Localized Problems	Teacher A (English): Utilized packaged, clean data tables instead of letting students gather real-life local data. Teacher B (MAPEH): Showed general bar graphs taken from textbooks rather than conducting actual community-based data gathering. Teacher C (Filipino): Concentrated on context-related storytelling without incorporating mathematical aspects such as units and scales. Teacher D (Science): Utilized laboratory data instead of allowing students to conduct experiments in real-life classroom settings. Teacher E (English): Avoided using any graphical presentation, going straight from word problems to solving equations.	Culturally-responsive mathematics instruction based on authentic student experience and culture.
Differentiated Instruction	Teacher A (English): Reverted to traditional, teacher-directed approaches that saw the class as a homogeneous unit. Teacher B (MAPEH): Provided the same physical activities to the students without providing different difficulty levels. Teacher C (Filipino): Conducted lectures to the entire class to avoid the hassle, confusing equality with sameness. Teacher D (Science): Utilized technical language in the subject, including terms without illustrations. Teacher E (English): Treated all students equally, seeing differentiation as an additional feature.	Diagnosing student preparedness using differentiated activities, flexible groups, and multiple modes of representation that match students' unique learning profiles.
Maximizing Hands-on and Manipulative Tools	Teacher A (English): Distributed teaching aids without proper procedure, causing lack of focus on learning. Teacher B (MAPEH): Utilized manipulative materials just for fun instead of understanding concepts. Teacher C (Filipino): Strictly followed the script, which did not allow enough time for discovery.	Constructivist approach to bridging from concrete manipulation to abstract symbolic notation using carefully selected tools and investigation.

Core Strategy	Teacher Examples & Specialization-Informed Variations	Primary Adaptive Function / Mechanism
	Teacher D (Science): Overscaffolded with constant interruption, forcing students to merely obey instructions. Teacher E (English): Did not relate concrete activities with formative assessment and reflection.	
Explicit Teaching	Teacher A (English): Blended explanations and demonstrations, emphasizing storytelling over modeling processes. Teacher B (MAPEH): Introduced learners to working independently before ensuring they mastered fundamental concepts. Teacher C (Filipino): Failed to mention learning objectives and importance, denying learners cognitive map guidance. Teacher D (Science): Commended effort rather than accuracy, omitting specific corrections in guided practice. Teacher E (English): Employed general questions directed at all learners, allowing personal misunderstandings to persist.	"Show me," "let's do it together," and "now you try" structure with detailed modeling, immediate feedback, and stringent checks for comprehension.
Peer Explanation Protocols	Teacher A (English): Preferred precision in processes rather than meaning-making, similar to concern for grammar. Teacher B (MAPEH): Failed to enforce accountability, letting student discussions become socializing activities. Teacher C (Filipino): Allowed superficial retelling without encouraging mathematical reasoning. Teacher D (Science): Enforced unnecessarily complicated and information-filled procedures. Teacher E (English): Gave general compliments instead of setting examples of good math discourse.	Structures of accountable talk that assign specific roles, include scaffolded sentence starters, and engage metacognition by pushing toward justification.
Learning Progression Tracking	Teacher A (English): Provided data in densely written narratives where information was buried within them.	Documenting, analyzing, and communicating learning trajectories against

	Teacher B (MAPEH): Depended on numeric table entries without any form of visualization. Teacher C (Filipino): Made use of complicated tables using a different color scheme. Teacher D (Science): Constructed charts that were broken down and incomplete, with the absence of labels. Teacher E (English): Utilized simple one-column graphs which obscured individual scores of the students.	predetermined skill continua, thus making evidence-based instructional decisions possible.
Math Journaling	Teacher A (English): Provided data in a fragmented story format emphasizing descriptions rather than exact numbers. Teacher B (MAPEH): Delivered confusing presentations not following the structure of having labeled axes. Teacher C (Filipino): Emphasized context rather than quantities such as scales and units in his/her presentation. Teacher D (Science): Listed observation after observation without drawing any conclusions. Teacher E (English): Provided seemingly thorough yet superficial presentations.	Reflective writing that encourages discipline-specific communication skills, reasoning skills, and evidence-based reasoning about mathematical concepts.

Teaching is the sixth strategy used in analyzing mathematics instruction. This particular strategy focused on whether the teachers could effectively execute the "I do, we do, you do" strategy and ensure systematic checking for comprehension. The seventh strategy used is called peer explanation protocols, which focused on how teachers planned and implemented student discourse on mathematics. The final strategy is referred to as math journaling, which focuses on how teachers used writing skills to make data presentations and draw inference based on the data.

Guided Learning Facilitation

A review of the facilitation skills used by the five teachers in guided learning showed consistency in inconsistency as it relates to pedagogical content knowledge. Teacher A showed inconsistency in structuring tasks for exploration. The teacher was inclined towards direct instruction once learners strayed off the intended direction. Teacher B displayed inconsistency in applying abstract ideas to practical examples. In this case, the teacher's guided practice involved a rigid sequence of procedural activities. Teacher C displayed inconsistency in the use of assessment data to regulate the progression of guided instruction. The teacher rushed to the next level even before the learner demonstrated mastery of previous instructions. Teacher D had inconsistencies in the use of learner independence. Here, the teacher equated guided learning to self-discovery, leading to piecemeal comprehension. Finally, Teacher E was inconsistent in scaffolding. The teacher provided solutions to questions at the expense of the process of thought induction.

> "Teacher A confessed, 'I always felt as if I was wasting my time with them struggling, and that is why I used to step in and show them the steps,' which confirmed her tendency to use direct instruction while carrying out exploratory activities. 'If they could follow the steps I told them and reach the correct answer, they had understood it,' Teacher B said, which demonstrated his inclination towards the process rather than conceptual connections. 'I always felt as if the clock was racing against me, and this is why, despite seeing blank faces, I used to move forward, assuming that they will be able to catch up at some other point,' Teacher C explained, highlighting his neglect for formative readiness signs. 'When I used to step back and leave them alone to explore what they can do without me, I used to feel that this is where real learning happens, but it is only afterwards that I found that they were lost,' Teacher D revealed, which confirmed his confusion between guided discovery and independent discovery. Lastly, Teacher E admitted, 'I never enjoyed watching them struggle and always felt the urge to jump in and give them the answer. "

All the discussed deficiencies can be considered as symptoms of a more fundamental issue: inability to properly implement the 'we do' stage of guided learning instruction. Thus, Teachers A, C, and E have difficulty balancing their structure and agency in terms of student readiness and task complexity. In case of the former, direct instruction is employed too early, while the latter removes the cognitive challenge for learners altogether by doing things themselves. On the other hand, Teachers B and D demonstrate extreme deficiencies on different sides of the guided learning spectrum. While the first shows a strong focus on procedural execution without attention to connectivity, the second has no grasp of the idea that guided learning presupposes teacher intervention. In general, the core issue lies in the fact that the level of facilitator support provided does not correlate with students' zone of proximal development during the crucial stage of transition from modeling to practice.

The identified teachers' deficiencies in terms of guiding the process of learning are not rooted in their respective experience in teaching mathematics, which is quite substantial for each instructor. Instead, these problems can be attributed to their deeply established instructional practices formed in the context of original non-mathematics specialization. Each instructor defaults to certain approaches related to content delivery (Teachers A and E) or skill-based execution (Teacher B). As such, the conclusion that needs to be drawn is that many-years experience in teaching mathematics is not sufficient to facilitate guided learning effectively. Rather, such instructors require deliberate pedagogical training that addresses the content-related needs.

The discussed findings are consistent with several theories discussed above. First, they can be attributed to postulate regarding the importance of responsiveness to the students' zone of proximal development (ZPD). Also, they align well with the definition of cognitive demand developed by Stein et al. (2008). Specifically, in case of Teacher A and Teacher E, demand is significantly reduced prematurely, while in case of Teacher D, it decreases throughout the lesson because of insufficient guidance. Finally, the tendency to employ the instructional practices of one's original specialization aligns with Shulman's (1986) pedagogical content knowledge theory. According to this theory, a deficiency in pedagogical content knowledge prevents a teacher from effectively representing mathematical concepts in the course of guided practice. The identified deficiencies are consistent with the findings of literature dedicated to OOF teachers. For instance, Teacher A's tendency to employ direct instruction when noticing that the student diverges from the correct path is consistent with the description of the pedagogical struggle experienced by OOF teachers. Similarly, the difficulty that Teacher B experiences in bridging the gap between abstract and concrete ideas which state that OOF teachers find it challenging to choose and implement appropriate strategies without deep content knowledge. Ignoring formative readiness assessments by Teacher C corresponds with the findings of Black and Wiliam (1998) according to which teachers seldom manage to adaptively use assessment results to change their instructional techniques in time. The confusion that Teacher D experiences with respect to the concept of guided learning is consistent. According to them, the inability to create a clear conceptual framework of the lesson leads to a decrease in its quality in case of OOF teachers. At last, the practice of providing answers prematurely employed by Teacher E. These authors claim that OOF teachers resort to such behavior patterns as a result of their anxiety and uncertainties in relation to mathematical content. All of the identified deficiencies correspond to Self-Efficacy Theory according to which teachers' lack of content mastery hinders their ability to perform required actions successfully. This theory has been explored in great detail with regard to OOF teachers in the literature (Loughland & Nguyen, 2021). At the same time, the fact that teachers rely on the instructional practices acquired during their initial training and the PCK theory developed by Shulman (1986).

As a result of conducting the analysis described above, the following measures were suggested for eliminating the discussed deficiencies in the practice of OOF teachers. First, a protocol should be introduced for initiating productive struggle with planned questions and wait times to discourage Teacher A from defaulting to direct instruction prematurely. Second, a series of professional development workshops are to be arranged to allow Teacher B to break down mathematical concepts into multiple concrete representations and apply scripted think-aloud technique. Third, mandatory use of non-verbal real-time formative assessment tools like mini-whiteboards should be enforced to make Teacher C pause instruction and take student feedback into account before moving to next tasks. Fourth, a co-teaching model should be created where Teacher D is assisted by a master mathematics instructor to learn how to guide students in a proper manner. Lastly, Teacher E should be trained in applying a least-to-most prompting hierarchy with required documentation.

Strategic Use of Collaborative Learning

The findings from the five teachers' profiles showed a considerable lack in the strategic application of collaborative learning regardless of their specialization. While Teacher A had spent nine years teaching mathematics, she was weak in developing collaborative activities where there would be interdependence among group members; instead, she resorted to distributing worksheets individually and having students complete them together as a group. Teacher B was found to utilize more competitive games within groups than collaborative problem solving. Teacher C lacked the ability to set group norms and roles, resulting in the diversion of the discussion from the intended topic. Although Teacher D was a science teacher, he did not use his scientific skills to develop collaborative and investigative activities; rather, he used collaborative learning mainly for answer checking.

> "Teacher A reflected upon the above practice, saying that "I believed grouping them with worksheets is collaboration already." She admitted to having "not known that they only worked individually but beside each other instead of collaborating." Teacher B seemed to have used much team game practices instead of structuring the students' problem solving collaboration. The teacher said, "I always did those team quiz bees for the kids because they liked it." She admitted, "I was not aware that competitions might discourage some of my struggling students from participating." Teacher C lacked the skill to structure the group norms and roles for group work which caused the students not to be engaged. Teacher C said, "I thought they were already able to work in groups since they are in Grade 6." She said, "I did not even bother teaching them group roles." Teacher D who came from the science field failed to use her experience in designing investigative and collaborative group practices in Math class and did group activity just for checking answers. The teacher said, "I just grouped them so that they can check each other's answers quicker." She said, "I never tried to utilize my experience in science for collaborative investigation in Math." Teacher E revealed her weakness in assessing group process formatively where she just let the kids do the activity without monitoring the dynamics. Teacher E said, "I usually stayed at my desk preparing for the next topic when they were doing collaborative group work." She admitted, "I did not even walk around the room listening to them or assisting since I thought they were really doing it properly."

As it became evident throughout this exploration, the main deficiency that existed among all of these participants lied in the nature of their previous approaches to collaborative learning. In fact, all five educators viewed collaborative learning not as an intricate pedagogical technique that requires purposeful planning but as merely an activity where students perform some task collectively. Moreover, these teachers tended to consider collaborative learning as a simple game or a group assignment that should be performed in order to achieve an arbitrary goal. Such approach towards collaboration in the educational setting was further supported by the teachers' original fields of specialization. The specialization in science was irrelevant to the use of inquiry-based group work, while the English specialists neglected their profound knowledge of discourse to facilitate student collaboration in mathematics.

It was concluded that the deficiency in strategic implementation of collaborative learning in mathematics was a result of a lack of professional development aimed at developing such skills among teachers. Having between four and eleven years of experience in math instruction did not make any of these educators proficient in using collaborative learning techniques. In addition, the educators' original fields of specialization were identified to serve as an obstacle in the development of proper collaboration since they resulted in what can be termed as pedagogical inertia. Namely, teachers used the same structures of collaboration they knew from the time when they were students but never adapted them to meet the requirements of elementary mathematics instruction. In such cases, collaboration cannot be seen as an effective teaching strategy since it does not ensure that positive outcomes can be expected.

Indeed, the findings of this study align well with the literature on collaboration that has been reviewed. As it has been discussed, the framework developed by Johnson and Johnson (1999) emphasizes the importance of certain structural components, namely, positive interdependence, individual accountability, and promotive interaction in making group work productive and beneficial. The teachers analyzed here failed to implement these elements and, therefore, could not ensure the effectiveness of collaboration. This confirmed the conclusion previously made on the basis of the reviewed literature, which pointed to the necessity of addressing structural issues associated with collaboration in order for it to become beneficial for learning.

Moreover, the findings of the current study reflect the findings of other reviewed papers. Namely, the inability of the teachers to transform content specialization into teaching strategies is fully consistent with the ideas. As it has been discussed, the transformation of content knowledge into specialized pedagogical knowledge remains challenging for many teachers despite the availability of various frameworks for doing that. It becomes evident that one needs to take more efforts in order to transform the subject matter expertise into a pedagogically oriented skill that will ensure effective collaboration in mathematics.

Lastly, the deficiencies in collaboration observed by the researchers are supported by the reviewed literature on professional development. For example, the paper by Darling-Hammond et al. (2017) argues that the latter plays a pivotal role in changing the teacher practice. In particular, it was found that the experience in mathematics education cannot serve as the only factor that will make teachers proficient in collaborative learning. In other words, even though these teachers had many years of experience working with mathematics, it was still necessary for them to undergo professional development aimed at developing the required skills. Thus, the findings of this study do not refute but support the conclusions derived from the literature. Specifically, it can be stated that the barriers to effective collaboration in elementary mathematics are systemic in nature since they are associated with a lack of skills to turn content specialization into pedagogically effective actions.

For Teacher A, it is recommended to implement a series of coaching sessions dedicated to establishing positive interdependence. Namely, during each session, the teacher will co-plan and co-teach with the coach a lesson involving the use of the "Jigsaw" approach. In such conditions, the participation of each student will be important since their input would determine the achievement of the common goal – completion of the problem-solving task. Teacher B is recommended to change the way he treats competition among students and make them focus on solving collaborative problems, not competing. In particular, the teacher can replace math-related games with small-scale "Number Talks," where each student will provide justifications and solutions to different math-related problems. As for Teacher C, it is advised that she take part in several rounds of classroom observations in order to learn how to implement specific roles during collaborative activities. The roles to be considered include facilitator, resource manager, and reporter. Since Teacher D is engaged in science-based instruction in mathematics, it can be recommended to her to restructure the lesson that currently involves completing a worksheet as a group. The teacher can implement the inquiry-based instruction where students need to collect data, formulate hypotheses, and then discuss their findings. Finally, Teacher E should work on monitoring students' performance in collaborative groups by means of real-time observation techniques and corresponding protocols for giving feedback. The proposed strategy involves integrating math instruction with relevant and authentic problems that relate to the community of students and their lived experiences. To effectively implement this strategy, one needs to cover all stages of the data life cycle from collection and organization to analysis and interpretation.

Leveraging Real-world, Localized Problem

In presenting data, the teachers exhibited a common lack of going above and beyond prepackaged and pre-organized information. The data they presented was always well-prepared and clean; thus, they bypassed the crucial first step of helping students prepare the data themselves. In the first lesson, Teacher A presented a perfectly organized table showing book sales in a national bookstore, overlooking the possibility to have students collect and organize the data through surveys in their families and local sari-sari stores. In the second lesson, Teacher B presented a bar graph of "popular sports," again based on generic textbook content, and did not lead students to collect data on sports played in their barangay. Teacher C presented data on the harvest yield per hectare for corn crops, once again based on the generic statistic provided in a textbook, instead of having the students collect data through interviews with a local farmer or compilation of data from a community garden. Similarly, in his statistics class, Teacher D presented data in the perfect form of a chart reflecting growth of plants in a laboratory experiment, ignoring the possibility to engage students in a more challenging and exciting experiment involving data collection and interpretation in a real classroom environment. Teacher E demonstrated the greatest deficiency in her data presentation, as she frequently neglected the visual representation of data, immediately leading students to solving equations following word problems. It seems that her data presentation consisted mostly in providing the formula that needed to be applied.

During the analysis of the data, the teachers manifested the key problem in their lack of ability to guide students in the process of transitioning from superficial observations to deeper and meaningful quantitative reasoning connected to their local context. Analysis was seen by them as an independent procedure rather than a collaborative process. Specifically, Teacher A guided students to calculating the "average" of the presented book sale statistics, asking them to make calculations without discussing why one month showed greater sales than others (for example, during a local fiesta or school opening). Teacher B asked students to find out what sport was the most popular in the bar graph; however, they were not encouraged to discuss the socio-economic or geographic reasons for such preference in the community. Teacher C required students to calculate a percentage increase in harvest yields; nonetheless, he overlooked the possibility to analyze the data with relation to local weather conditions, availability of seeds, or practices of the local community. Teacher D's students computed the mean and median of the neat plant growth data; therefore, there was no room left for analysis of possible data discrepancies. Finally, Teacher E demonstrated her greatest procedural deficiency when she guided students to treating numbers as just abstract symbols, without considering their connection to any context that could be analyzed to prove whether the answer is reasonable.

As part of drawing inferences and conclusions, the teachers manifested a common problem in not being able to move from the data set to more meaningful and action-oriented reflections concerning their personal lives and community. Conclusions made by them were restricted by the results of analysis; none of them led students to making meaningful reflections in relation to the real-life problem that the data referred to. Teacher A concluded her lesson with students giving statements regarding the "average number of books sold" without concluding anything about the literacy practices in their community and what measures could be taken to promote local literacy. Teacher B's class ended up with the students' conclusions saying that "basketball is the most popular," but they did not make any inferences about the community, resource allocation, or other sports available to play. Teacher C's class ended with a calculation of the percentage of increase; yet, there was no time left to conclude what consequences these figures would have on local farming practices or food security issues in the community. Teacher D's lesson concluded with students stating that "the plants grew as expected," which was a pre-defined result in the neat data presentation used. Finally, Teacher E's lesson concluded with students giving a numerical answer (e.g., $x = 15$) without making any further reflection or inference concerning the original problem context.

Teacher A's justification of her choice to use prepared data for the sake of "efficiency" directly contrasts the ideas of authentic literacy and situated learning that were considered in this study. Teacher B's rationale that she needs to follow "what's in the book" in order to teach bar graphs overlooks a vast amount of literature on culturally relevant pedagogy and place-based education.Teacher C did not justify the use of Tagalog language in solving word problems, thus failing to connect with mother tonguebased multilingual education. Research shows that effective mathematics education involves teaching the students' first language (Cummins, 2000; UNESCO, 1953). Teacher D's approach to data as a static object overlooks the importance of inquiry-based learning principles and the nature of science. Finally, Teacher E's purely procedural approach to mathematics learning directly contradicts a wide range of literature on problem-solving heuristics and mathematics discourse communities that were reviewed. According to the aforementioned literature, mathematics is a socially constructed concept, in which sense is developed through argumentation and collaboration with respect to learners' real-world experiences (Vygotsky, 1978; NCTM, 2021).

It was recommended that Teacher A should capitalize on her skills in creating narratives to have students author their own multi-step word problems based on information they collect from local communities. Such an approach will transform her role from data presenter to a facilitator of the narrative construction process. For Teacher B, who holds an MAPEH special qualification, the recommendation includes designing a lesson where students gather, organize, and analyze data from a local sports tournament or a health survey. The teacher should apply her skills in physical education to create a meaningful statistical project for her students. It was also recommended that Teacher C collaborates with a barangay elder or barangay office to get hold of some real data related to the community's demographic characteristics, business trends, or agricultural productivity. Using the knowledge in Filipino language will help him lead students through a discussion and document findings in the language of local community. It was recommended that Teacher D designs an extended project where students conduct an experiment related to composting or water filtration. Such a long-term project allows students to collect, organize, analyze, and present data themselves, thus facilitating authentic scientific work. Finally, Teacher E can use her English language skills to teach students how to formulate mathematical claims and draw conclusions to solve local problems based on data gathered through investigation.

Differentiated Instruction

However, there were several observable trends from the data that stood out. Teachers A, C, and E always used a mode of instruction that involved lectures to the entire class; they saw students as a single entity. In the case of teacher B, he showed a propensity to use kinesthetic instruction that would engage the students, although he did not develop tiers within his activities, thus making the lesson too easy or difficult for some students. On the other hand, teacher D made her instructions more complex than necessary due to the lack of simplification techniques.

> "Teacher A said, 'I only have them all do the same thing at the same time.' Teacher C declared, 'Lecturing them all together is easier,' whereas teacher E said, 'I treat all of them equally because I see that as being fair.' Teacher B said, 'I love playing games and being active; however, I have everyone do the same activity.' Teacher D remarked, 'I use the scientific terminology from the start because I believe they should learn it from the beginning.''

Based on my analysis, the main weakness of the teachers in the observed class practices was their inability to accurately diagnose students' readiness and plan instruction accordingly. Teachers A, teacher C, and teacher E did not engage in diagnosing prior student knowledge, resulting in a lesson that was too repetitive for more advanced students or too difficult for students who struggled with the subject matter. Similarly, teacher B placed such importance on ensuring that all students physically participated in an activity that they lost sight of differentiating the cognitive engagement of students based on their readiness level. Also, the activities presented in class by teacher D assumed that all students needed the same mode of instructional delivery to be able to comprehend the material covered during the lesson. It was evident that these teachers' preferences influenced their choice of instruction rather than an attempt to cater to students' needs. None of these teachers was weak in classroom management or was not putting enough effort into instruction. On the contrary, they exhibited a major deficiency in designing effective learning experiences. These teachers viewed differentiated instruction as an addition to a lesson rather than being the foundation of it, believing that it is fair treatment of all students that matters. Teacher B equated high engagement in a learning activity with high learning, failing to realize the need to scaffold content within an activity. Lastly, teacher D believed that they were responsible for delivering information as experts to their students without realizing that all students had equal abilities to comprehend abstract information. All the teachers in the observed lesson revealed their inability to effectively implement differentiated instruction based on a student-centered approach.

She explains that teachers struggle to implement differentiation not because they have issues with the idea of personalized learning but because they do not know how to deal with the complexity of managing instruction along several pathways. The behavior exhibited by teachers A, C, and E was very similar to the 'one-size-fits-all' approach that according to Tomlinson and Imbeau (2010) occurs when teachers are so focused on covering the curriculum that they forget about students' needs. The practices used by teachers B and D were a classic example of poor scaffolding of activities on zone of proximal development (ZPD). Activities presented in class could be easily classified as either mastered and fully internalized or frustrating to do.

In general, all five teachers should abandon their rigid whole-class instructional approach and adopt flexible grouping for effective differentiated instruction. It is recommended for teachers A, C, and E to conduct brief diagnostic pre-assessment before presenting each new unit in order to clearly identify prior knowledge of students and then plan for tiered learning objectives that provide clear entry and exit points for struggling and advanced learners. Teacher B is recommended to change his/her kinesthetic activities to tiered activities to keep all students physically engaged in class but at a level within their ZPD. Finally, teacher D should change his/her mode of instructional delivery and start using concrete manipulatives, pictures, and abstraction together before presenting the content using academic language.

Maximizing Hands-on and Manipulative Tools

The unique deficits found in each of the five teachers in utilizing hands-on/manipulative activities. Teacher A was deficient in preparation because materials were handed out without any set method, causing the students to get distracted from classwork. Teacher B was deficient in integration since he used manipulatives as a gimmick to close out the class instead of using it for concept building purposes. Teacher C was deficient in pacing because the teacher stuck to a pre-planned script that did not allow the students enough time to explore the manipulatives. Teacher D was deficient in over-scaffolding, in which the teacher took control of the process too much and made the students do things the way they should be done instead of letting the students explore on their own. Lastly, Teacher E was deficient in assessment because no assessment took place after the activity.

> "Teacher A confessed, 'I believed that immediately providing them with the materials would be more efficient. However, what I failed to realize is that I should have a system regarding the distribution of the materials. This resulted in confusion before the class even started." Teacher B added, "My goal was to create a fun learning experience for them. Thus, I decided to use the blocks at the end of the session to motivate them as an extra element of the concept that they had already grasped through the lesson itself." Teacher C expressed her thoughts in this regard: "I stuck to the lesson plan precisely since I did not want to get behind in terms of the schedule. Hence, I did not provide enough time for them to play with the materials. I expected them to be able to learn all the information provided in the script." "It made me go around to different groups and demonstrate the proper procedure since I was scared they would do it incorrectly," said Teacher D. Lastly, Teacher E admitted that she finished distributing the materials due to time constraints. In her opinion, using them during the lesson was already sufficient for the children to grasp the concept."

It appears that those gaps were linked directly to a fundamental misalignment between PCK and the processes involved in mathematical inquiry. Thus, Teacher A's emphasis on the sequential procedure in lieu of exploration suggests her inclination toward employing traditional literacy-oriented classroom management techniques within the more fluid, open-ended manipulative-rich environment. Similarly, Teacher B's superficial use of hands-on tools is likely a sign that she was not able to recognize these tools as means for developing abstract thinking and treat them just as entertaining objects. Teacher C's rigid adherence to the pace was associated with the lack of proper formative assessment techniques and unwillingness to adjust the lesson plan on the go. Teacher D's controlling attitude indicates an aversion towards productive struggle and a belief that student independence poses a serious risk. Lastly, the inability of Teacher E to integrate assessment techniques implies the lack of necessary awareness about the importance of completing the lesson loop and giving due attention to comprehension.

Teachers' lack of specialized training in the subject can be linked to their limited understanding of how mathematical concepts are built up. It appears that teachers found it difficult to become facilitators of discovery and instead resorted to their usual roles of activity directors. Therefore, although hands-on tools can facilitate the process of concept formation in the students, in this instance, they did not because the way they were managed was either wrong or ineffective. The conclusion made based on this analysis is that without adequate training, even well-selected manipulatives will prove to be inadequate at bridging the gap between hands-on operations and abstract symbolism.

In this case, the deficiencies observed in the teachers' performance coincide entirely with the findings by Ball and Forzani (2024), who emphasize that "academic rigor and pedagogical skill must go hand-in-hand," a connection lacking in the analyzed lessons. Moreover, the observed misuse of the hands-on tools reflects the warning issued by the scholars concerning technique-centric instruction, in which the focus on the process takes precedence over the mathematical purpose. In addition, the teachers' inability to provide enough exploration time aligns with the concern raised by the National Research Council regarding the necessity of having "explicit instructional designs in place for using manipulatives." At the same time, Teachers A, B, and E demonstrated a tendency to rely on traditional non-mathematical routines associated with their areas of specialization.

Given the similarity of deficiencies exhibited by the teachers, it is reasonable to conclude that a single intervention would be sufficient to address them all. It is assumed that the intervention should include the introduction of structured routines and inquiry-based sequencing, as well as flexible pacing protocols and facilitation of student autonomy while implementing embedded formative assessment techniques. As already mentioned, the core strategy used as part of the planned professional development program is structured instruction.

Explicit Teaching

The consistent weakness among all five teachers in terms of the implementation of the Explicit Teaching approach. While Teacher A was quite experienced, having taught for 10 years, he showed a major weakness in the modeling part where he tended to confuse explanations with demonstrations. The structured independent practice served as a major weakness in Teacher B where he rushed his students to move into activities without ensuring they grasped the concepts being covered. The lesson opening was one of the main weaknesses shown by Teacher C where he did not set clear objectives for the students, leaving them confused about where to go. Feedback became the main weakness in Teacher D where he failed to give corrective advice to his learners and focused on effort rather than precision.

> "Teacher A: "When I thought I was modeling the problem, I now understand that I was just narrating it because I failed to demonstrate how the problem-solving process worked. Teacher B: "I used to let my students do their own work even though some of them weren't understanding the concept. I didn't

> know that my premature rush meant that they hadn't mastered the basic concepts yet. Teacher C: "As for myself, I would always begin the class without ever explaining my objectives to my students or telling them what I wanted them to get out of the session. Teacher D: "In the guided practice stage of my classes, I was always congratulating my students for doing a great job even when they got it wrong. I was more concerned about encouraging them than correcting them. Teacher E: "Whenever I asked the entire class if everybody understood something, those who nodded their heads were just following the herd mentality. I never knew that broad questioning meant ignoring their individual problems."

Analysis revealed that there was a strong relationship between the teachers' initial specialization and deficiencies associated with the structured and pedagogically prescribed "I do, We do, You do" process. Specifically, teachers A and E, specializing in English, had tendencies to emphasize creativity and narrative flow in instruction over a systematic unpacking of the procedure. Previous teaching performances had shown that these teachers tended to follow an approach similar to that used to teach literary analysis in which ambiguity can be tolerated. Teacher B, being a specialist in MAPEH, approached the topic of mathematics using fluid, exploratory methodologies appropriate for skill development in physical education or artistic subjects. Teacher C's deficiencies were found to be based in a linguistic and literary approach to the presentation of mathematics in that the teacher emphasized the meaning and context of a math problem rather than the technical skill development of Explicit Teaching. Lastly, Teacher D showed deficiencies related to the precision of mathematical feedback in which the teacher encouraged hypotheses to pass unchecked and considered them to be correct answers to problems – an approach more reflective of the field of science and less applicable to mathematics.

The influence of the teachers' specializations on their pedagogical content knowledge led to significant deficiencies in their implementation of Explicit Teaching strategies. Their years of experience in mathematics instruction seemed to have solidified their use of a mathematics-specific pedagogy, which was not appropriate to teach math explicitly. These findings contradicted the common assumption that good teachers can effectively instruct in any subject matter; the experience of the teachers in question seemed to strengthen their non-mathematics instruction methodologies as opposed to mathematics instruction strategies. Moreover, the deficiencies observed among the teachers were reflective of the literature on pedagogical content knowledge (PCK) as discussed by Shulman (1986).

Specifically, PCK entails not just general knowledge of the pedagogical process and the subject matter but their amalgamation and application to specific subject content. Deficiencies noted were directly related to mathematics-specific PCK. Additionally, the issues observed were consistent with the concerns raised in Explicit Instruction literature by Archer and Hughes (2021), according to which, teachers tend to approach explicit instruction contrary to their training and experience and fail to appreciate its systematic and unambiguous process. The performance of these teachers confirmed the findings of the reviewed literature, indicating that instructors tend to default to their original instructional practices and methodologies without proper re-training in the desired strategy.

A single professional development intervention was recommended for implementing Explicit Teaching through an instructional coaching approach. It involved a six-week coaching cycle in which teachers received weekly individual coaching, including observation and feedback. The first two teachers – A and E, specializing in English – were tasked with creating verbatim "think-aloud" scripts with the help of the coach prior to each class to avoid falling into narrative instruction approaches. Teacher D received personalized instruction regarding the need for randomized response and feedback during guided instruction. Specifically, the teacher was taught how to incorporate individual whiteboards or response cards in daily instruction to foster precise and effective feedback instead of vague encouragement. Teacher C was required to start every math class with a clearly stated content- and language-focused objective along with a relevance slide approved by the coach prior to the start of the lesson. Teacher B was assigned a mathematics coach who monitored every daily class and required an exit ticket assessment protocol, which needed to confirm students' basic mastery of the material.

Peer Explanation Protocols

The implementation of protocols by teachers for peer explanations. Teacher A, though experienced in teaching mathematics, had protocols that valued procedural fluency over conceptual communication, which may have been the result of having an English specialization that is focused on language correctness. The protocols of Teacher B lacked structure and accountability since her peer explanations became unstructured conversations rather than discussion in academics, which she may have difficulty in establishing due to her MAPEH background where there are no such strict procedures during collaborative exercises. Teacher C had protocols that were deficient when it comes to metacognitive aspects of peer talk because she was satisfied with superficial responses of steps rather than asking for reasons why things happen, which may be due to her Filipino specialization focused on narrative comprehension over explanation. Teacher D, with specialization in Science, had complicated and content-rich protocols that are difficult to understand due to complexity, thus indicating difficulty in scaffolding the procedure of peer discussion. Lastly, Teacher E’s protocols lacked models for peer critique that resulted in vague comments made by students in their discussions, which may have been due to her specialization in English where praise is more common than mathematics argumentations.

> "Teacher A: "I told them to check their partner's solution and ensure all steps were properly recorded in their notebook. If the answer was the same as mine, then they can move on." Teacher A had much experience in mathematics teaching, yet she arranged her peer interaction protocols in such a way that ensured procedural accuracy took precedence over conceptual communication; possibly because of her specialization in

English, which emphasizes proper grammar use. Teacher B: "I simply told them to, 'Okay, now, exchange your solutions with your seatmate and discuss.' That's what I did since they looked excited enough to have some discussion going." There is evidence that peer interaction protocols used by Teacher B lacked accountability. Her students' discussion sessions usually led to unproductive conversations; hence, indicating an absence of established formal routines in academic discourse, probably due to her specialization in MAPEH. Teacher C: "When I asked them how they arrived at that answer, most of the time they would answer me, 'Since I added first, of course.' And I would say, 'Good job, very well.' I didn't want to confuse them with many questions anymore." Teacher C exhibited a deficiency in fostering meta-cognitive peer talk. She tended to accept simple retelling of the steps involved in arriving at answers without inquiring further about their rationale, possibly owing to her specialization in Filipino studies. Teacher D: "It is my desire for the students to fully understand the concept, thus, I made them do this: define, state the formula, write down all the steps, provide an example and give its application. Hopefully, it will be better this way." Protocols established by Teacher D proved to be too complicated for her class to comprehend; hence, indicating a deficiency in scaffolding of explanation process, possibly because of her specialization in Science. Teacher E: "As usual, after their discussion, all I did was say, 'Well done, excellent! Applause for them.' I didn't want them to feel embarrassed by pointing out what they missed out.'" Teacher E's peer interaction protocol suffered from a deficiency in peer criticism. This was evidenced in ineffective and non-productive feedback from the peer's part, which might probably be related to her specialization in English."

A closer look at these deficits indicated that the initial fields of specialization of the teachers played an important part in affecting their ability to guide student-led peer explanation protocol. Teacher A's focus on the final answer emphasized the product more than the process of explanation – much like a typical lesson in Language Arts, where a polished final product is valued over a developmental process. Teacher B's failure to maintain academic rigor in discussion among peers revealed an inherent lack of application of pedagogical models in the absence of content. Teacher C's failure to take student discussion to a deeper level hinted at an inadequate training in discursive pedagogy that would apply to mathematics, which is all about the "why" in addition to the "what". Teacher D's difficulty in translating scientific expertise to pedagogy reflected a significant lack of specialized pedagogical content knowledge (PCK). Finally, Teacher E's vagueness in giving feedback suggested a deficit in knowledge of specific language used to communicate ideas in mathematical context.

Experience with mathematics did not translate to proficiency with the pedagogy of teaching mathematical concepts through discourse. The identified deficiencies in their discourse pedagogies were a result of ingrained pedagogical habits derived from teachers' backgrounds in other disciplines, rather than a result of insufficient knowledge of mathematics. The conclusion drawn was that these teachers were in need of pedagogical content knowledge related to mathematics discourse; the years of experience in the field had not been sufficient to develop this knowledge. Specialization in another discipline may have introduced some cognitive biases in how they approached instruction and evaluation of student-to-student discussion.

These observations are congruent with both Shulman's (1986) framework for pedagogical content knowledge (PCK) and Chapin et al.'s (2009) discussion on academic talk in mathematics lessons. In particular, the teachers' poor performance revealed an insufficiently developed pedagogical content knowledge (PCK), as defined in the framework proposed by Shulman. Instead of developing new PCK specific to discourse-based math lessons, teachers relied on their own pedagogical content knowledge from their field of specialization. Furthermore, the problems that the teachers experienced are also consistent with Chapin et al.'s findings regarding the importance of teaching talk moves in math class.

It was recommended to provide professional development training to improve teacher's mathematical discourse pedagogical content knowledge (PCK). Teacher A should undergo coaching to shift her focus from the product to the process of explanation. Structured peer explanation protocol, role assignments, and sentence starters would help Teacher B to create academic rigor and establish expectations for peer explanations. Teacher C needs specific training for distinguishing retelling of a story and mathematical explanation, along with proper questioning methods to facilitate such differentiation. Collaboration with a mathematics education specialist is recommended to Teacher D for helping him translate his advanced content knowledge to students-appropriate explanations. Teacher E needs to attend workshops to increase competence in giving conceptual feedback on mathematics explanation.

Learning Progression Tracking

The common problem when presenting data was the inability of all the teachers to convert tracking data into understandable and easily interpretable form. For instance, Teacher A had used long narrations in paragraph format to present data in such an untidy way that made comparisons impossible between students and even at different points in time. Teacher B had presented her data using just numbers in a tabular form but failed to use any graphs or charts that would make it easier to identify trends. Teacher C had used complicated spreadsheets and inconsistent coloring without giving any legend that could help understand what is being represented. On his part, Teacher D had used scattered charts that lacked proper labeling, titles, and units. Teacher E preferred only to show the aggregate performance using a single bar chart.

> “Teacher A mentioned, “I simply write down what happened in some paragraphs in order to explain all in words.” Teacher B said, “I fill the scores in the table and allow others to analyze the numbers on their own.” Teacher C revealed, “I have my own formula in Excel using the colors that I understand myself, yet I do not actually provide any sort of legend.” Teacher D said, “I create some graphs hastily, yet everyone understands what they

represent." Teacher E said, "I generate one bar chart to display the average score of the class."

Teacher A approached the data analysis task through descriptive means only, without going into any depth of investigation of patterns and causes of the results obtained. The teacher noticed low scores and did not attempt further analysis aimed at identifying the pattern of mistakes and the level of lacking skills among students. Teacher B identified discrepancies between scores of certain students and the class average, yet failed to analyze the components of the class average and distinguish sub-groups among the learners with varying needs. Teacher C conducted calculations of learners' growth between two periods (pre-test and post-test) yet did not analyze how the process took place between the two points, seeing learning as one-time action instead of the process. Teacher D conducted analyses of the data according to separate subjects without considering whether there were common skills developed among different areas of mathematics. Teacher E analyzed data in a very short time frame and without considering long-term trends or the influence of previous instructions.

The conclusions the teachers drew from the analyzed data proved insufficiently evidence-based. Teacher A concluded that the low results were caused by the lack of students' efforts; however, the conclusion was not evidence-based as the teacher did not provide specific evidence of disengagement or lack of work on the part of the students. Teacher B concluded that a particular teaching method had failed because of poor results on an assessment test, while in fact, a high level of improvement could be observed in the previous data (tracking). Teacher C generalized the results to the whole class while drawing conclusions about the sample group only. Teacher D concluded that the speed of instruction should be adjusted due to the difficulty of material without considering whether the material is presented properly and at what points the learners experience difficulties. Teacher E concluded that learners mastered a particular skill due to one low-stakes exit test without considering other performance data.

While interpreting data, the teachers failed to provide links with current research on the topic. Teacher A referenced a theory of learning styles without providing evidence of recent research on numeracy. Teacher B mentioned "rote learning" yet failed to refer to recent works dedicated to conceptual vs. procedural learning in mathematics. Teacher C referred to some theoretical pedagogical models without explaining in which way they correspond to or differ from the findings. Teacher D referred to only one outdated source related to assessment, neglecting many new studies devoted to formative assessment and data-based instruction. Teacher E invoked the philosophy of education without considering research about proficiency strands in mathematics.

In order to improve the process of tracking, I recommend introducing a unified, competency-based tracking framework for all five teachers. For Teacher A, I suggest introducing a structured skill-based matrix in which progress can be recorded and tracked in terms of the degree of mastering skills. In the case of Teacher B, I would offer to develop the routine of recording formative checkpoints in addition to summative results, in order to monitor the sequence of partial understandings of the students. A flexible tracking tool will be suggested to Teacher C in order to facilitate tracking the recurrent nature of the learning process, including regression. Collaborating with the data specialist, Teacher D will revise the existing log and design new visuals of interconnection between various mathematical skills. Finally, Teacher E will need professional development to switch from a chronological log to a competency-based tracking system.

Math Journaling

Teacher A, having taught mathematics for ten years, did not properly display the data in a way that could be considered proper in mathematics since she presented it in a way that was fragmented and narrative in nature. This type of presentation would better have been done in English class and not in mathematics class because she chose description over numbers when presenting her data. Teacher B was disorganized in presenting the data because she did not follow the usual structures followed by data presentation like having labelled axes and a sequential flow. Teacher C presented an extensive narrative about how the data collection was conducted. This method is similar to how narratives are made during Filipino class but lacks important information such as units of measure and scaling. Although Teacher D had a solid background in science, his presentation of the data was purely technical and accurate but was unable to synthesize the numbers into one concrete finding. Teacher E’s data presentation was technically sound but lacked substance.

> "Teacher A "I just narrated what the students did in their journals. I told the story of how they explained their rationale. The numbers just came along. It seemed easier for me to describe the way they approached solving the problem than presenting the numbers per se. I am more comfortable in using descriptive language. Teacher B "It's hard for me to figure out how to organize this section. I simply presented the findings as they are, without any specific organization in mind. I don't know why but it just occurred to me to label the axes and arrange things in a particular manner-I just reported the data. Teacher C "I tried to describe the context first. I told how the data were collected. What happened inside the classroom when they gathered the data? I got too immersed in the story behind the numbers. The units and scales escaped my memory-I was basically narrating the story behind the data like I always do in my Filipino class. Teacher D "I took care to include all procedures. I enumerated each step carefully since I wanted to make sure everything was in place. I did not give importance to synthesizing the information into one major finding-I was more interested in the procedural aspect, as I often do in science. Teacher E"I followed the prescribed format in reporting the results. I presented the data in tables or graphs with appropriate labels. However, I did not exceed beyond those things. I believed that I only had to report what was already there."

The deficiencies among the teachers were most apparent in the Analysis section as the teachers tended to stick with superficial descriptions rather than interpret the data further. Teacher A identified obvious outliers without further investigation of possible reasons behind them; this is a typical problem among non-mathematicians since identifying patterns is more crucial than interrogating them in mathematics. Teacher B provided circular analyses that consisted merely of retelling the data rather than developing any additional ideas, indicating a failure of mathematical analysis due to the absence of mathematical background. Teacher C combined subjective impressions about the data with mathematical analysis; this tendency is characteristic of humanities majors whose education emphasizes interpretation of texts, which interferes with the objective analysis of mathematics. Teacher D provided all necessary calculations but did not interpret them further to develop inferences, which reflects a failure to transition from procedural sciences to more abstract concepts of mathematics. Teacher E conducted simple analyses and formulated simplistic inferences without detecting any patterns or complex reasoning processes; this reflects low analytical confidence typical of teachers who specialize in something else than mathematics.

As for drawing inferences and conclusions, the teachers demonstrated collective problems with logical reasoning and making evidence-based generalizations. Teacher A made unnecessary leaps of logical reasoning and provided too general conclusions that did not necessarily follow from the collected data. Teacher B failed to draw a proper inference from their analysis and provided vague conclusions or even their own subjective interpretations, which reveals the inability to use convergent thinking. Teacher C provided moral or practical lessons in connection with their analysis, which is characteristic of the humanities approach to text analysis. Teacher D stuck only to the initial hypothesis without providing any additional information, which implies a deficiency in drawing logical conclusions and making new inferences in connection with mathematical data. Teacher E tended to formulate very vague and hesitant conclusions despite being confident in the validity of their inferences, which reflects the inability to make definite claims about mathematical data.

The above-discussed deficiencies of five teachers, their difficulty in conducting deep mathematical analysis and linking their inferences to discipline-specific literature, are confirmed by the existing body of research on pedagogical content knowledge in mathematics education. First, it is acknowledged that effective mathematics instruction involves an integrated combination of mathematics-specific pedagogical and content knowledge; however, generalist teachers do not have this competence . Further, the teachers' difficulty in recognizing students' learning difficulties and selecting adequate instruction techniques based on their expertise has been reported . In addition, the teachers' inability to link their mathematical findings with literature in a different field can be explained by the concept of epistemic bunkers proposed by Cohen et al (2025), which refers to the way educators perceive knowledge as confined to a particular discipline and tend to filter out information from outside. Lastly, the teachers' inability to base their inferences and conclusions on discipline-specific literature can be explained by the finding that mathematics teachers do not link theories to practice and conduct classroom activities in isolation .

Based on the above discussion, it is suggested that each of the five teachers should receive a personalized plan of targeted professional development that would help them improve their skills in math journaling. Specifically, Teacher A should receive training in conventions of mathematical writing and presenting mathematical data. Teacher B needs to work with a lead mathematics teacher under mentorship for modeling analytical reasoning. It would be useful for Teacher C to attend workshops dedicated to distinguishing between subjective and objective aspects of mathematical data analysis. Teacher D should participate in collaboration with mathematics education specialists for building their abilities to draw conceptual inferences from procedural knowledge. Finally, it is recommended that Teacher E engage in a year-long learning community that focuses on mathematical inferences and the current state of mathematics education. The current status of out-of-field math teachers in regard to the examined teaching strategy can be characterized by a consistent use of instructional practices specific to their original specialties rather than mathematics instruction. The examination of their instructional practices has revealed certain deficiencies in eight core strategies, including Facilitation of Guided Learning, Strategic Use of Collaborative Learning, Leveraging Real-world Localized Problems, Differentiated Instruction, Maximizing Hands-on and Manipulative Tools, Explicit Teaching, Peer Explanation Protocols, Learning Progression Tracking, and Math Journaling. As for the English specialists, Teachers A and E tended to prioritize narrative description over numerical precision and conflated explanations with demonstrations, and gave general feedback to students rather than specific instructions related to the analyzed data. On the other hand, the MAPEH specialist (Teacher B) paid attention to engagement with students through competition and kinesthetic activities and ignored academic rigor. The Filipino specialist (Teacher C) emphasized story-telling but omitted the numbers and mathematical analysis. As for the Science specialist (Teacher D), the teacher used precise calculation and an inquiry approach but did not understand the specificity of mathematics pedagological content. Although all five teachers had four to eleven years of experience in mathematics teaching, they lacked mathematics-specific pedagogical content knowledge.

Conclusions

Research Objective no. 1

To analyze the Teaching Strategies of Out-of-field Elementary Mathematics Teachers in the San Pascual, North District.

1. To facilitate successful guided learning within mathematics, there must be carefully planned construction in accordance with student’s current zone of proximal development; unfortunately, however, out-of-field teachers do not possess this ability due to their own pedagogical routines formed from their prior non-mathematics educational backgrounds.

2. In order to provide collaborative strategies for mathematics learning, schools need intentional roles and interdependent structures; therefore, these types of strategies cannot exist when educators continually use generic grouping techniques derived from their original discipline(s).

3. Accurate (authentic) learning in mathematics requires culturally responsive

instruction by utilizing local-use data; yet, out-of-field educators typically revert back to traditional textbook examples due to their lack of instructional content knowledge in the field of mathematics.

4. When differentiating instruction within mathematics, none can occur without conducting pre-assessment diagnostics prior to implementing flexible grouping strategies; hence, out-of-field educators often confuse equal treatment with equitable learning.

5. Although manipulatives can be of aid to creating an understanding of the concept of transitioning from concrete to abstract reasoning, they also require structured inquiry, flexible pacing, and ongoing assessment to arrive at such an understanding, none of which can be accomplished without specialized professional development/training for out-of-field educators.

6. The process of 'I do, We do, You Do' will fail to produce successful outcomes when out-of-field educators implement the aforementioned strategies by using their own disciplinary conditional (linear narrative, exploratory, linguistic-based, tolerant feedback) instead of implementing systematic mathematical modeling.

7. The development of mathematical discourse requires the strategic use of talk moves along with the incorporation of accountability structures; however, when out-of-field educators engage in the development of mathematical discourse, they will revert back to the discourse style/structure they were trained/educated in (use of literary embellishments, flexibility in general fitness activities, narrative-based understanding, and complex scientific explanation) which do not align or resemble the expectations illustrated in math explanation protocols.

8. In order to utilize data as a primary instructional tool, mathematics teachers must use competency-based systems for tracking and continuously provide means for the assessment of visual performance data to allow data-driven mathematics instruction; this requires out-of-field educators to have previous training on how to convert raw performance data from multiple performance evaluations into learning trajectories that are specifically designed for teachers to use as ongoing formative assessments and to assist in making instructional decisions.

9. To develop effective mathematical writing and inferences, out-of-field educators need to use the following standards: objectivity, evidence-based assessment; discipline-specific writing conventions; however, the educators will always revert back to the style of writing used in their prior field of study (for example, narrative writing from humanities, listing of procedures, or providing subjective impression) which demonstrate the educator still resides in an epistemic bunker created by the boundaries of their specialization.

Recommendations

1. The introduction of a productive struggle protocol will include both a structured plan for asking guiding questions and anticipate that a prescribed wait period will be implemented prior to moving on to the "we do" phase to avoid providing direct instruction too soon.

2. The implementation of jigsaw coaching cycles to support the assignment of specific collaborative roles (facilitator, resource manager, reporter) for all teachers will ensure that each student's contribution in a given group is critical to the success of that group.

3. Teachers will receive training to create data-collection projects from their local communities that will address each component of the data life cycle: collection, processing, analysis, dissemination, evaluation – including (e.g., sari-sari store sales; barangay sports tournaments).

4. The requirement of a short diagnostic pre-assessment (before each new unit) will allow for tiered learning objectives that provide specific entry and exit points for students who are not achieving grade-level expectations, and for those who are.

5. A unified intervention protocol will include structured distribution routines, an inquiry-based approach to instruction, flexible pacing for students, and student control of their learning trajectory; as well as formative checkpoints embedded in the protocol.

6. All out-of-field math teachers will participate in six-week coaching cycles; in which they must follow verbatim think-aloud scripts, use random response tools (i.e., individual whiteboards), utilize daily exit tickets, and ensure that their lesson objectives are approved by their coach.

7. Professional development for teachers will include providing structured protocols for teachers to use when explaining their thought processes to peers; including the assignment of roles, the provision of sentence starters, and the use of accountability checklists to ensure an emphasis on process (i.e., mathematical justification) as opposed to product (i.e., the correct answer).

8. A unified competency-based tracking framework will be developed and implemented; including the creation of and adherence to a structured skill matrix, the maintenance of formative checkpoint records, and the use of flexible and regression-capable tools; coupled with the creation of cross-skill visual maps developed in conjunction with a data specialist.

9. Each teacher who is out-of-field for math will have an individualized plan for professional development on his/her own. These plans will include, but are not

limited to, the following: training in mathematical writing conventions for English teachers; mentorship in analytical reasoning for MAPEH teachers; workshops on subjective vs. objective analysis for Filipino teachers; collaborative workshops with Math Education Specialists for Science teachers; and a year-long learning community focused on mathematical inference for all teachers who are out-of-field.

Compliance with Ethical Standards

As part of the preparation process for the study, the researcher collaborated with the selected schools located within San Pascual North District. The Public Schools District Supervisor (PSDS) was also contacted in order to present the research objectives and request permission to carry out the study. An agreement was made wherein both the PSDS and the researcher committed themselves to ensuring that the confidentiality of the information obtained from the interviews remains intact, which means the names of the schools included in the study will not be divulged on any documents that may arise throughout the entire process.

In accordance with the Data Privacy Act, no personal data, such as name and affiliation of respondents, were used when entering data in the spreadsheet. Only pseudonyms (Teacher A, Teacher B, etc.) were used to ensure confidentiality of identity. All files, meanwhile, will be saved in a password-protected device that is accessible only by the researcher and his research adviser. These data will be retained until the completion of the thesis but will be permanently deleted once the thesis is completed. It is also made clear to the participants that they have the right to refuse participation or withdrawal from the study without having to give any reason. In case they decide to withdraw from the study, the collected data from these participants will not be used.

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