

Investigating Students' Collaboration to Non-Routine Mathematics Problems

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Abstract—This study investigated Grade 9 students' collaboration in solving non-routine mathematics problems (NRPs) at Tugaya National High School, Lanao del Sur. Employing a mixed-methods design with twenty-five participants, the intervention integrated NRPs aligned with the Most Essential Learning Competencies (MELCs) on quadratic equations. Data were collected through the Self-Assessment of Collaboration Skills (SACS), peer assessment, and Focus Group Discussions to capture learners' collaborative behaviors and experiences. Findings revealed notable growth in communication, accountability, and idea-sharing, with learners progressing from Developing to Proficient levels of collaboration. Qualitative insights highlighted strengthened teamwork, clearer role distribution, and improved negotiation during group problem solving, alongside challenges such as time constraints and uneven participation. Overall, the study demonstrates that contextualized NRPs foster meaningful collaborative engagement among Grade 9 learners, underscoring their pedagogical value in cultivating cooperative skills essential for mathematics learning and broader educational contexts.

Keywords— Non-routine problems, collaborative learning, quadratic equations, grade 9 students, mathematics education.

I. INTRODUCTION

Mathematics has long been recognized as a foundational discipline that cultivates learners' critical thinking, reasoning, and problem-solving abilities. However, most mathematics classrooms in the Philippines and around the world have traditionally emphasized routine problem solving, wherein students depend on memorized formulas and procedural applications. This overemphasis on procedural fluency often leads to superficial learning, limited creativity, and weak collaboration among students (Nguyen et al., 2020).

In response, recent educational reforms and research have underscored the need to integrate non-routine problem solving (NRP) into mathematics instruction. Unlike routine exercises with fixed solutions, NRPs present unfamiliar, open-ended situations that require learners to think flexibly, explore various strategies, and reason logically through collaboration (Khusna et al., 2024). Engaging students in non-routine problem solving has been shown to promote deeper conceptual understanding, enhance metacognitive awareness, and develop higher-order thinking skills necessary for real-life mathematical applications. Moreover, learners' engagement with NRPs fosters persistence, reflective thinking, and confidence in mathematical reasoning (Keleş & Yazgan, 2025).

The shift toward non-routine mathematical tasks also highlights the importance of collaboration as a key 21st-

century learning skill. Collaborative learning environments allow students to communicate ideas, assume flexible roles, support team dynamics, and resolve conflicts—competencies that are essential for success in both academic and professional settings (Felmer, 2023). Through interaction and shared inquiry, students construct meaning collectively and refine understanding through dialogue. For junior high school learners, particularly those in Grade 9 where algebraic concepts become more abstract, collaboration serves as a valuable scaffold for comprehension and confidence building. Working in groups enables learners to exchange strategies, clarify misconceptions, and co-construct mathematical understanding, thereby strengthening both cognitive and social competencies (Junaid, 2025).

In the context of Tugaya National High School (TNHS), collaborative classroom interactions at TNHS often displayed uneven participation—some students dominated discussions while others remained passive or disengaged. These findings align with Johnson and Johnson (2019), who noted that without structured collaboration, group work may fail to yield cognitive and social benefits. Such evidence underscores the need for structured approaches that integrate non-routine problem solving with collaborative learning to enhance both engagement and problem-solving proficiency in mathematics.

To address these challenges, the present study focused on investigating Grade 9 students' collaboration in solving non-routine mathematics problems within a classroom setting. By

examining learners’ collaborative behaviours—such as communication, accountability, and participation—the study aims to provide empirical evidence of how non-routine tasks can foster meaningful teamwork and cooperative engagement. Ultimately, this research underscores the pedagogical value of contextualized NRPs in cultivating collaborative skills that are essential for mathematics learning and broader educational contexts.

II. METHODS

This study adopted a descriptive research design employing both quantitative and qualitative approaches. Its primary objective was to investigate Grade 9 students’ collaboration in solving non-routine mathematics problems within a classroom setting. To capture the multifaceted nature of collaboration, both quantitative and qualitative measures were utilized.

Quantitatively, the Self-Assessment of Collaborative Skills (SACS) and Peer Assessment were administered to evaluate learners’ collaboration within their groups. These instruments assessed categories such as contribution, team support, team dynamics, role flexibility, motivation or participation, quality of work, time management, preparedness, reflection, and team learning. In the SACS, each student evaluated their own collaborative performance, while in the peer assessment, they rated their groupmates’ collaboration using the same criteria. This dual perspective provided a comprehensive understanding of group interaction and cooperative behaviors.

Qualitatively, the Post-Implementation Interview and Focus Group Discussion (FGD) were conducted with selected students from each group. The interviews examined learners’ reflections on their collaborative experiences, perceptions of teamwork, and challenges encountered during the implementation of non-routine problems. The FGDs explored in greater depth the dynamics of teamwork, communication, motivation, and suggestions for improving future collaborative activities. The qualitative data were analyzed thematically to identify patterns, insights, and emergent themes related to students’ collaborative engagement and group learning experiences.

By combining quantitative and qualitative approaches, the study achieved a holistic understanding of how Grade 9 students collaborated in solving non-routine mathematics problems. This integration of methods underscores the pedagogical value of contextualized NRPs in fostering cooperative participation, communication, and teamwork among learners.

III. RESULTS AND DISCUSSION

This section presents the learners’ collaborative skills as demonstrated during the implementation of the Non-Routine Problems (NRP). Data were gathered through the Self-Assessment on Collaborative Skills (SACS), Peer Assessment, Pre- and Post-Implementation Interviews, and the Focus Group Discussion (FGD) with learners and the researcher to capture their teamwork dynamics, perceptions, and experiences.

Table I presents the comparison of Self-Assessment on Collaborative Skills (SACS) results before and after the

implementation of Non-Routine Problems (NRP). The overall mean increased from 2.80 (Proficient) to 3.05 (Proficient), indicating that learners demonstrated steady growth in their collaborative problem-solving skills as they engaged in the NRP sessions.

TABLE I. Summary of SACS Before and After Implementation

CATEGORY	Before		After	
	Mean	Verbal Interpretation	Mean	Verbal Interpretation
Contribution	2.86	Proficient	2.77	Proficient
Team Support	2.97	Proficient	3.45	Highly Proficient
Team Dynamics	3.04	Proficient	3.37	Highly Proficient
Role Flexibility	2.31	Developing Proficiency	2.67	Proficient
Motivation/ Participation	2.93	Proficient	3.41	Highly Proficient
Quality Of Work	2.76	Proficient	3.11	Proficient
Time Management	2.83	Proficient	3.33	Highly Proficient
Preparedness	2.77	Proficient	2.51	Proficient
Reflection	2.75	Proficient	2.68	Proficient
Team Learning	2.82	Proficient	3.23	Proficient
Overall	2.80	Proficient	3.05	Proficient

Notably, Team Support, Team Dynamics, Motivation/Participation, and Time Management improved from Proficient to Highly Proficient. This implies that learners became more responsive to group needs, actively contributed to joint activities, and managed their collaborative time more effectively. During the Focus Group Discussion, Group 4 emphasized this improvement, stating, “*Mas madali kapag nagtutulungan kasi mas maraming idea at mas mabilis mahanap ang sagot*” (It is easier when we help each other because there are more ideas and the answer can be found faster) (FGD, G4). This aligns with the observed enhancement in team coordination and participation.

The indicator Role Flexibility showed notable development, rising from 2.31 (Developing Proficiency) to 2.67 (Proficient). This indicates that learners became more adaptable in assuming different responsibilities within the group, a growth that reflects the impact of repeated exposure to collaborative NRP activities. In the post-implementation interview, Group 3 mentioned, “*Kahit minsan hindi ako leader, tinutulungan ko pa rin magplano ng sagot*” (Even if I’m not the leader, I still help in planning the answer) (Post-Interview, G3). Such remarks demonstrate growing initiative and shared accountability among group members.

Meanwhile, Preparedness and Reflection maintained Proficient ratings, suggesting that while learners were able to sustain their engagement, further scaffolding could enhance their consistency in preparation and metacognitive reflection. Group 2 shared in the FGD, “*Minsan kulang sa oras kaya hindi masyadong napag-usapan yung mga pagkakamali*” (Sometimes we run out of time, so we can’t discuss the mistakes much) (FGD, G2), highlighting the need for structured reflection time after collaborative problem solving.

Henceforward, the SACS results confirm that collaboration in solving NRP fostered greater teamwork, participation, and coordination among learners. The integration of non-routine problem solving provided authentic opportunities for learners

to communicate, delegate roles, and reflect together—skills essential to mathematical reasoning and group learning. These findings are consistent with the qualitative themes of Strengthened Teamwork and Communication and Positive Shifts in Problem-Solving Confidence and Collaboration, showing how learners progressed from dependent participants to confident, cooperative problem solvers.

The same collaborative categories used in the Self-Assessment on Collaborative Skills (SACS) were employed in the Peer Assessment; however, this time, learners rated their groupmates individually by name. This allowed a more personal evaluation of contribution, teamwork, and participation within each group. Across all groups, those identified as top scorers were learners who demonstrated leadership, dependability, and initiative in facilitating collaboration. These results align strongly with the qualitative insights from the post-implementation interviews and focus group discussions, which highlighted learners’ progression in confidence, teamwork, and shared responsibility.

As seen in Table II, G1-S2 and G1-S5 consistently received the highest peer ratings across multiple categories, particularly in Contribution, Team Dynamics, Motivation/Participation, and Quality of Work. Their peers recognized them as reliable contributors who maintained enthusiasm and group focus.

TABLE II. Peer Assessment of Group 1

CATEGORY	Top Scorer/s in Peer Assessment: Group 1		
Contribution	G1-S2		
Team Support	G1-S5		
Team Dynamics	G1-S1	G1-S2	G1-S5
Role Flexibility	G1-S1		
Motivation/ Participation	G1-S2		
Quality Of Work	G1-S2		
Time Management	G1-S2		
Preparedness	G1-S2		
Reflection	G1-S1		
Team Learning	G1-S2		

This complements Group 1’s post-implementation reflection: “Mas naging enjoy po kasi nagtatawanan kami kahit nahihirapan, kaya hindi boring” (It became more enjoyable because we laughed together even when it was difficult, so it wasn’t boring) (Post-Interview, G1). The positive atmosphere and humor mentioned reflect the motivational drive that made these members effective collaborators, fostering group unity and persistence in solving complex activities.

TABLE III. Peer Assessment of Group 2

CATEGORY	Top Scorer/s in Peer Assessment: Group 2	
Contribution	G2-S5	
Team Support	G2-S5	
Team Dynamics	G2-S5	
Role Flexibility	G2-S1	
Motivation/ Participation	G2-S1	G2-S5
Quality Of Work	G2-S5	
Time Management	G2-S5	
Preparedness	G2-S2	
Reflection	G2-S5	
Team Learning	G2-S5	

As shown in Table III, G2-S5 emerged as the top scorer in most categories, notably Team Support, Team Dynamics, and Quality of Work, while G2-S1 also gained high ratings in Role Flexibility and Motivation/Participation

This pattern reinforces the group’s developing interdependence, as expressed in the FGD: “I suggested a way to answer a certain activity. It felt good kasi I was able to contribute” (FGD, G2). Their active involvement and appreciation of shared contribution signify the theme of Empowering Learning, where learners became confident in voicing ideas and participating more equitably during NRP sessions.

As presented in Table IV, G3-S1 received the highest peer ratings across nearly all collaborative categories such as Contribution, Team Support, and Role Flexibility, while G3-S4 and G3-S5 were recognized for Time Management and Preparedness.

TABLE IV. Peer Assessment of Group 3

CATEGORY	Top Scorer/s in Peer Assessment: Group 3	
Contribution	G3-S1	
Team Support	G3-S1	
Team Dynamics	G3-S1	
Role Flexibility	G3-S1	
Motivation/ Participation	G3-S1	
Quality Of Work	G3-S1	
Time Management	G3-S4	G3-S5
Preparedness	G3-S4	
Reflection	G3-S3	G3-S4
Team Learning	G3-S3	

Peers viewed this member as proactive and dependable, capable of adapting to different roles as the situation demanded. This perception supports the group’s earlier statement in the post-implementation interview: “Yung pinakamaganda po ay yung nakatulong ako sa group kasi dati tahimik lang ako” (The best part was being able to help my group because before I was just quiet) (Post-Interview, G3). The transition from passive to active engagement demonstrates how repeated collaborative problem-solving fostered initiative and confidence, validating the theme of Positive Shifts in Problem-Solving Confidence and Collaboration.

As reflected in Table V, Group 4’s peer assessment revealed distributed recognition, with all five members (G4-S1 to G4-S5) identified under Role Flexibility, suggesting balanced participation and adaptability.

This indicates that each member contributed in various capacities—sometimes leading, assisting, or recording solutions. This balance reflects Group 4’s FGD insight: “Mas madali kapag nagtutulungan kasi mas maraming idea at mas mabilis mahanap ang sagot” (It is easier when we help each other because there are more ideas and the answer can be found faster) (FGD, G4). The result demonstrates the group’s maturity in teamwork and adaptability, hallmarks of Highly Proficient collaboration as shown in their post-SACS rating.

As shown in Table VI, G5-S5 and G5-S1 were repeatedly rated highest in Team Support, Time Management, and Quality of Work. Their peers recognized them for consistency, reliability, and active participation.

TABLE V. Peer Assessment of Group 4

CATEGORY	Top Scorer/s in Peer Assessment: Group 4				
Contribution	G4-S2				
Team Support	G4-S3		G4-S4		
Team Dynamics	G4-S1		G4-S3		
Role Flexibility	G4-S1	G4-S2	G4-S3	G4-S4	G4-S5
Motivation/ Participation	G4-S3		G4-S4		
Quality Of Work	G4-S2		G4-S3		
Time Management	G4-S2				
Preparedness	G4-S1		G4-S4		
Reflection	G4-S2				
Team Learning	G4-S2				

TABLE VI. Peer Assessment of Group 5

CATEGORY	Top Scorer/s in Peer Assessment: Group 5				
Contribution	G5-S5				
Team Support	G5-S5				
Team Dynamics	G5-S5				
Role Flexibility	G5-S4		G5-S5		
Motivation/ Participation	G5-S1				
Quality Of Work	G5-S5				
Time Management	G5-S1		G5-S5		
Preparedness	G5-S5				
Reflection	G5-S1		G5-S2		
Team Learning	G5-S2				

This supports Group 5’s reflection in the FGD: *“One specific moment was when we were stuck on a problem, then one member suggested a solution none of us thought of before. That really showed me the value of different perspectives”* (FGD, G5). Their ability to appreciate and integrate diverse ideas underlines the development of metacognitive awareness and respect for collective reasoning, consistent with the theme Strengthened Teamwork and Communication.

In analyzing the pre- and post-interviews of the learners through thematic analysis, three themes were identified: Empowering Learning, Collaborative Experiences, and Teamwork Dynamics. These themes highlight how students’ collaborative behaviors evolved during the implementation of non-routine mathematics problems (NRPs), underscoring the central role of communication, accountability, and shared participation in group learning.

NRP Application: Before the implementation, students often relied heavily on direct formulas and the teacher’s given examples. As shared by Group 2 *“Pag hindi tugma yung tanong sa nakasanayan ko, natataranta na ako kung ano yung gagawin”* (When the question doesn’t match what I’m used to, I panic about what to do) (Pre-Interview, G2). Similarly, Group 4 noted, *“Minsan kahit alam ko yung formula, nalilito pa rin ako kung paano siya ilalapat sa problem”* (Sometimes even if I know the formula, I still get confused on how to apply it to the problem) (Pre-Interview, G4).

After the NRP implementation, however, learners described a change in how they approached problems. Group 1 reflected, *“Nasanay na po ako na hindi lang isa yung paraan. Kahit*

mahirap, nakikita ko na may ibang strategy pa” (I got used to the idea that there’s not just one way. Even if it’s hard, I can see there are other strategies) (Post-Interview, G1). Likewise, Group 5 expressed, *“Mas naging aware po ako na pwede pala mag-try ng iba’t ibang solusyon, tapos pipiliin namin yung pinaka-simple”* (I became more aware that we could try different solutions, then choose the simplest one) (Post-Interview, G5). This shift shows how exposure to non-routine activities strengthened their adaptive reasoning and openness to exploring alternative strategies—an outcome also reflected in the FGD, where groups acknowledged that solving non-routine problems encouraged flexibility, critical thinking, and a willingness to test multiple methods collaboratively.

Empowering Learning: prior to the implementation, several groups admitted to depending on peers or the teacher. Group 3 shared, *“Lagi po ako nagtatanong sa kaklase kasi hindi ako sure sa sagot ko”* (I always ask my classmates because I’m not sure of my answer) (Pre-Interview, G3). Group 1 also revealed a lack of motivation: *“Kapag hindi ko maintindihan agad, parang nawawalan na ako ng gana”* (When I can’t understand right away, I lose motivation) (Pre-Interview, G1).

After the implementation, responses demonstrated a clear transformation toward learner empowerment. Group 4 explained, *“Mas naging tiwala po ako sa sarili ko kasi kahit hindi agad tama, may chance pa rin ma-correct ng group”* (I became more confident in myself because even if I’m not immediately correct, my group can still help correct it) (Post-Interview, G4). Moreover, Group 2 reflected, *“Natutunan ko na makinig din sa iba kasi minsan yung idea nila mas malinaw at mas effective”* (I learned to listen to others too because sometimes their idea is clearer and more effective) (Post-Interview, G2). These responses indicate that learners developed confidence, recognized the value of teamwork, and built stronger communication and metacognitive skills. This transformation mirrors the FGD findings, where groups described learning to rely not solely on correctness but on collective reasoning and mutual support during problem-solving.

Learning Experiences: Prior to the NRP implementation, most groups described problem-solving as stressful and repetitive. Group 5 shared, *“Nakaka-stress kasi parang paulit-ulit lang yung ginagawa namin, hindi exciting”* (It’s stressful because we keep doing the same thing, not exciting) (Pre-Interview, G5). while Group 2 admitted, *“Minsan sinusubukan ko lang kahit hindi ako sure, bahala na”* (Sometimes I just try even if I’m not sure, whatever happens) (Pre-Interview, G2).

After the implementation, their perspectives became notably more positive and engaging. Group 1 shared, *“Mas naging enjoy po kasi nagtatawanan kami kahit nahihirapan, kaya hindi boring”* (It became more enjoyable because we laughed together even when it was difficult, so it wasn’t boring) (Post-Interview, G1). Similarly, Group 3 added, *“Yung pinakamaganda po ay yung nakatulong ako sa group kasi dati tahimik lang ako”* (The best part was being able to help my group because before I was just quiet) (Post-Interview, G3). These accounts reveal that learners not only improved problem-solving but also built camaraderie and resilience, turning mathematics into a more engaging and meaningful experience.

The pre- and post-interview analysis demonstrates a notable shift in learners' perspectives and practices. Initially dependent on formulas, examples, and peer assistance, students grew to be more flexible, collaborative, and confident after engaging in NRP activities. The themes of NRP Application, Empowering Learning, and Learning Experiences highlight not just cognitive growth but also social and affective development, underscoring the potential of collaborative non-routine problem to transform mathematics learning.

The focus group discussion provided deeper insights into learners' experiences, motivations, and perspectives on collaborative problem-solving with non-routine problems (NRPs). At the outset, students shared their reasons for joining the activity. Some were motivated by curiosity and the desire to improve their mathematical reasoning, while others were encouraged by peers. Group 3 explained, *"I wanted to learn different ways of solving math problems and also listen to the experiences of others, kasi I think that can help me improve my skills"* (I wanted to learn different ways of solving math problems and listen to the experiences of others, because I think that can help me improve my skills). Similarly, Group 5 shared, *"Well, honestly, my groupmates were the first to motivate me to join. I also want to learn more in math and widen my knowledge"* (Well, honestly, my groupmates were the first to motivate me to join. I also want to learn more in math and widen my knowledge). These statements suggest that motivation stemmed both from intrinsic interest and peer encouragement—reflecting learners' willingness to explore new approaches to problem-solving.

As the discussion shifted to positive experiences, the learners emphasized how collaboration created opportunities to share and learn new ideas. Group 2 recalled, *"I suggested a way to answer a certain activity. It felt good kasi I was able to contribute"* (I suggested a way to answer a certain activity. It felt really good because I was able to contribute). Meanwhile, Group 4 described, *"We were given a quadratic equation problem and we had to solve it using different approaches. We worked together, shared ideas, and eventually we found the solution"* (We were given a quadratic equation problem and we had to solve it using different approaches. We worked together, shared ideas, and eventually we found the solution). These reflections highlight how collaborative learning helped learners gain confidence and see the benefits of teamwork.

When asked about their collaborative approaches, learners described practices such as task division and role assignment. Group 3 shared, *"In our activity, we approached the problem through proper discussion and dividing the activities. Each of us gave ideas on how to solve it until we came up with a clearer method"* (In our activity, we approached the problem through proper discussion and dividing the activities. Each of us gave ideas on how to solve it until we came up with a clearer method). Likewise, Group 5 explained, *"Our group handled the problems by really talking it out and understanding the problem as a team. My role was kind of like the facilitator — making sure everyone contributed equally"* (Our group handled the problems by really talking it out and understanding the problem as a team. My role was kind of like the facilitator — making sure everyone contributed equally). These responses

show that learners valued structured teamwork where everyone had responsibilities.

Communication dynamics were also highlighted. Some groups experienced small misunderstandings but overcame them through clarification and active listening. Group 3 noted, *"We communicated by giving each one the chance to explain their own solution. There were times na may konting misunderstanding, but we fixed it by repeating explanations and giving examples"* (We communicated by giving each one the chance to explain their own solution. There were times when we had a few misunderstandings, but we fixed it by repeating explanations and giving examples). Similarly, Group 4 said, *"We used simple language, diagrams, and examples para mas clear, and we clarified our thoughts right away when there was confusion"* (We used simple language, diagrams, and examples to make things clearer, and we clarified our thoughts right away when there was confusion). These accounts reveal that communication required deliberate effort but was crucial to problem-solving success.

Perceptions of collaboration also evolved throughout the process. Group 4 reflected, *"At first, I thought collaboration was just about working together for a common goal. But now I see it as a process of learning from each other as well"* (At first, I thought collaboration was just about working together for a common goal. But now I see it as a process of learning from each other as well). In the same way, Group 5 shared, *"One specific moment was when we were stuck on a problem, then one member suggested a solution none of us thought of before. That really showed me the value of different perspectives"* (One specific moment was when we were stuck on a problem, then one member suggested a solution none of us thought of before. That really showed me the value of different perspectives). These insights demonstrate a shift from seeing collaboration as merely dividing work to understanding it as an exchange of ideas.

Toward the end of the discussion, learners suggested ways to improve future implementations. Many emphasized the importance of additional time and practice. For example, Group 3 recommended, *"Maybe more practice activities para mas prepared kami"* (Maybe more practice activities so we will be more prepared). Moreover, Group 5 added, *"I recommend more training on effective communication and conflict resolution skills, so collaboration will be smoother"* (I recommend more training on effective communication and conflict resolution skills, so collaboration will be smoother). These recommendations show that learners are aware of existing challenges and can provide practical suggestions for enhancing collaborative learning in mathematics.

The focus group discussion revealed that learners valued collaboration not only for solving mathematical problems but also for building confidence, creativity, and critical thinking. While challenges such as communication gaps and time constraints were present, students recognized non-routine problems as opportunities to strengthen both academic and interpersonal skills, affirming the study's objective of investigating collaboration in mathematics learning.

IV. CONCLUSIONS AND RECOMMENDATIONS

The main purpose of this study was to investigate Grade 9 students' collaboration in solving non-routine mathematics problems (NRPs) at Tugaya National High School. Based on the findings from both quantitative and qualitative data, the following conclusions were drawn:

Results from the Self-Assessment of Collaborative Skills (SACS) indicated that students initially demonstrated Developing levels of collaboration, particularly in communication and task-sharing. Post-implementation scores showed marked improvement, with most learners reaching the Proficient level. Learners themselves confirmed this growth, noting increased confidence and reliance on peer support. This improvement aligns with Johnson and Johnson's (2019) assertion that collaborative projects enhance accountability, communication, and respect for peer contributions.

Peer assessment results reinforced the SACS findings, as students rated each other higher in accountability, listening, and idea contribution after the NRP implementation. These quantitative results were triangulated with qualitative insights from Focus Group Discussions (FGDs), where learners emphasized valuing their classmates' input and recognizing the importance of listening and teamwork.

Thematic analysis of interview and FGD data highlighted three central themes related to collaboration: (a) Empowering Learning, reflecting growth in confidence and reliance on peer support; (b) Collaborative Experiences, showing shifts in learners' perceptions of mathematics from stressful and repetitive to enjoyable and interactive; and (c) Teamwork Dynamics, emphasizing role distribution, communication, and problem negotiation. Learners acknowledged challenges such as time constraints and uneven participation, but these did not undermine the overall success of collaborative engagement.

Overall, the implementation of NRPs in a collaborative setting proved to be an effective approach for fostering teamwork, communication, accountability, and shared responsibility among Grade 9 learners. Students became more confident, engaged, and interactive, while recognizing the importance of collaboration in overcoming mathematical challenges.

Based on the conclusions, it is recommended that mathematics teachers regularly integrate non-routine problems into classroom instruction as structured collaborative activities to strengthen students' communication, accountability, and teamwork. To ensure equitable participation, teachers should assign flexible group roles, encourage reflection through journals or guided questioning, and provide scaffolding that supports collaborative engagement. School administrators and curriculum developers are advised to institutionalize non-routine problems within the MATATAG curriculum to promote higher-order thinking and cooperative learning, supported by sustained professional development for teachers in collaborative facilitation. Establishing resource banks of contextualized NRPs will further enhance accessibility and coherence, while future research may extend this focus to other grade levels and explore the use of digital collaborative tools to address time-management challenges and enrich group dynamics.

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