Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika
JRPIPM. 2025 (Vol. 9, no. 2, 143-164)
ISSN: 2581-0480 (electronic)
URL: journal.unesa.ac.id/index.php/jrpipm

A Collaborative Learning Model for Developing Problem-Solving Skills in Mathematics: the Role of Respect and Support

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Submitted: 21 October 2025; Revised: 19 November 2025; Accepted: 5 Desember 2025

ABSTRACT

This study examined the influence of a respectful and supportive collaborative learning environment on Senior High School Year 3 (SHS3) students' problem-solving skills and mathematics achievement in Ghana. A mixed-methods approach was adopted with open-ended questionnaire and achievement test, employing Braun and Clarke's thematic analysis for qualitative data and paired-sample t-test statistics for quantitative analysis. The intervention focused on promoting mutual respect, peer support, and structured collaboration during mathematics problem-solving tasks. Pre-test findings highlighted barriers such as fear of negative peer judgment, low confidence, avoidance of challenging problems, limited knowledge of problem-solving strategies, and surface-level learning. Post-test results revealed marked improvements, including enhanced confidence, constructive peer interaction, persistence, deeper learning, accuracy, and the use of diverse strategies. Statistical results from the SHS 3 further confirmed significant gains in mathematics achievement after the intervention. These findings demonstrate that fostering respect and support within collaborative learning environments can strengthen both problem-solving competencies and academic performance. The study recommends that mathematics educators adopt respect-based collaborative approaches to cultivate positive peer dynamics, encourage active engagement, and develop higher-order thinking skills among students.

Keywords: *collaborative learning, mutual respect, problem-solving skills, peer support.*

How to cite: Isaiah, D.D. (2025). A Collaborative Learning Model for Developing Problem-Solving Skills in Mathematics: The Role of Respect and Support. *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, *9*(2), 143-164. https://doi.org/10.26740/jrpipm.v9n2.p143-164

1. Introduction

Over time, mathematics education has been moving away from the traditional teacher-centred model and towards approaches that place greater emphasis on learner engagement, active participation, and the shared construction of knowledge (Wright, 2021; Akpalu et al., 2018; Lombardi, et al., 2021). One approach that has gained significant attention is collaborative learning, which is firmly rooted in Vygotsky's (1978) social constructivist theory. Respect is also grounded in social learning theory, which posits that learning occurs through observation, imitation, and social interaction (Bandura, 1986). In this framework, respect serves as a catalyst for fostering a supportive learning environment where students engage in collaborative learning activities, interact meaningfully with their peers, and construct knowledge collectively (Fakomogbon & Olalekan, 2017). By modeling respect for students' diverse perspectives and ways of thinking, educators demonstrate the importance of valuing and appreciating the contributions of others in the learning process (Amanda et al., 2025). Through collaborative problem-solving tasks, peer discussions, and cooperative learning experiences, students observe and imitate respectful communication and collaboration behaviors, leading to the development of a positive learning culture where mutual respect and understanding thrive (Sidgi, 2022; Wagino, 2023; Menekse, 2019). Moreover, respectful interactions between educators and students bolster students' self-efficacy beliefs, motivating them to actively participate in their mathematical learning and persist in the face of challenges (Schürmann et al., 2024). Thus, within the framework of social learning theory, respect serves as a fundamental principle that underpins collaborative learning, social interaction, and the development of students' problem solving skills in mathematics.

In a collaborative learning environment, students work together to explore mathematical ideas, engage in discussions, and solve problems collectively (Lu & Smiles, 2022; Agustiningtyas et al., 2025; Smucker & Nuss, 2022; Baanqud et al., 2020). This process allows them to build deeper understanding by drawing on shared reasoning and considering multiple perspectives. Importantly, the benefits of such environments extend beyond improved cognitive outcomes; they also nurture essential skills for the 21st century, such as effective communication, negotiation, and the ability to provide (Jagadianti & Wijayanti, 2025) and respond to peer feedback (Siller & Ahmad, 2024). Through these experiences, students build mathematical understanding while also strengthening the interpersonal and problem-solving skills essential for success in today's collaborative world.

However, the success of collaborative learning in mathematics does not depend only on how tasks are designed (Maula et al., 2025) or how groups are organized. It is also deeply influenced that peer relationships can influence motivation and engagement, which in turn influences academic achievement (Shao et al., 2024). One key factor that has received relatively little attention is respect, the mutual acknowledgement and valuing of each learner's ideas, contributions, and identity. When respect is present, it creates a sense of psychological safety, encouraging students to share their reasoning openly, question and challenge ideas in a constructive way, and take intellectual risks without fear of embarrassment or ridicule. Without respect, collaborative learning can devolve into shallow cooperation or disengagement, hindering meaningful understanding.

Although collaborative learning and its cognitive benefits have been widely studied, far less attention has been given to the role of respect as a mediating factor in mathematics classrooms (Azmi et al., 2022). Much of the existing literature focuses on structural aspects, such as group size, task design, and teacher guidance, while giving less consideration to the socio-emotional norms that sustain equitable participation and meaningful dialogue (Thanheiser, 2023; Handoko & Mubarikah, 2025). This oversight is particularly significant in mathematics education, where misunderstandings, over-reliance on procedural shortcuts, and communication breakdowns are common unless a culture of mutual regard is established.

In the Ghanaian context in this study (means interpreting findings or concepts in a way that reflects Ghana's unique realities rather than applying general or foreign assumptions), the importance of respect is deeply rooted in our cultural fabric. From an early age, children are taught to respect parents, elders, and authority figures that a value that extends naturally into the classroom, where teachers are held in high esteem (Albeshree et al., 2022). However, this cultural respect is often hierarchical, with students deferring to authority and sometimes hesitating to question ideas or challenge their peers (Mohamed et al., 2020). While this deference can maintain order, it may also limit open dialogue and peer-to-peer exchange in collaborative learning settings.

Ghanaians, driven by the belief that education is a pathway to upward mobility, often emphasized discipline and obedience, expecting children to “listen more than they speak” (Rodríguez-Jiménez et al., 2023). Teachers, influenced by their own upbringing and professional norms, may unconsciously reinforce this one-directional flow of knowledge. Students, in turn, may see questioning or correcting a peer as disrespectful, especially in mixed-age or senior-junior group settings.

When respect in Ghanaian classrooms is reframed, not merely as obedience to authority but as mutual recognition of each learner’s worth and contribution, it can transform collaborative learning (Klingenberg et al., 2019). In such an environment, students feel empowered to share alternative solution methods, address misconceptions without fear of offending, and co-create deeper mathematical understanding. This shift aligns with our cultural emphasis on community (Aslan, 2021) and collective success, turning respect from a silent classroom norm into an active driver of equitable participation and intellectual growth.

Considering this gap, it becomes essential to examine how respect within collaborative learning environments shapes students’ problem solving skills in mathematics. Respect in the classroom is not a superficial courtesy, it is the bedrock upon which open dialogue, active listening, and meaningful exchange of ideas are built (Ramirez & Devesa, 2019). When students feel that their thoughts are valued and their identities acknowledged, they are more willing to engage in discussions, question each other’s reasoning, and propose alternative solutions without fear of embarrassment or dismissal. In the Ghanaian mathematics classroom, where traditional hierarchies and deference to authority often influence communication patterns (Atta & Boyah, 2023), cultivating respect can shift the learning dynamic from passive reception to active co-construction of knowledge. For instance, when a teacher deliberately affirms contributions from all students, whether correct or incorrect, it signals that every idea has merit as a steppingstone toward deeper understanding (Scheiner & Montes, 2025). When peers respond with curiosity instead of criticism, discussions deepen, and misconceptions are addressed collaboratively.

Such an environment naturally boosts classroom interactions: students ask more questions, elaborate on their thought processes, and confidently challenge ideas using evidence (Ramirez & Devesa, 2019). The resulting exchange of diverse strategies strengthens collective reasoning, leading to more robust and lasting conceptual understanding. Respect, therefore, does not simply make the classroom “feel” better, it creates the social conditions necessary for collaborative learning to fulfil its potential, transforming the mathematics class into a space where every learner is both a contributor and a beneficiary of shared intellectual growth (Mohamed et al., 2020; Ramirez & Devesa, 2019).

Given this gap, there is a pressing need to investigate how respect within collaborative learning environments influences the development of conceptual understanding in mathematics (Fakomogbon & Olalekan, 2017). Understanding this relationship will not only contribute to the theoretical discourse on socio-emotional factors in mathematics education but also provide practical insights for educators seeking to create inclusive, intellectually stimulating classrooms (Bandura, 1986). This study therefore aims to explore the role of respect as a central, yet under-researched (Rodríguez-Jiménez et al., 2023), driver of effective collaborative mathematics teaching (Klingenberg et al., 2019), with the goal of developing a model that integrates both cognitive and affective dimensions of group work to enhance conceptual understanding.

Based on these objectives, the study seeks to address two key research questions: How does mutual respect among Queen of Peace SHS students in collaborative learning environments influence their problem-solving skills in mathematics? To what extent does students' respect for one another within collaborative learning groups contribute to their overall mathematics achievement?

2. Method

2.1 Research Design

This study employed a mixed methods design to investigate how mutual respect in collaborative learning relates to students' problem-solving skills and mathematics achievement at Queen of Peace SHS. The population comprised of SHS 3 students and a sample of 79 was selected using purposive sampling. Data were collected using a validated questionnaire measuring mutual respect and problem-solving indicators, and students' mathematics scores obtained from test conducted. Data collection followed these steps: (1) obtain ethical and institutional approvals, (2) secure informed consent/assent, (3) administer questionnaires during class and (4) retrieve academic records. Quantitative data were analyzed using paired sample t-test in SPSS, the students' open-ended responses from both pre-test and post-test phases were analyzed using Braun and Clarke's (2006) six-phase thematic analysis framework. Measures to ensure validity and reliability included pilot testing, use of established scales, triangulation of data sources, and anonymization of responses. Ethical protocols were observed throughout, and main limitations of the design are discussed in the limitations section.

2.2 Population and Sampling

The population comprises Queen of Senior High Students from diverse socio-economic and cultural backgrounds, ensuring that findings reflect a broad range of learning experiences. A purposive sampling technique is employed to select 79 Senior High School Year 3 (SHS3) mathematics students as participants and 9 of them were purposefully selected for the collection of qualitative data. This group is chosen because they are in their final year and, as such, possess a higher level of maturity, better academic exposure, and the ability to articulate their thoughts clearly in English. Their advanced stage in the academic journey provides a unique opportunity to gather accurate, reflective, and detailed accounts of their experiences, making it easier to attribute observed changes in achievement, engagement, and problem-solving skills to the collaborative learning strategy. Furthermore, SHS3 students are generally known to demonstrate respectful interactions with peers and teachers, developed over their years in the school environment. This established predisposition towards respect creates an enabling social atmosphere for implementing collaborative learning effectively, allowing the research to explore how respectful peer dynamics contribute to mathematics learning outcomes.

2.3 Data Collection Instruments

Battaglia et al. (2015) illustrate how open-ended questionnaire responses can be quantitatively analyzed via cluster analysis to reveal patterns in students' thinking. It underscores the feasibility and usefulness of integrating qualitative responses into rigorous quantitative analysis. Two primary instruments are used: (1) Achievement Tests, these measure quantitative outcomes such as mathematical achievement. Administered both as pre-tests and post-tests, they allow for the measurement of changes in performance attributable to collaborative learning interventions; and (2) Open-Ended Questionnaires, these collect qualitative data on students' perceptions, attitudes, and experiences with collaborative learning.

The open format enables participants to share detailed and authentic reflections that might not emerge from fixed-response surveys.

2.4 Validity and Reliability

To ensure the credibility and trustworthiness of findings, both instruments undergo validity and reliability assessments. For the achievement tests, content validity is established through expert review, while reliability is measured using internal consistency indices. For the open-ended questionnaires, trustworthiness is enhanced through piloting, peer debriefing, and member checking to confirm the accuracy of interpreted responses.

2.5 Data Collection Procedure

The study employs a structured three-phase intervention lasting a total of six weeks, combining pre- and post-assessments with targeted instructional strategies to measure the role of respect in collaborative mathematics learning. Data for the first research question was collected using an open-ended questionnaire designed to explore how mutual respect influences students' problem-solving skills in mathematics. The questionnaire included items addressing key indicators of mutual respect in collaborative learning, such as listening attentively to peers, valuing classmates' contributions, encouraging participation from all group members, demonstrating patience when others make mistakes, and sharing responsibilities fairly within the group. Responses were analyzed qualitatively to identify patterns of respectful interactions and their influence on students' problem-solving approaches.

For the second research question, data were collected through a mathematics achievement test consisting of items specifically designed to measure students' problem-solving abilities. Each test item corresponded to an indicator of mathematics achievement, including the ability to identify the problem, plan a solution strategy, apply formulas correctly, use logical reasoning in step-by-step problem-solving, and check or evaluate the solution for correctness. Students' scores on these items were used to quantitatively determine the extent to which mutual respect within collaborative learning groups contributes to overall mathematics achievement.

2.6 Conceptual Framework illustrates the two Phases of the Intervention

Figure 1 below illustrates the two phases of the intervention: Phase 1, Collaborative Learning without Respect Focus, and Phase 2, Collaborative Learning with Respect Emphasis. In Phase 1, students work collaboratively on mathematical tasks but without structured attention to respectful dialogue. In Phase 2, respectful communication is deliberately embedded in the group learning process. Respectful communication is conceptualized as a mediating factor that bridges collaborative learning and student outcomes. When respect is emphasized, group discussions become more supportive, inclusive, and constructive. It enables all members to participate meaningfully. This in turn enhances student outcomes such as engagement, teamwork, problem-solving ability, and positive attitudes toward mathematics learning.

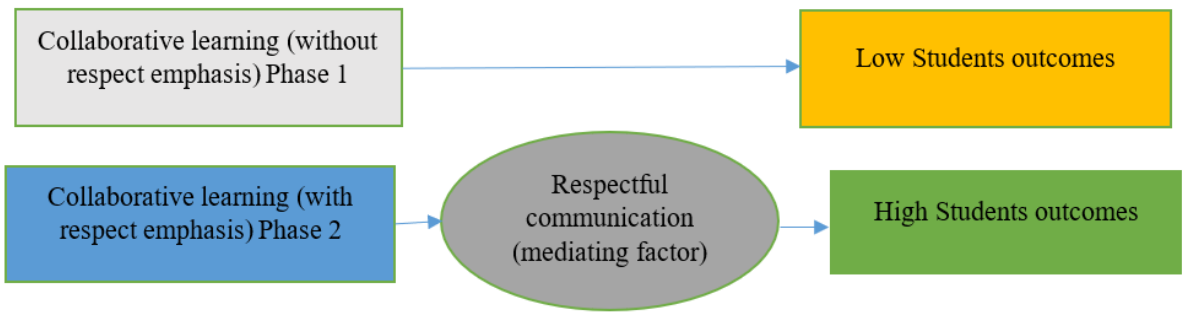

Figure 1. Conceptual Framework of the Intervention

Baseline Assessment (Pre-tests)

Before the intervention, pre-tests in mathematics are administered to establish a baseline measure of students' achievement. Open-ended questionnaires are also distributed at this stage to capture initial perceptions, attitudes, and conceptual understanding. Establishing baseline data is essential to ensure that any observed changes in achievement, attitudes, or understanding can be attributed to the intervention rather than pre-existing differences among participants.

Phase 1 – Collaborative Learning without Respect Focus (3 Weeks)

In the first three weeks, students engaged in collaborative learning activities designed to promote peer interaction, joint problem-solving, and shared responsibility for learning mathematical concepts. During this phase, the instructional focus is on collaboration as a cognitive and social process, without explicit emphasis on respect as a variable. This phase provides a control-like condition to measure the general benefits of collaborative learning alone. It enables the researcher to isolate the effects of collaboration from those specifically arising from the deliberate cultivation of respect.

Phase 2 – Collaborative Learning with Respect Emphasis (3 Weeks)

In the following three weeks, collaborative learning continues but is deliberately infused with activities, norms, and teacher facilitation strategies that explicitly promote respect among group members. This includes respectful listening, valuing diverse ideas, constructive feedback, and equitable participation. By intentionally embedding respect into the collaborative learning process, this phase tests the hypothesis that respect acts as a catalyst for deeper interaction, increased trust, and greater willingness to share ideas, factors expected to enhance conceptual understanding and achievement beyond collaboration alone.

Post-Assessment and Comparative Analysis

After the full six-week intervention, post-tests in mathematics and follow-up open-ended questionnaires are administered. Comparisons are made between the pre-test and post-test results, as well as between Phase 1 and Phase 2, to examine differences in achievement, perceptions, attitudes, and conceptual understanding. This comparative design enables the identification of the added value of respect in collaborative learning environments, thereby providing empirical evidence for its role in maximizing classroom interaction and learning outcomes.

2.7 Data Analysis

The study employed both quantitative and qualitative approaches to analyze the data collected. Quantitatively, a paired samples t-test was conducted to determine whether there was a statistically significant difference in students' mathematics achievement before and after the implementation of a respectful collaborative learning environment. The t-test compared pre-test and post-test scores, enabling the measurement of changes in performance attributable to the intervention. This approach was chosen because it is well-suited for examining within-subject differences over time and controlling for individual variability. All assumptions of the paired-sample t-test, including dependent observations, a continuous dependent variable, independence of pairs, and absence of significant outliers in the difference scores, and normality of the difference scores, were thoroughly checked and met before analysis.

Qualitatively, the students' open-ended responses from both pre-test and post-test phases were analyzed using Braun and Clarke's (2006) six-phase thematic analysis framework. This process involved (1) familiarization with the data, (2) generation of initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the final narrative. The thematic analysis allowed for the identification of patterns of meaning regarding students' experiences of respect within collaborative mathematics groups and its influence on their problem-solving abilities.

The combination of the paired samples t-test and thematic analysis provided a comprehensive understanding of the effects of respect in collaborative learning on both measurable achievement outcomes and the underlying experiential processes that shaped students' mathematical problem-solving development.

3. Results And Discussion

3.1 Respondents Description

Demographic information plays a crucial role in research data analysis and should not be overlooked. It examines both the static and dynamic characteristics of the studied population (Paquette et al., 2020). In this study, the empirical survey included questions on respondents' gender, age, program of study, and school affiliation. These aspects provided key insights into participant characteristics and ensured the validity of their inclusion in the research.

Table 1. Gender of respondents

Gender	Frequency (f)	Percentage (%)
Male	47	59.5
Female	32	40.5
Total	79	100.0

As shown in Table 1, the study's gender distribution reveals a fairly balanced representation, with 47 male participants (59.5%) and 32 female participants (40.5%) out of a total of 79 respondents. While there is a slight majority of males, the difference is minimal, indicating that both genders are nearly equally represented in the study.

Table 2. Age of respondents

Age	Frequency (f)	Percentage (%)
17-19 years	22	27.8
20-22 years	30	38.0
23-24 years	16	20.3
≥25	11	13.9
Total	79	100

Table 2 displays the age distribution of respondents, showing that the largest proportion, 27.8% (22 out of 79), falls within the 17–19 age range. This is followed by the 20–22 category, which comprises 38% (30 out of 79). A smaller segment, 20.3% (16 out of 79), falls between 23 and 24 years, while only 13.9% (11 out of 79) are aged 25 and above. These findings suggest that the majority of respondents are mature and possess experiences that can contribute valuable insights to address the research questions. In the Ghanaian context, particularly in rural regions like the Upper West, delayed school enrolment is common due to sociocultural factors such as early responsibilities at home, farming duties, or limited access to nearby schools. As a result, many students begin formal education later in life, leading to a wider age range in senior high school classes.

3.2 Familiarization with the Data

After reading through all nine student responses several times, I noticed a common thread:

mutual respect in the group gave students confidence, improved their participation, and supported better learning. For example, one student explained, "Even if my answer is wrong, my friends explain to me without making me feel bad" (Respondent 1), showing how respect reduced fear of mistakes. Many said respect encouraged them to speak up, such as "I know nobody will insult me or laugh if I make a mistake" (Respondent 2). Others linked respect to smoother teamwork and focus, as in "We do not waste time arguing, so we focus on the mathematics problem" (Respondent 3).

Several students described respect creating a calm environment, for example, "Respect makes the group calm, so I can think well before answering" (Respondent 4). Others emphasized how it made it easier to ask for help: "If I don't understand something, they explain without shouting at me" (Respondent 5). Some associated it with inclusion and belonging, like "We don't look down on anyone, even the slow learners" (Respondent 6). Enjoyment was also a recurring feeling, "Respect makes me enjoy the group work… This makes me feel like trying again until I get it" (Respondent 7).

Across all responses, mutual respect was linked to trust ("We share ideas freely and help each other when someone is stuck" – Respondent 9), open discussion ("I can ask questions without feeling shy" – Respondent 8), and positive attitudes towards problem-solving. These reflections show that respect was not only a social value but also a driver for better collaboration, confidence, and math learning.

Table 3. Represents of Generating Initial Codes

s/n	Respondent name	Initial code	Excerpts
1	Bataa Ernest	Encouragement despite mistakes; Respectful correction	*"Even if my answer is wrong, my friends explain to me without making me feel bad."*
2	Akoligo Richard	Safe environment; Freedom from ridicule	*"I know nobody will insult me or laugh if I make a mistake."*
3	Mwiyele Timothy	Constructive collaboration; Reduced conflict	*"We do not waste time arguing, so we focus on the maths problem."*
4	Dapila Diebeng	Calm learning atmosphere; Mental clarity in problem-solving	*"Respect makes the group calm, so I can think well before answering."*
5	Dakura Tuli Sumuel	Patient explanation; Supportive peer help	*"If I don't understand something, they explain without shouting at me.*
6	Situo Ayaari	Inclusivity; Equal treatment of group members	*"We don't look down on anyone, even the slow learners."*
7	Dikuma Dora	Motivation to persist; Enjoyment of learning	*"Respect makes me enjoy the group work… This makes me feel like trying again until I get it."*
8	Kuoing-numa Charles	Confidence to seek help; Openness in communication	*"I can ask questions without feeling shy."*
9	Tituogee Amanda	Knowledge sharing; Mutual assistance	*"We share ideas freely and help each other when someone is stuck."*

Based on Table 3, which presents the process of generating initial codes, the subsequent steps of defining and naming the themes were carried out as follows.

Theme 1: Psychological Safety, Trust, and Confidence

Codes included: Feeling confident to speak without fear of ridicule, asking questions without shyness, no fear of making mistakes and trust among group members. Excerpts: *"I know nobody will insult me or laugh if I make a mistake." (R2) and "I can ask questions without feeling shy." (R8)*

All included codes clearly relate to students feeling safe and confident in group discussions. This theme also encompasses aspects of “trust,” which could be emphasized more strongly in the theme name—for example, Psychological Safety, Trust, and Confidence. It should remain distinct from collaboration, as it focuses on emotional comfort rather than teamwork alone.

Definition: This theme captures how mutual respect fosters a safe and trusting environment, enabling students to share ideas confidently without fear of embarrassment. It reflects emotional security, reduced anxiety, and a willingness to take intellectual risks during collaborative problem-solving. Core meaning: Respect → Safety → Confidence → Increased Participation.

Theme 2: Enhanced Collaboration & Sharing of Ideas

Codes included: Sharing ideas freely, learning from others’ methods, giving equal opportunities to speak and Helping each other when stuck. Excerpts*: “We share ideas freely and help each other when someone is stuck.” (R9) and “We work well together… I get to learn different methods from my friends.” (R3)*

Codes consistently highlight the benefit of mutual respect in promoting cooperation and diverse problem-solving approaches. The theme could be refined by explicitly including “knowledge exchange.” While there is slight overlap with “Motivation & Engagement” when students express increased willingness to try, this reflects an outcome rather than the collaborative process itself, so the themes remain distinct.

Definition: This theme describes how mutual respect strengthens cooperation among group members, encouraging the sharing of diverse perspectives and collective problem-solving strategies. It highlights mutual listening, equitable participation, and valuing of peers’ contributions. Core meaning: Respect → teamwork → richer solutions.

Theme 3: Positive Group Atmosphere

Codes included: Calm and respectful interactions, no arguments or fighting, enjoyment of group work and corrections done in a nice way. Excerpts: *“Respect makes the group calm, so I can think well before answering.” (R4) and “Even when my answer is not correct, they correct me in a nice way.” (R7)*

The excerpts consistently describe a calm, respectful environment that reduces stress. Although this theme could be merged with “Psychological Safety” if fewer themes were desired, it remains distinct here as it emphasizes the overall group mood rather than individual feelings.

Definition: This theme emphasizes the creation of a calm, friendly, and supportive learning climate. Mutual respect reduces tension, minimizes conflicts, and enhances enjoyment in group tasks. The focus is on the emotional tone of the group rather than individual feelings alone.
Core meaning: Respect → good vibes → stress-free learning.

Theme 4: Motivation & Engagement in Learning

Codes included: Seriousness towards work due to respect, willingness to try again after mistakes and Interest in solving more questions. Excerpts: “*This makes me understand the topic better and also try to solve more questions.” (R1) and “This makes me feel like trying again until I get it.” (R7)*

Reviewing Themes in Braun & Clarke’s thematic analysis.
I check it in two levels:

1. Level 1: Do the themes fit the coded data extracts?
2. Level 2: Do the themes reflect the entire dataset without overlapping or missing meaning?

All excerpts indicate increased persistence and interest resulting from mutual respect. For clarity, the theme can be named “Motivation, Persistence, and Learning Drive.” Overlap with

"Group Atmosphere" is minimal; while enjoyment appears in both, it appropriately bridges mood and motivation without conflating the themes.

Definition: This theme relates to the way mutual respect boosts students' willingness to engage with challenging tasks, persevere through difficulties, and take an active role in problem-solving. Respect is seen as an energizing factor that sustains focus and effort. Core meaning: Respect → motivation → better performance.

3.3 Producing the Report

This study explored how mutual respect among students in collaborative learning groups influences their problem-solving skills in mathematics. Data from nine SHS 3 students revealed four interrelated themes: Psychological Safety, Trust, and Confidence; Enhanced Collaboration and Knowledge Exchange; Positive Group Atmosphere; and Motivation, Persistence, and Learning Drive.

Theme 1: Psychological Safety, Trust, and Confidence

Students described mutual respect as a key factor that created a safe environment for expressing mathematical ideas without fear of ridicule. When peers valued each other's contributions, participants felt encouraged to take risks in problem-solving. As one student explained:
"When my group listens without laughing at my wrong answer, I can try again until I get it right." (Respondent 2). Similarly, another student shared: "I don't feel shy to speak my mind when everyone treats me nicely. Even if I'm wrong, they help me." (Respondent 5). This emotional safety nurtured a willingness to explore different solution strategies, which strengthened problem-solving confidence.

Theme 2: Enhanced Collaboration and Knowledge Exchange

Mutual respect promoted active collaboration, allowing diverse strategies to emerge. Students noted that they learned new approaches from each other and were more willing to work together toward a common solution. For instance: "We listen to each other's ways of solving and pick the best. Sometimes my method is better, sometimes theirs.*" (Respondent 1) "If we respect each other, it's easy to combine ideas and finish the question faster." (Respondent 4)* This reciprocal sharing fostered richer mathematical reasoning and improved the accuracy of solutions.

Theme 3: Positive Group Atmosphere

Participants highlighted the role of respect in maintaining a calm and enjoyable group dynamic. A positive atmosphere minimized conflict and made problem-solving more engaging. One student reflected: "When everyone talks nicely, we enjoy the work and don't fight." (Respondent 6) "Respect makes the group friendly, so nobody feels left out." (Respondent 8) Such an atmosphere encouraged sustained engagement during collaborative tasks.

Theme 4: Motivation, Persistence, and Learning Drive

Respect among group members acted as a motivational driver. Students reported greater persistence in tackling challenging problems when they felt respected. As one participant expressed: *"Even if the question is hard, I keep trying because my group encourages me." (Respondent 3) Another noted: "Respect makes me serious about the work, so I don't give up easily." (Respondent 9)* This mutual encouragement increased focus and commitment, directly contributing to improved problem-solving performance.

Overall, the findings indicate that mutual respect in collaborative mathematics learning groups builds psychological safety, enhances collaboration, fosters a positive group atmosphere, and motivates persistence. These factors work together to improve students' problem-solving skills by creating a supportive, cooperative, and confidence-building environment.

In the Ghanaian context, these findings suggest that mutual respect within collaborative mathematics learning groups is a powerful driver of both academic and social growth. Respect fosters psychological safety, which is particularly important in Ghanaian classrooms where students may feel shy or hesitant to speak for fear of embarrassment or ridicule. When students know they will not be mocked for mistakes, they are more willing to share their ideas, ask questions, and try new problem-solving strategies.

It also enhances collaboration by encouraging students to listen to each other, value diverse viewpoints, and build on one another's contributions, aligning with Ghana's communal cultural values where collective success is highly prized. A positive group atmosphere created through respect helps maintain harmony, avoids unnecessary conflicts, and allows students to concentrate on the task, which resonates with the Ghanaian belief in peaceful coexistence as a foundation for productivity.

Finally, mutual respect motivates persistence, as students are more likely to keep working on difficult mathematics problems when they feel supported and encouraged by their peers. In a context where mathematics anxiety is common, especially in rural and resource-limited schools, such respectful interactions can transform mathematics learning into a more engaging, confidence-building experience that empowers students to achieve higher.

3.4 Thematic Analysis Findings from Braun and Clarke

Following Braun and Clarke's (2006) six-phase thematic analysis approach, the responses from the nine participants were systematically examined to uncover patterns of meaning connected to the role of mutual respect in collaborative mathematics group work. The process began with familiarization with the raw data through repeated reading, followed by generating initial codes to capture significant features in the students' accounts. These codes were then collated into potential themes, which were subsequently reviewed and refined to ensure they accurately represented the data. The themes were then defined and named to clearly capture their essence, and finally, the analysis was written up with supporting excerpts from participants' narratives.

In the Ghanaian context, these findings highlight how cultural values of communal living, mutual respect, and harmonious relationships shape students' engagement in learning. Respect in group activities reflects the Akan proverb *"Ti koro nko agyina"* ("One head does not go into council"), which emphasizes the value of shared thinking and collective wisdom. This cultural orientation helps create a classroom atmosphere where SHS students from diverse ethnic, linguistic, and socio-economic backgrounds feel confident to express their ideas without fear of criticism.

Such an environment aligns with the broader Ghanaian ethic, often compared to Ubuntu, *"I am because we are,"* which encourages cooperation, empathy, and shared responsibility. Within this supportive setting, students engage more actively, listen to peers, and collaborate more meaningfully during mathematical tasks. Because mathematics is frequently viewed as a challenging subject, these culturally grounded values help reduce anxiety, strengthen peer support, and contribute to more effective problem-solving. Ultimately, respect becomes both a social and academic resource that enhances students' participation and overall learning outcomes.

Thematic Analysis RQ1

An overview of the thematic analysis addressing RQ1 is provided in Table 4, illustrating how mutual respect within group work contributes to students' development of problem-solving skills in mathematics.

Table 4. Represents of Thematic Analysis RQ1

RQ1	**Mutual Respect Among Students Within Collaborative Learning Groups Affect Their Problem-Solving Skills in Mathematics**				
Themes	**Increased Enjoyment and Motivation**	**Knowledge Sharing and Peer Learning**	**Improved Collaboration and Efficiency**	**Supportive and Non-Judgmental Environment**	**Enhanced Confidence and Participation**
Codes	- Enjoying group work - Feeling encouraged to try again - Fun and less stressful	- Learning new methods - Asking questions freely - Explanations in own words	- Reduced conflict - Focus on problem-solving - Giving each member a chance	- Explaining without ridicule - Encouraging slow learners - Helping without shouting	- Feeling confident to speak - Encouraged to share ideas - Not afraid of making mistakes
Excerpts	*"Respect makes me enjoy the group work."* (R7) *"It also makes the group work more fun and less stressful."* (R9)	*"I also get to learn different methods from my friends."* (R3) *"I also learn new steps when my friends explain in their own words."* (R8)	*"If we respect each other, we can discuss without fighting."* (R8) *"We do not waste time arguing, so we focus on the maths problem."* (R3)	*"If I don't understand something, they explain without shouting at me."* (R5) *"We don't look down on anyone, even the slow learners."* (R6)	*"Mutual respect makes me confident to talk in the group. I know nobody will insult me or laugh if I make a mistake."* (R2) *"When we respect each other, it is easy to share our ideas in the group."* (R1)

Table 4 represents the thematic analysis of RQ1 and provides a deeper understanding of how respect operates as a transformative element within collaborative mathematics learning. The findings show that respect does not merely function as a social nicety but plays a central role in shaping group interactions, learning behaviors, and overall academic engagement. Respectful communication contributed to smoother group dynamics, reduced tension, and facilitated a climate where students could work together more effectively.

Respect helped establish a supportive and non-judgmental learning environment in which students felt psychologically safe to express their thoughts, propose alternative solutions, and admit confusion without fear of embarrassment or ridicule. This sense of safety significantly strengthened students' confidence and willingness to participate, especially in mathematics, a subject where many learners often experience anxiety or hesitate to share their reasoning. The respectful atmosphere also enhanced the cognitive dimension of learning. Students were more open to exchanging strategies, questioning their own assumptions, and integrating peer feedback, which contributed to deeper conceptual understanding. As learners listened attentively and valued each other's contributions, group discussions became more substantive and reflective, allowing for richer exploration of mathematical ideas.

Affectively, respect increased students' enthusiasm, enjoyment, and motivation. Conflicts within groups tended to diminish, enabling more efficient task completion and smoother progress toward goals. Students reported feeling more connected to their peers and more committed to the collaborative process, which further strengthened engagement.

Taken together, these findings suggest that embedding respect within collaborative learning environments creates conditions for psychological safety, productive discourse, and sustained motivation. Respect not only enhances the quality of peer interaction but also supports the development of confidence, persistence, and positive attitudes toward mathematics—elements that are essential for meaningful and equitable mathematics education.

Pre-test Thematic Analysis

The thematic patterns emerging from the pre-test phase are outlined in Table 5, which provides a summary of students' initial responses prior to the intervention.

Table 5. Represents of Pre-test Thematic Analysis

Theme	Code	Frequency	Excerpts
Fear of Negative Peer Reaction	Fear of ridicule	R1, R2	*"I was scared to answer in group work because if I'm wrong, they laugh small." (R1); "I didn't ask questions because I felt shy." (R2)*
Group Conflict & Distraction	Arguments wasting time	R3	*"Group arguments wasted time, so I didn't complete the last problems." (R3)*
Low Confidence in Problem-Solving	Lack of confidence with specific topics	R3, R4	*"I wasn't confident with word problems." (R3); "I mixed up steps for simultaneous equations." (R4)*
Withholding Participation	Not sharing ideas	R4, R6	*"I kept my ideas to myself." (R4); "I kept quiet." (R6)*
Avoidance Behavior	Leaving questions unanswered	R1, R5	*"I left a few blank." (R1); "I left two items unanswered." (R5)*
Lack of Peer Support	No assistance during difficulty	R5	*"When I got stuck, I just waited." (R5)*
Negative Labelling	Being called "slow"	R6	*"I was labelled 'slow', so I kept quiet." (R6)*
Surface Learning	Copying without understanding	R6	*"I copied methods without understanding." (R6)*
Careless Errors	Sign errors & rushing	R7, R9	*"I made small errors with signs." (R7); "I missed steps in linear equations." (R9)*
Avoidance of Challenging Tasks	Skipping hard questions	R8	*"I avoided the hardest questions." (R8)*
Limited Strategy Knowledge	Few problem-solving methods	R8	*"I didn't know different ways to solve." (R8)*

Table 5 represents pre-test analysis demonstrates that students' overall performance in collaborative mathematics learning was weak. Primarily, this was due to the prevalence of emotional insecurity, social tension, and limited cognitive engagement. Fear of peer ridicule (coupled with group conflicts and the absence of supportive interactions) discouraged active participation and suppressed risk-taking, both of which are central to mathematical exploration. Students' reliance on surface strategies (such as copying, guessing, or avoiding complex tasks) highlighted not only a lack of confidence but also restricted problem-solving capacity and minimal strategic flexibility. Furthermore, the presence of careless errors and a noticeable preference for easier problems indicated not only weak self-regulation but also limited monitoring skills, suggesting that students lacked the confidence and discipline needed to engage in more challenging tasks. These patterns reveal that, before the intervention, the existing classroom culture did little to cultivate psychological safety, mutual respect, or productive peer interaction, leaving students hesitant to participate fully in collaborative learning. Consequently, students' capacity to engage meaningfully in mathematical problem-solving was considerably limited. Many tended to depend on surface-level strategies, such as rote procedures or pattern recognition, rather than employing deeper, more analytical approaches that require critical thinking and conceptual understanding.

Post-Test Thematic Analysis (Themes, Code, Frequency and Excerpts)

The thematic analysis of the post-test data, summarizing the themes, codes, frequencies, and representative excerpts that emerged after the intervention presented in Table 6.

Table 6. Represents of Post-test Thematic Analysis (Themes, Code, Frequency and Excerpts)

Theme	Code	Frequency	Excerpts
Increased Confidence	Willingness to answer without fear	R1, R2	*"Now I can answer in group without being laughed at." (R1); "I asked questions in algebra and didn't feel shy." (R2)*
Constructive Group Interaction	Reduced conflict, better focus	R3	*"We worked together without arguing, so I finished all the problems." (R3)*
Improved Problem-Solving Confidence	Better handling of difficult topics	R3, R4	*"I could solve word problems step by step." (R3); "I remembered the steps for simultaneous equations." (R4)*
Active Participation	Sharing ideas openly	R4, R6	*"I shared my ideas and explained my steps." (R4); "I joined the discussion confidently." (R6)*
Persistence in Tasks	Completing all questions	R1, R5	*"I answered all items this time." (R1); "I didn't leave any blank." (R5)*
Peer Support	Helping and receiving help	R5	*"When I got stuck, friends explained kindly." (R5)*
Positive Identity	Removal of negative labels	R6	*"No one called me slow. They listened to me." (R6)*
Deep Learning	Understanding methods	R6	*"I understood the methods we used." (R6)*
Accuracy and Carefulness	Fewer careless errors	R7, R9	*"I checked my signs carefully." (R7); "I followed all steps for linear equations." (R9)*
Engagement with Challenges	Attempting hard questions	R8	*"I tried the hardest questions and solved them." (R8)*
Expanded Strategy Knowledge	Using multiple problem-solving methods	R8	*"I knew two ways to solve it." (R8)*

The post-test findings reveal a significant transformation in students' collaborative learning experiences and problem-solving performance, underscoring the positive impact of the intervention. As shown in Table 6, unlike the pre-test phase, where hesitation, conflict, and avoidance behaviors dominated, students demonstrated increased confidence, constructive interaction, and a willingness to engage with challenging mathematical tasks. The classroom atmosphere became more supportive and respectful, allowing learners to take intellectual risks, persist through difficulties, and celebrate collective progress. Importantly, the shift from surface-level approaches such as copying to deeper conceptual engagement reflected a strengthened ability to transfer knowledge across different contexts and apply a broader repertoire of strategies with greater flexibility and confidence. This transition shows that students were no longer relying solely on memorized steps but were beginning to understand underlying concepts, make connections between ideas, and justify their reasoning in more meaningful ways. Students also demonstrated noticeable improvements in accuracy, self-monitoring, and resilience, signaling a movement toward more thoughtful, deliberate, and reflective problem-solving processes.

In addition, the post-test responses revealed that learners became more willing to ask questions, seek clarification, and negotiate ideas collaboratively, suggesting that their interpersonal and metacognitive skills had grown alongside their mathematical abilities. This development was supported by a learning environment that gradually fostered psychological safety, encouraged respectful dialogue, and minimized the fear of making mistakes. Overall, the post-test outcomes indicate that the intervention not only enhanced students' mathematical performance but also cultivated trust, mutual respect, and social-emotional maturity, ultimately contributing to a more cohesive, supportive, and cognitively rich learning environment.

Comparative Thematic Analysis of Pre-Test and Post-Test

The comparative thematic analysis of the pre-test and post-test data, highlighting the shifts in students' behaviors, attitudes, and collaborative practices following the intervention presented in Table 7. This comparison illustrates how initial challenges evolved into more constructive and supportive learning patterns, offering a clearer picture of the intervention's impact. The table provides an integrated view of changes across themes, enabling a deeper understanding of students' developmental progress throughout the study.

Table 7. Represents of Comparative Thematic Analysis of Pre-Test and Post-Test

Theme	Pre-Test (Challenges)	Post-Test (Improvement)
Confidence in Participation	*Fear of ridicule and shyness prevented active participation.* (R1, R2, R4) – "I was scared to answer… they laugh small." (R1); "I felt shy to ask questions." (R2)	*Willingness to answer without fear and asking questions openly.* (R1, R2) – "Now I can answer in group without being laughed at." (R1); "I asked questions and didn't feel shy." (R2)
Group Interaction Quality	*Arguments and poor coordination wasted time.* (R3) – "Group arguments wasted time, so I didn't complete the last problems." (R3)	*Reduced conflict and better focus on tasks.* (R3) – "We worked together without arguing, so I finished all the problems." (R3)
Problem-Solving Ability	*Lack of confidence in difficult topics.* (R3, R4) – "I wasn't confident with word problems." (R3); "I mixed up steps for simultaneous equations." (R4)	*Better handling of difficult problems.* (R3, R4) – "I could solve word problems step by step." (R3); "I remembered the steps for simultaneous equations." (R4)
Idea Sharing	*Kept ideas to self due to fear of criticism.* (R4, R6) – "I kept my ideas to myself." (R4)	*Sharing ideas openly and explaining reasoning.* (R4, R6) – "I shared my ideas and explained my steps." (R4)
Task Persistence	*Leaving questions unanswered when stuck.* (R1, R5) – "I left a few blank." (R1); "I left two items unanswered." (R5)	*Completing all questions.* (R1, R5) – "I answered all items this time." (R1)
Peer Support	*Lack of helpful responses when stuck.* (R5) – "When I got stuck, I just waited." (R5)	*Active help from peers and kind explanations.* (R5) – "Friends explained kindly when I got stuck." (R5)
Self-Perception & Labels	*Negative labeling reduced participation.* (R6) – "I was labelled 'slow', so I kept quiet." (R6)	*Removal of negative labels, valued contributions.* (R6) – "No one called me slow. They listened to me." (R6)
Understanding of Methods	*Copying without understanding.* (R6) – "I copied methods without understanding." (R6)	*Deep understanding of methods used.* (R6) – "I understood the methods we used." (R6)
Accuracy in Work	*Careless sign errors and skipped steps.* (R7, R9) – "I made small errors with signs and gave up quickly." (R7)	*Careful checking and accurate solutions.* (R7, R9) – "I checked my signs carefully." (R7)
Approach to Challenging Questions	*Avoiding hardest problems.* (R8) – "I avoided the hardest questions." (R8)	*Attempting and solving hard problems.* (R8) – "I tried the hardest questions and solved them." (R8)
Strategy Knowledge	*Limited to one method.* (R8) – "I didn't know different ways to solve." (R8)	*Multiple methods for problem-solving.* (R8) – "I knew two ways to solve it." (R8)

Table 7 presents the comparative thematic analysis of the pre-test and post-test results, showing clear improvements in students' responses after the intervention. The post-test themes revealed stronger evidence of collaboration, confidence, and diverse problem-solving strategies, indicating that the learning approach had a positive and meaningful impact on students' mathematical engagement and skills compared to the pre-test.

Theme-By-Theme Comparative Interpretation

The theme-by-theme comparative interpretation, providing a detailed examination of how each theme evolved from the pre-test to the post-test presented in Table 8. This table highlights the specific areas of growth, shifts in students' behaviors and perceptions, and the ways in which the intervention influenced their collaborative and problem-solving practices. By comparing each theme individually, the table offers a clearer and more nuanced understanding of the overall developmental changes observed in the study.

Table 8. Represents of Theme-By-Theme Comparative Interpretation

Theme	Pre-test Interpretation	Post-test Interpretation
Group Interaction	Collaboration was hampered by arguments, distractions, and lack of focus.	Group discussions became constructive, respectful, and centered on shared problem-solving goals.
Persistence	Learners gave up quickly when stuck, leaving tasks incomplete	Students persisted through difficulties, revisiting steps and exploring alternatives until solutions were found.
Participation	Many withheld contributions, keeping ideas to themselves due to shyness or fear of ridicule.	Active engagement was common, with students freely sharing ideas and questions.
Peer Support	Little to no encouragement from peers; some experienced negative labeling.	Strong peer support emerged, with learners explaining concepts and celebrating each other's success.
Learning Approach	Reliance on surface learning, copying methods without understanding.	Shift to deep learning, focusing on understanding concepts and applying them to new contexts.
Accuracy	Frequent careless errors due to rushing, stress, or lack of checking work.	Greater attention to detail, careful checking, and reduction in avoidable mistakes.
Engagement with Challenges	Avoided difficult problems, focusing only on easier items.	Actively sought to engage with challenging problems, showing curiosity and determination.
Strategy Knowledge	Limited awareness of multiple solution strategies.	Expanded repertoire of problem-solving strategies, enabling flexible approaches.
Identity in Mathematics	Negative peer labels reinforced a "weak student" identity.	Emergence of a positive identity as capable and valuable group members.

Based on Table 8, the transition from pre-test to post-test reflects a major cultural and pedagogical shift in the classroom. Respectful and supportive collaborative learning not only boosted mathematical achievement but also fostered emotional safety, mutual respect, and problem-solving resilience. Students went from hesitant and disconnected to confident, engaged, and strategic learners**.**

Paired Sample Test Mathematics Achievement

Paired sample test on the respect of students can enhance their mathematics achievement that showed in Table 9.

Table 9. Paired Sample Test

	Test	n	m	SD	df	Paired Means Difference	t	P-value
Group	*Post-test*	*79*	*7.52*	*1.092*	*78*	*3.260*	*11.657*	*0.000*
	Pre-test	*79*	*4.26*	*1.838*				

A Shapiro-Wilk test was conducted to assess the normality of the difference scores between pre-test and post-test results. The test indicated that the difference scores were approximately normally distributed, $W(n = 79) = 0.97$, $p = .412$, thus meeting the assumption of normality for the paired-sample *t*-test. It's also evident from the results of the paired samples t-test that there was a significant difference between the pre-test and post-test means scores *($M = 4.26$, $SD = 1.838$ and $M = 7.52$, $SD = 1.092$)* respectively, with *p*-value well below the standard significance level of *0.05*. Specifically, the paired mean difference for the pre-test and post-test is reported at *3.260.* What's particularly exciting is that upon closer examination, this difference reveals that the paired mean difference observed in the post-test showed a remarkable achievement.

The finding that mutual respect within collaborative learning groups significantly enhances students' problem-solving skills and mathematics achievement aligns with a growing body of literature emphasizing the social dimensions of effective mathematics learning. Previous studies have consistently shown that respectful peer interactions promote deeper engagement and improve learning outcomes. For instance, Jaya et al. (2022) found that collaborative learning with peer interaction significantly improves student learning outcomes. Student interviews reported that peer interaction fosters understanding, motivation, and self-confidence, as well as making students more active in discussions and exchanging ideas.

Similarly, Niu et al. (2022) highlighted that supportive and respectful learning environments strengthen both cognitive and affective engagement, which is essential for successfully navigating complex mathematical tasks. My results corroborate this by demonstrating that mutual respect fosters cooperation and reduces the fear of making mistakes, thereby improving problem-solving performance.

However, my study extends previous research by showing that respect is not merely a background social factor but a core academic driver of mathematics achievement in the specific context of Queen of Peace SHS. While earlier studies have emphasized collaboration more broadly (Hsu & Lin, 2020; Kim et al., 2022), they often treat respect as an assumed condition rather than an explicit variable. My findings challenge this assumption by positioning mutual respect as an active component that shapes the effectiveness of collaborative learning.

At the same time, some research suggests that collaborative learning alone is not always beneficial without structured support and clear group norms. Studies such as Theobald et al. (2023) caution that poorly managed group interactions can lead to unequal participation or dominance by certain students. This highlights a critical nuance in my results: the positive effects observed at Queen of Peace SHS may depend heavily on how intentionally teachers cultivate and maintain respectful norms. Without such structures, the benefits of collaboration might not emerge as strongly.

Overall, your study reinforces and deepens existing knowledge while providing context-specific evidence that respectful interpersonal dynamics are foundational to successful mathematical collaboration. It contributes to the field by demonstrating that when respect is deliberately nurtured, collaborative learning becomes a more powerful tool for improving problem-solving ability and academic achievement.

The findings of this study demonstrate that mutual respect within collaborative learning environments plays a pivotal role in enhancing students' problem-solving skills in mathematics. The thematic analysis of qualitative responses revealed that when respect was present among group members, students felt more confident to share their ideas, ask questions, and explore diverse solution strategies without fear of ridicule. This aligns with Vygotsky, 1978; Thanheiser, 2023; and Yonwilad et al., 2022 social constructivist perspective, which emphasizes the importance of supportive social interaction in the co-construction of knowledge. In Ghana, mathematics classrooms have often been shaped by traditional instructional practices, where the teacher is viewed as the central authority and students are expected to listen, follow, and reproduce procedures. Such hierarchical dynamics sometimes limit students' willingness to ask questions, challenge ideas, or collaborate meaningfully with peers. The findings present suggest that when mutual respect is cultivated within collaborative learning environments, these traditional barriers can be reduced. Respectful peer interactions allow students to feel safe in expressing their thoughts, even if incomplete or incorrect, and to engage in joint exploration of mathematical problems. This is especially critical in Ghana, where cultural norms may discourage students from openly questioning authority or peers for fear of embarrassment or being perceived as disrespectful. By embedding respect into group work, classrooms shift towards student-centered learning, encouraging active participation, agency, and deeper reasoning. Ultimately, this aligns with broader educational reforms in Ghana that emphasize not just rote learning, but the development of higher-order thinking, problem-solving, and communication skills in mathematics.

Respect fostered an atmosphere where students were more willing to collaborate constructively, leading to improved clarity of thought, richer peer-to-peer explanations, and greater persistence when confronting challenging mathematical tasks. Within this environment, learners felt encouraged to articulate their reasoning, question assumptions, and refine their understanding through supportive dialogue, ultimately strengthening both individual and collective problem-solving processes. This finding aligns closely with the assertions of Rodríguez-Jiménez et al. (2023), as well as Schürmann et al. (2024) and Siller & Ahmad (2024), who note that positive interdependence within group work enhances higher-order thinking, deepens conceptual understanding, and contributes to improved academic performance. The themes identified in the post-test, such as the emergence of a more supportive and non-judgmental learning climate, increased willingness to share knowledge, and enhanced collaborative engagement, demonstrate a clear shift from the pre-intervention context. Previously, students' participation was constrained by fear of negative peer reactions, low confidence, and avoidance behaviors that limited meaningful engagement. In contrast, the strengthened respect observed after the intervention enabled students to take intellectual risks, rely on one another as learning resources, and contribute more actively to group tasks. Collectively, these changes reflect a transformation toward a more cohesive, trusting, and academically productive environment that fosters both social-emotional development and deeper mathematical learning. Quantitative evidence further supports this improvement. The pre-test and post-test comparisons indicated a remarkable increase in mathematics achievement following the introduction of respect-oriented collaborative learning strategies. The pre-test responses revealed patterns of incomplete work, careless errors, and avoidance of challenging tasks, suggesting that students' problem-solving skills were limited by social barriers. However, post-test data showed clear shifts toward increased confidence, accuracy, persistence, and willingness to engage with difficult problems. This progression suggests that mutual respect not only reduces anxiety and conflict but also enables students to channel their cognitive resources more effectively toward mathematical reasoning. These results corroborate earlier research (Akpalu et al., 2018; Albeshree et al., 2022; Azmi et al., 2022; Klingenberg et al., 2019; Naamati- Schneider & Alt, 2023) showing that respectful peer interactions enhance both cognitive and affective learning outcomes in mathematics. In Ghanaian Senior High School settings, where competitive academic cultures sometimes discourage peer assistance, embedding respect as a core principle of collaborative learning may help dismantle negative labeling and promote equitable participation. This, in turn, nurtures students' problem-solving capacity that an essential competency for both academic success and real-world applications.

In sum, the integration of mutual respect within collaborative learning groups not only improved students' mathematics achievement but also transformed the classroom culture into one that supports constructive dialogue, deep learning, and resilience in problem-solving. The evidence suggests that respect should be intentionally cultivated as a pedagogical strategy to maximize the benefits of collaborative problem-solving approaches in mathematics education.

Implications

The following implications outline how the study's findings can inform classroom practice, school policy, and teacher development to enhance collaborative mathematics learning.

1. Mutual respect should be treated as an academic resource, meaning teachers must intentionally foster respectful peer interactions during mathematics lessons.
2. Collaborative structures need to promote equitable participation, since respect was shown to increase students' confidence and willingness to contribute.
3. Mathematics instruction should integrate activities that strengthen positive interpersonal skills, as these skills directly support problem-solving and achievement.
4. School leadership should reinforce policies that build respectful student relationships, recognizing their direct impact on learning outcomes.
5. Teacher professional development should include strategies for creating respectful, cooperative learning environments, ensuring consistent practices across classrooms

4. Conclusion

In conclusion, the findings reveal that mutual respect among Queen of Peace SHS students in collaborative learning environments significantly enhances their problem-solving skills and contributes positively to their mathematics achievement. Respectful interactions foster cooperation, active participation, and confidence, enabling students to share ideas freely and engage more deeply with mathematical tasks. This demonstrates that building a culture of respect is not only a social value but also a critical factor in improving academic outcomes. Therefore, promoting mutual respect in collaborative learning should be considered an essential strategy for advancing mathematics education in school.

Despite the valuable insights generated, the study has certain limitations. First, the research was conducted in only one school, Queen of Peace SHS, which may limit the generalizability of the findings to other contexts with different student demographics or school cultures. Second, the study relied largely on students' self-reported perceptions, which may be influenced by social desirability or personal biases. Additionally, the collaborative learning activities were implemented within a specific period, making it difficult to determine long-term effects of mutual respect on mathematics achievement. Future studies involving multiple schools, longitudinal designs, and mixed data sources would help strengthen the validity and applicability of the results.

Based on this research, teachers at Queen of Peace SHS should integrate structured collaborative strategies that emphasize respectful dialogue, active listening, and valuing diverse perspectives in group work in mathematics. Rotational leadership roles and recognition systems can be used to build responsibility, teamwork, and motivation among students. Furthermore, the long-term benefits of collaborative learning can be reinforced by systematically incorporating respect-based interaction into the mathematics curriculum, ensuring that students consistently experience and practice these values during lessons. Engaging parents in this process can provide reinforcement at home, creating a consistent message about the importance of respectful collaboration. Moreover, involving the wider community can help establish a supportive learning ecosystem, where students see the relevance of respectful and cooperative behavior beyond the classroom, ultimately strengthening both their social and academic development.

5. Acknowledgement

I am also grateful to the SHS students who willingly participated in this study. Their openness and contributions were central to the paper's success.

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