# MOTIVATED TO LEARN: DEAF LEARNERS' EXPERIENCES WITH EXPERIENTIAL AND COLLABORATIVE MATHEMATICS INSTRUCTION IN INCLUSIVE AND NON-INCLUSIVE CLASSROOMS

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## Abstract

*This study looked at how experiential learning and collaborative teaching impact the motivation and self-confidence of deaf students in Mathematics within both inclusive and non-inclusive classrooms. The study used a qualitative method, conducting semi-structured interviews with six deaf students, three each from inclusive and non-inclusive. Thematic analysis revealed five main themes in inclusive settings: clarity and relevance through experiential teaching, emotional motivation from achievement and feedback, collaborative learning as a source of motivation, obstacles to motivation and ways to overcome them, and self-confidence through experience. In non-inclusive classrooms, the study identified four similar themes: experiential engagement boosts motivation, peer and teacher collaboration as sources of motivation, barriers to learning and ways to cope, and building self-confidence through interaction and practice. In both contexts, students showed more motivation when learning mathematical concepts through real-world, hands-on activities and group work. They often pointed out that peer interaction and teacher support were vital for keeping them engaged. However, ineffective teaching methods and negative feedback were viewed as demotivating. Despite these challenges, students employed proactive strategies like peer support, repeated practice, and teacher feedback to stay motivated. Researchers interpret the findings through Kolb's Experiential Learning Theory and Vygotsky's Sociocultural Theory, highlighting how experiential and social learning help improve mathematical motivation among deaf students. The study offers practical suggestions for inclusive and special education by encouraging learner-centered, collaborative, and contextually relevant teaching methods that meet the needs of deaf students.*

**Keywords**: *Collaborative teaching, deaf learners, inclusive education, mathematics education, motivation*

## Introduction

Mathematics is a key part of education and personal growth, but teaching it poses special challenges for deaf learners. This is particularly true in environments where teaching methods do not meet their communication and learning needs (Pocaan, 2022). In Ghana, deaf education has seen important changes, with more support for inclusive education as outlined in the Inclusive Education Policy (Abreh, 2025; Amoako, 2019). However, whether in inclusive or non-inclusive classrooms, deaf learners often struggle to access meaningful mathematics instruction. This is due to gaps in teaching strategies, teacher training, and the language demands of Mathematics. These challenges often result in low motivation, decreased confidence, and poor performance among deaf students in mathematics classes (Asare, 2022). Despite policy goals, classrooms in Ghana often fail to respond effectively to the specific needs of deaf learners, especially in mathematics

where abstract concepts and logical reasoning require customized teaching methods (Quaye, 2023).

The use of hands-on learning and collaborative teaching can help tackle these problems. Experiential learning gives deaf learners practical, real-world experiences that aid understanding. At the same time, collaborative teaching promotes peer interaction and support that meet their social and cultural needs (Hatsu, Boateng, Arthur, & Akosah, 2025). However, there is limited research on how these teaching methods impact the motivation of deaf learners in Ghana, especially in comparing inclusive and non-inclusive settings.

Around the world, researchers have pointed out the importance of student-centered teaching methods in boosting both academic and emotional engagement for students with special needs. Kolb's Experiential Learning Theory (1984) and Vygotsky's Sociocultural Theory (1978) explain how learners, including the deaf, benefit from active, interactive, and socially connected learning. Studies from countries like the United States, South Africa, and Finland have shown that when deaf learners participate in hands-on mathematics tasks and receive help through peer collaboration or co-teaching, they show higher motivation, better self-confidence, and improved problem-solving skills (Scruggs, Mastropieri, & McDuffie, 2007).

Despite these innovations, education systems in sub-Saharan Africa, including Ghana, still struggle to fairly implement these teaching innovations. Many classrooms lack resources, specialized teacher training, and a supportive atmosphere for tailored instruction (Agbata, Obeng-Denteh, Abraham, Asante-Mensa, Kwabi, Okpako, & Arivi, 2024). Consequently, deaf learners in both inclusive and non-inclusive settings often find themselves excluded from educational progress. It is essential to understand how these learners feel motivated in experiential and collaborative mathematics instruction to develop teaching strategies that are both fair and effective (Walton, & Engelbrecht, 2024).

This study looks at the experiences of deaf learners in both inclusive and non-inclusive classrooms in Ghana, focusing on how hands-on and collaborative teaching affect their motivation in mathematics. By using Kolb's and Vygotsky's theories as a foundation, this research adds to the growing knowledge about inclusive teaching and provides valuable insights for educators, policymakers, and curriculum developers aiming to improve mathematics outcomes for deaf learners in various educational contexts.

**Statement of the Problem**

Despite a growing global focus on inclusive education and learner-centered teaching, research specifically on the motivation of deaf learners in mathematics is limited. Most existing studies on deaf education have concentrated on language acquisition, communication issues, or differences in academic performance, often ignoring the emotional and motivational aspects of learning. This is particularly true for technical subjects like mathematics (King & Metcalf, 2024; Bashir, Batool, & Amjad, 2024).

In Ghana, the situation is worsened by insufficient teacher training in inclusive methods, a lack of specialized teaching resources, and minimal research on how deaf learners experience motivation in specific subjects (Nketsia, 2016; Addai-Mununkum & Setordzi, 2023). While national education reforms promote inclusion and active teaching methods, little is known about how these changes affect deaf learners in the classroom, especially regarding their motivation and engagement in mathematics.

Furthermore, previous studies in inclusive or special education in Ghana have seldom distinguished between inclusive and non-inclusive classroom settings when examining teaching effectiveness or learner motivation. This leads to a significant knowledge gap about how factors like class makeup, teaching styles, and social interactions affect the motivation of deaf learners in mathematics.

This study addresses these important gaps by:

1. Exploring how experiential learning and collaborative teaching affect motivation among deaf learners.
2. Comparing these experiences in inclusive and non-inclusive classrooms.
3. Framing the analysis within Kolb's Experiential Learning Theory and Vygotsky's Sociocultural Theory, which provides a context for the study in established teaching frameworks while offering insights from the Ghanaian education system.

By focusing on the perspectives of deaf learners and examining their experiences in mathematics classrooms, this study contributes new empirical evidence to an area of special and inclusive education that is often overlooked and under-researched. It helps close both national and international literature gaps.

**Theoretical Framework**

This study is based on Kolb's Experiential Learning Theory (1984) and Vygotsky's Sociocultural Theory. These theories provide a useful way to understand how deaf learners interact with mathematics through hands-on and group instruction.

Kolb's Experiential Learning Theory (ELT) suggests that learning is an active process where knowledge comes from transforming experiences. Kolb describes a four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation. This cycle helps learners understand and use knowledge. For deaf learners, concrete experiences like using Mathematics tools, real-life applications, and visual aids make abstract ideas clearer. The reflective and active stages allow learners to think about mistakes, use feedback, and build confidence through practice. Kolb's model supports using touch and visual methods to strengthen mathematics understanding and keep students motivated.

Vygotsky's Sociocultural Theory focuses on the social and cultural aspects of learning. It highlights the role of language, interaction with peers, and guided help within the Zone of Proximal Development (ZPD). For deaf learners, teaching improves when instructors and peers support learning through sign language, visual signals, and group work. These interactions narrow the gap between what learners can do independently and what they can accomplish with help. This support encourages deeper understanding and motivation.

Together, these theories form a solid basis for this study. They emphasize the importance of hands-on activities and teamwork in boosting motivation, engagement, and mathematics skills among deaf learners in both inclusive and non-inclusive classrooms.

**Empirical Literature Review**

Mathematics education for deaf learners in Ghana is still not well researched, even with inclusive education reforms that aim to improve equity and access. Local studies show ongoing barriers that affect deaf learners' engagement and motivation in mathematics (Raby, Legusov, Addae, Martel, Mou, & Wood, 2023). For instance, Obosu, Opoku-Asare, and Deku (2016) noted that deaf students often find it hard to understand concepts because of the focus on auditory instruction and

the lack of visual or hands-on strategies. While this study highlights general teaching challenges, it does not look at how structured experiential or collaborative teaching methods could impact motivation for deaf learners.

Another challenge in inclusive education in Ghana is isolation. Deaf learners frequently feel left out in regular classrooms due to communication barriers and teachers not being prepared (Attia, Nyatsikor, & Amoako, 2023; Hendry, Hendry, Ige, & McGrath, 2021). However, their study did not explore how teamwork in teaching or experiential learning models could address these systemic issues. Kizilaslan, Zorluoglu, and Sozbilir (2021) studied how to improve learning with hands-on activities in science for students with visual impairments. Their findings showed better engagement when visual aids and practical tasks were included for deaf learners. Still, they mostly focused on engagement and retention rather than on the learners' inner motivation or how the learning environment (inclusive vs. non-inclusive) might affect that motivation.

There is more global research supporting the use of experiential and collaborative teaching methods in deaf education (Salter, Swanwick, & Pearson, 2017). In a study from the United States, researchers found that the intrinsic motivation of deaf learners improves when they participate in problem-solving tasks related to real-life situations. Consequently, this study focused on cognitive improvements and did not investigate how motivation varies across different learning environments (Al-Thani, & Ahmad, 2025). Studies in South Africa showed that collaborative inquiry-based learning can enhance deaf students' performance in mathematics (Gormally, 2017). However, these studies did not consider the learners' viewpoints or how teaching methods affect emotional and motivational factors in inclusive versus specialized classrooms.

Additionally, Secora and Shahan (2023) demonstrated how co-teaching and collaborative models can help deaf learners engage in mainstream settings. While such studies are consistent with Vygotsky's Sociocultural Theory, especially the Zone of Proximal Development, they often focus on academic access and do not thoroughly examine emotional aspects like self-efficacy and motivation based on the learners' experiences. Thus, the existing research is limited in understanding how experiential learning and collaborative teaching influence deaf learners' motivation, particularly in different teaching settings.

The current study aims to fill these gaps by using a learner-centered, qualitative approach to explore how deaf learners feel about motivation in mathematics when taught through experiential and collaborative methods. By comparing experiences in inclusive and non-inclusive classrooms, this study provides a detailed understanding of how context influences motivation, self-efficacy, and learner engagement. It builds on previous research by connecting cognitive, social, and emotional aspects of learning, offering valuable insights for policy, teacher training, and inclusive teaching practices in Ghana and beyond.

### *Deaf Learners' Experiences in Inclusive Mathematics Classroom*

Inclusive education seeks to ensure fair learning for all students, including deaf learners, in regular settings. In Ghana, after the 2015 Inclusive Education Policy, many deaf learners are placed in mainstream schools (Ametepee, & Anastasiou, 2015). However, their experiences in mathematics classes often show significant challenges due to language barriers, limited support, and teaching methods that are not accessible. Mathematics instruction usually depends on verbal explanations and abstract reasoning. This reliance makes it hard for deaf learners to participate meaningfully, especially without sign language interpreters or visual aids (Krause, & Wille, 2021).

Deaf learners often feel excluded from peer interactions and group activities because of communication difficulties. This leads to feelings of isolation and a dip in their academic

confidence (Arif, Rani, & Siddique, 2024). In Ghanaian classrooms, where resources and teacher training in inclusive education are often insufficient, deaf learners risk "silent exclusion." This means they are present in class but do not participate meaningfully.

Mainstream teachers often do not have the skills and tools to modify mathematics instruction for deaf learners. Effective practices like visual aids, hands-on tools, experiential learning, and collaborative teaching methods are limited (Moon, Todd, Morton, & Ivey, 2012). Theories such as Vygotsky's Sociocultural Theory and Kolb's Experiential Learning Theory highlight the value of interactive, hands-on, and socially driven learning. These approaches can particularly benefit deaf learners when applied correctly.

Despite these challenges, new practices like peer buddy systems, visual teaching methods, and inclusive training workshops show promise (Siy & Tanseco, 2024). To improve results, schools need to invest in accessible teaching materials, sign language support, teacher training, and inclusive curriculum design. Ultimately, deaf learners should be empowered to take an active role in shaping inclusive education that truly meets their needs in mathematics and beyond (Amiyani, & Adhiwibowo, 2025).

### *Deaf Learners' Experiences in Non-Inclusive Mathematics Classroom*

Deaf learners in non-inclusive mathematics classrooms, often called special or segregated schools, experience a unique educational setting. This environment features specialized teaching, accessible communication, and a strong sense of belonging (Palla, & Vallberg Roth, 2022). Unlike inclusive classrooms, these spaces are tailored to meet the language and learning needs of deaf students. Instruction is usually delivered in sign language, supported by visual aids, tactile resources, and a classroom culture that is friendly to deaf learners. In Ghana and many similar places, non-inclusive schools typically serve as the main centres for deaf education. They offer structured support systems that mainstream schools often lack (Mensah, Campbell-Evans, & Main, 2024).

One of the key experiences reported by deaf learners in these environments is a clearer understanding and more active participation in mathematics lessons. Teachers in non-inclusive settings frequently have specialized training in sign language and methods for teaching deaf students. This training allows them to explain mathematical concepts more effectively using visual, concrete, and hands-on strategies (Goldstein, 2017). Using Ghanaian Sign Language (GSL) as the main language of instruction helps students understand better in real time. This, in turn, boosts their academic confidence and lowers the anxiety often tied to abstract mathematics concepts (Adu-Gyamfi, 2023).

Peer interaction in these settings tends to be smooth and cooperative since all learners communicate in the same way. Group work, peer tutoring, and class discussions happen more naturally, enabling deaf students to support each other and build their mathematical knowledge together. This approach creates a positive learning environment where students feel valued, understood, and capable, essential elements for maintaining motivation in a subject that many see as difficult (Tenenbaum, Winstone, Leman, & Avery, 2020).

Despite these benefits, non-inclusive classrooms have their drawbacks. They often lack resources, with outdated instructional materials, limited digital tools, and little exposure to broader curricular advancements (Ashenfelter, 2022). Additionally, the lack of interaction with hearing peers can hinder social integration and limit opportunities for deaf learners to practice communication skills that are important in society. Still, the focused nature of non-inclusive environments often gives

deaf learners more equal access to the curriculum and instructional help than what is usually found in inclusive classrooms (Durán, Herrera, Fernández, Alvarez, & Zampar, 2024).

In effect, non-inclusive mathematics classrooms provide a language-accessible and emotionally supportive learning space for deaf learners. They are based on shared communication and specialized teaching methods. While they may not encourage full societal inclusion, these classrooms are crucial for promoting academic achievement and mathematics skills among deaf students, particularly in places where inclusive systems are not fully ready to meet their needs (Zwane, & Malale, 2018).

## Methodology

### Research Design

This study used a qualitative phenomenological research design to capture the lived experiences of deaf learners participating in mathematics instruction through hands-on learning and group teaching methods. Phenomenology helped explore how learners interpret and describe their motivation in different classroom settings, such as inclusive and non-inclusive environments (Parks, 2025). This design allowed for a deep exploration of learners' personal stories, thoughts, and feelings as they engaged with mathematical content in rich social and experiential contexts (Alhazmi, & Kaufmann, 2022).

### Participant Demographics

The study involved six deaf learners selected from inclusive and non-inclusive classroom settings, chosen from Junior High School (JHS) form two (2) in Ghana. Three participants came from inclusive mathematics classrooms, and three came from non-inclusive (specialized) mathematics classrooms. The participants were chosen based on their regular attendance in mathematics classes, their ability to communicate in Ghanaian Sign Language, and their willingness to share their learning experiences.

In the inclusive classrooms, participants attended mainstream schools where they learned alongside hearing peers. They received support from sign language interpreters and inclusive education facilitators. This group included two males and one female, aged between 13 and 16 years. All had different levels of hearing loss and had been in inclusive settings for at least two academic years.

In the non-inclusive classrooms, participants were enrolled in schools specifically for deaf learners. Here, instruction was mainly delivered through sign language by teachers trained in deaf education. This group consisted of two females and one male, also aged between 13 and 16 years. These learners had spent a minimum of three years in non-inclusive environments and received mathematics instruction designed for their communication needs.

### Research Setting and Participants

The study took place in two different educational settings in Ghana: (1) inclusive classrooms, where deaf and hearing students learn together with support services, and (2) non-inclusive specialized classrooms, where only deaf students receive instruction. The study used purposeful sampling to select six deaf learners, three from each setting, who had been part of mathematics lessons that included experiential learning and collaborative teaching strategies for at least one academic term.

Participants were between 12 and 16 years old and were skilled in Ghanaian Sign Language (GSL) and/or written English. The selection criteria included (a) regular attendance, (b) active

participation in mathematics lessons, and (c) the ability to express learning experiences through signed or written communication. We obtained informed consent from participants, their guardians, and school authorities.

***Implementation of Experiential Learning with Collaborative Teaching Approaches in Inclusive and Non-Inclusive Mathematics Classrooms***

In this study, researchers explored experiential learning through collaborative teaching in both inclusive and non-inclusive mathematics classrooms. Our goal was to examine how deaf learners experience motivation. The study based on Kolb's Experiential Learning Theory and Vygotsky's Sociocultural Theory, focused on learning through direct experience and social interaction. Combining these two teaching models was crucial to understanding how deaf students learn mathematics in different settings and how their motivation is affected.

The experiential learning component followed a four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation. In both types of classrooms, students participated in hands-on activities, like using mathematics objects, measuring physically, and tackling real-world problems with physical tools. These experiences allowed students to explore mathematics concepts actively instead of just receiving information. After each activity, students engaged in reflective observation. They thought about their experiences, using visual aids and sign language support to help clarify what they learned. Teachers encouraged students to describe what they experienced and how they felt, helping them connect better with the material.

Abstract conceptualization was the third step, where students connected hands-on tasks with theoretical mathematics knowledge. Teachers introduced the appropriate symbols, formulas, and rules based on the students' actual experiences. This connection made abstract ideas more relatable and easier to understand. Finally, in the active experimentation phase, students applied what they learned to solve new problems. They worked on different variations of problems they had previously solved or developed their own mathematics models. This spiral method helped students take ownership of their learning and view mathematics as a tool for problem-solving and exploration.

Co-teaching in inclusive classrooms involved collaboration between a special education teacher trained in deaf education and sign language, and a general education mathematics teacher. These instructors worked together to plan, teach, and assess lessons, ensuring that both deaf and hearing students had equal access to the curriculum. They designed instruction to include varied practices that met the diverse needs of the students. Usually, one instructor led the lesson while the other provided simultaneous sign language interpretation, clarified instructions, or facilitated group discussions. Both hearing and deaf students were grouped together purposively to encourage teamwork, mutual respect, and collective learning. Communication support played a key role, with strategies like visual aids, gesture-supported speech, and peer mediation used to help deaf students participate fully in group conversations and activities. This inclusive approach fostered social learning, boosted participation, and helped deaf students feel competent and included in the mathematics classroom.

In non-inclusive classes exclusively for deaf students, the collaborative teaching approach was adjusted to fit the learners' language and cultural needs. These classrooms typically included a mathematics teacher, a sign language interpreter, and sometimes a deaf education specialist or expert in visual learning strategies. Instruction emphasized visual-spatial content, and the learning materials were culturally relevant, often using mathematics concepts from Deaf culture to make mathematics more meaningful and engaging. Problem-solving activities took place in groups, with

students collaborating to model mathematics processes, address real-life issues, or participate in role-playing exercises that incorporated mathematical thinking. Students often took turns demonstrating solutions or explaining concepts to each other in sign language. Technology tools like interactive whiteboards and mathematics software with sign capabilities also enhanced learning and maintained high engagement levels.

Though both settings used the principles of experiential learning and team teaching, they functioned differently based on the unique social and linguistic makeup of each classroom. Inclusive classrooms aimed for equal participation among deaf and hearing students, using a variety of communication aids and team-teaching methods. Non-inclusive classrooms promoted language immersion and cultural validation, creating an environment where deaf students could use sign language and receive tailored instructions. These differences were critical in understanding how various contextual factors, such as communication access, peer interaction, and teacher collaboration, shape deaf learners' motivational experiences in mathematics.

The implementation of experiential learning and collaborative teaching in these two settings provided valuable insights into how deaf learners create meaning, maintain interest, and build confidence in mathematics. Through active and experiential learning in supportive social environments, students viewed mathematics as significant, engaging, and attainable. The comparative design of the study allowed for an exploration of how inclusive and non-inclusive settings uniquely affect students' motivation, independence, and confidence related to mathematics. Ultimately, this approach highlighted the intricate relationship between teaching strategies and motivational outcomes, contributing to a deeper understanding of how to best support deaf students in mathematics education.

**Data Collection**

Data were collected through semi-structured interviews, which took place in Ghanaian Sign Language (GSL) or written English, based on what participants preferred. Semi-structured interview was chosen for two major reasons, not only does it enable participants to share detailed insights and experiences but also provide a deeper understanding of the research topic. Also, semi-structured interviews prioritize the participant’s voice and perspective, allowing their experiences and opinion which is the focus of this study. Questions centered on learners’ emotional reactions, teaching preferences, peer interactions, and coping strategies during tough lessons.

Each interview lasted from 30 to 45 minutes, participants feel comfortable and express themselves accurately. All sessions were recorded on video (with permission), transcribed word for word, and then translated into English for thematic analysis. Member checking was done to ensure the transcripts and interpretations were accurate.

**Data Analysis**

Thematic analysis was used to work with the data. This included generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Transcripts were coded and analysed independently using both inductive (data-driven) and deductive (theory-informed) methods. This approach ensured that the themes reflected the participants’ voices and the theoretical frameworks of Kolb’s Experiential Learning Theory and Vygotsky’s Sociocultural Theory.

Data were organized by classroom setting (inclusive vs. non-inclusive) to identify differences and similarities in motivational experiences. Two additional researchers cross-validated the codes and

themes to ensure reliability and reduce bias. NVivo 12 software helped manage and support the qualitative coding and retrieval processes.

### Trustworthiness and Rigor

To ensure credibility, triangulation was reached using multiple data sources: Transferability was handled by providing detailed descriptions of the participants and context. Dependability was assured by keeping a clear audit trail that documented decisions made during data analysis. Confirmability was established through reflective journaling and discussions with peers, which helped reduce the impact of researcher bias.

### Ethical Considerations

The study followed the ethical standards of Akenten Appiah-Menka University of Skill Training and Entrepreneurial Development (AAMUSTED) in Kumasi. It received approval from the Institutional Review Board. Participants and their guardians signed consent forms, and we kept data confidential by using pseudonyms and secure storage. All participants could withdraw from the study at any time without facing any consequences.

## Results

### Inclusive Classroom Setting

Thematic analysis of interviews with three deaf learners in an inclusive mathematics classroom revealed five interrelated themes highlighting how experiential learning and collaborative teaching enhanced their motivation. The themes are:

1. Clarity and Relevance through Experiential Teaching,
2. Emotional Drive from Achievement and Correction,
3. Collaborative Learning as a Motivational Anchor,
4. Challenges to Motivation and How They Are Overcome, and
5. Self-Efficacy and Learner Confidence through Experience.

#### *1. Clarity and Relevance through Experiential Teaching*

Participants described motivation arising when abstract mathematical concepts were clarified through hands-on or real-world activities. These experiences provided learners with a sense of mastery and usefulness.

What motivates you to learn mathematics when engaged in hands-on activities or real-world applications?

> *"Anytime the mathematics teacher explains the concept, or any topic in mathematics and he understands, he feels like he has now overcome mathematics. And that motivates him... he wants to do more and practice more."* (R1)
>
> *"He uses what he learns in buying, counting, marketing, and measuring... even electricity, positive and negative things."* (R2)

Experiential learning provided authentic contexts that helped learners perceive mathematics as meaningful, in line with Kolb's "concrete experience" stage, which stresses learning by engaging directly with concepts.

#### *2. Emotional Drive from Achievement and Correction*

Learners expressed heightened motivation when they succeeded in solving problems after initial errors or after guidance from teachers.

Were you motivated when taught through experiential learning?

> *"When exercise is given and he gets it wrong, and the teacher asks him to redo it, if after the correction he gets it right, then he feels very happy."* (R3)
>
> *"Through experiential learning activities, I have improved in the solving of problems in mathematics."* (R1)
>
> *"Those times I felt discouraged, but now through experiential activities, peer teaching, and group work, I have seen that I am improving."* (R2)

These experiences reflect Kolb's "reflective observation" and "active experimentation", where learners internalize feedback and refine their skills through trial and correction.

***3. Collaborative Learning as a Motivational Anchor***

Collaboration with peers and teachers was described as a central source of motivation, offering support, shared understanding, and emotional affirmation.

Does collaborative learning motivate you?

> *"He feels good with peer learning."* (R1)
>
> *"Very helpful."* (R2)
>
> *"Engaged and joyous."* (R3)

Learners credited collaborative teaching with improving their engagement and mathematical understanding:

How does collaborative teaching enhance your engagement and understanding mathematical concepts?

> *"Combined collaborative teaching is good because he has seen that it will help him improve."* (R1)
>
> *"Through peer discussion, what is accepted by the group is what is presented. You feel sure of yourself."* (R3)

These responses reflect Vygotsky's Sociocultural Theory, particularly the importance of the Zone of Proximal Development (ZPD), where peer and teacher scaffolding enhances motivation and competence.

***4. Challenges to Motivation and How They Are Overcome***

While learners acknowledged demotivating moments, such as negative teacher feedback or peer rejection, they emphasized the value of supportive structures in overcoming these challenges.

Were there any challenges or obstacles that affected your motivation? How did you overcome them?

> *"It is embarrassing when the teacher tells you 'You don't know this. Go to your friend to teach you.'"* (R1).
>
> *"Sometimes when you get answers wrong, the way the teacher behaves discourages him."* (R1)
>
> *"In group study, when group members reject his idea but later realize he was right, it discourages."* (R3)

Despite these challenges, learners were resilient, largely due to peer encouragement and the structure of experiential tasks:

*"His mathematics was very poor but through experiential learning he is getting on, little by little."* (R2)

***5. Self-Efficacy and Learner Confidence through Experience***

Participants described how their confidence to engage with mathematics was directly enhanced by experiential and collaborative practices.

How has experiential learning and collaborative teaching impacted yourself efficacy in mathematics?

> *"The use of resources and peer discussion helps in the learning of mathematics."* (R1)
>
> *"It gives you the authority to establish that when given more resources, you can be able to learn."* (R3)
>
> *"Even if the teacher is not able to explain everything, I can follow steps in other books to solve problems."* (R2)

Learners recounted specific difficult topics, such as fractions and long division, and how experiential learning helped them overcome conceptual challenges:

Can you describe a time when you overcame a difficult mathematical concept?

> *"Fraction was confusing... but through experiential learning, I was taken through and now I'm okay."* (R1)
>
> *"Long division was difficult... but now I use it to solve problems and get the answer."* (R3)

**Results**

**Non-Inclusive Classroom setting**

A thematic analysis of participants' responses revealed four interrelated themes describing how experiential learning and collaborative teaching influenced deaf learners' motivation, engagement, and self-efficacy in mathematics: (1) experiential engagement enhances motivation, (2) peer and teacher collaboration as motivational anchors, (3) barriers to learning and strategies for overcoming them, and (4) strengthening self-efficacy through interaction and practice. Participants are identified by codes (Participant R1, R2, and R3) to ensure confidentiality.

***Experiential Engagement Enhances Motivation***

All participants emphasized that real-world applications and hands-on experiences significantly improved their motivation to learn mathematics.

What motivates you to learn mathematics when engaged in hands-on activities or real-world applications?

Participant R1 remarked,

> *"Using resources, materials, and different approaches to learning motivates me."*

Similarly, Participant R2 stated,

> *"When I'm able to apply what is learnt in the classroom (for example, buying and selling and how to economize) it makes me want to learn more."*

Participant R3 highlighted the role of continuous engagement and interaction:

> *"What motivates me is constant practice, teacher motivation, and assistance from peers. When I understand a mathematical concept and can teach it to others, I feel more confident and want to keep learning."* (R3)

Experiential tasks, such as practical demonstrations and application-based problem solving, helped deepen understanding and maintain attention. Participant R2 added:

> *"When we are given the opportunity to try hands-on mathematical concepts, I feel more engaged."*

This suggests that experiential learning strengthens learners' sense of competence and autonomy, fostering intrinsic motivation.

***Peer and Teacher Collaboration as Motivational Anchors***

Collaboration with teachers and peers served as a major motivational factor.

How do you feel about working with peers or teachers to solve mathematics problems?

Participant R1 shared,

> *"I feel more motivated when working in groups. When a colleague acts as a teacher during group work, it helps me stay focused."*

Participant R2 described similar benefits:

> *"During peer discussions, I feel more engaged and motivated."*

These collaborative interactions provided not only academic support but also a safe space for error correction and social reinforcement. Participant R3 noted,

> *"When we work together, we get additional explanations and more practical support. That helps a lot."*

Teacher guidance also played a strong motivational role. For example, Participant R2 explained:

> *"Sometimes when I don't understand a concept, the teacher asks another student who is good at mathematics to assist. That support helps me stay motivated and not give up."* (R2)

However, not all collaborative experiences were positive. Participant R1 admitted that collaboration became demotivating:

> *"When group members have no idea about a topic being studied,"*

while Participant R2 emphasized the importance of preparedness:

> *"It helps when I'm allowed to try my hands on work examples and prepare before group work."*

***Barriers to Learning and Strategies for Overcoming Them***

Despite the advantages of experiential and collaborative teaching, learners encountered obstacles. Inadequate explanation by teachers emerged as a common de-motivator.

What demotivates you in mathematics classes?

Participant R1 stated, *"When the teacher is not explaining well, it becomes frustrating and demotivates me."*

Learning styles mismatched with teaching methods also posed challenges. Participant R2 reflected,

> *"The different approaches used by some teachers don't fit my learning style."*

For Participant R3, the instructional method itself sometimes created confusion:

> *"At times, the approach used to teach a topic makes it very difficult to understand."*

In addition, affective factors like teacher attitude influenced motivation. Participant R2 shared:

> *"The teacher's approach and mood can affect us. Sometimes they don't allow us to practice, and that makes mathematics feel even more difficult."* (R2)

To overcome these challenges, learners adopted active strategies, such as seeking peer help (R2), requesting concept repetition from teachers (R3), or initiating group discussions (R1). These responses underscore the importance of adaptable pedagogy and learner-centered instruction in deaf education.

***Strengthening Self-Efficacy through Interaction and Practice***

All participants expressed a high degree of confidence in their mathematical abilities, especially when they received adequate guidance, practice opportunities, and peer support.

Do you feel confidence in your ability to solve mathematical problems?

Participant R1 explained,

> *"When the topic is introduced with the guidance and approaches given to us, it motivates us and makes me feel confident."*

Participant R2 affirmed the value of instructional strategies:

> *"The way the topic is taught and giving us more work to try on our own or in groups helps me believe in myself."*
>
> *"I'm always among the first three to solve the question on the board. That makes me feel confident."* (R3)

Experiential and collaborative strategies were credited with building this self-efficacy. Participant R2 emphasized that group learning helped her grow into a leadership role:

> *"Through group discussion and collaboration, I can boldly say that I can take a leading role to teach my peers in mathematics class."* (Participant R2)

Participants also recounted instances where they overcame difficult concepts. For R2, the use of sign language to interpret word problems, despite the limited sign vocabulary was a strategy to bridge understanding gaps. Participant R3 noted that when she missed a lesson, she would proactively request the teacher to revisit the topic.

However, emotional setbacks still occurred. Participant R3 admitted,

> *"When I don't understand what was taught because I was absent, I feel a bit down,"*

indicating that missed learning opportunities directly impact motivation.

**Discussion**

In the Ghanaian education system, the challenge of providing fair, engaging, and effective mathematics instruction for deaf learners continues in both inclusive and non-inclusive classrooms (Nketsia, 2016). This study shows that when experiential learning is combined with collaborative teaching, deaf learners feel more motivated, confident, and engaged in mathematics. Participants from both types of classrooms shared that hands-on activities, real-life applications, and chances for social interaction formed the basis of meaningful mathematics learning. This aligns well with ongoing educational reforms in Ghana that focus on learner-centered education and inclusive practices (Addai-Mununkum, & Setordzi, 2023).

In inclusive classrooms, deaf learners emphasized how experiential teaching made abstract mathematics concepts easier to understand and connect to everyday life. Practical tasks, like using manipulatives or applying math in market transactions, improved learners' clarity and mastery (King, & Metcalf, 2024). This finding is important in a context where deaf learners often struggle with abstract instruction due to communication barriers and limited support (Bowen, & Probst, 2023). These results echo Kolb's Experiential Learning Theory, especially the phases of "concrete experience" and "reflective observation," where learners find meaning through direct involvement and then refine their understanding through reflection.

The study also points out the emotional aspect of motivation. Learners in both settings noted that feedback loops, such as correcting mistakes and getting help to find the right answer, led to emotional satisfaction and increased commitment. This ongoing process fits with Kolb's "active experimentation" phase and shows how learners process their progress. In Ghana, where traditional teacher-centered methods are still common in many schools, these findings stress the need for feedback-rich, formative teaching practices, especially for deaf learners who often face neglect.

Moreover, the importance of collaboration, between peers and among students and teachers, emerged as a key motivational factor in both inclusive and non-inclusive environments. This supports Vygotsky's Sociocultural Theory, especially the idea of the Zone of Proximal Development (ZPD), which suggests that learners achieve more when they receive support from capable peers or adults. In both environments, collaborative learning not only encouraged academic progress but also created emotional safety and a sense of belonging (MacAllister, 2025). Participants regularly linked motivation to explanations from peers, guidance from teachers, and working together to solve problems. In Ghana's evolving education system, these findings highlight the value of structured collaborative teaching methods that support deaf learners' education and social integration.

However, challenges to motivation were still present. Both groups experienced moments of discouragement due to insensitive teacher feedback, peer exclusion, or mismatched teaching methods (Elballah, & Alsayed, 2025). These issues reveal ongoing structural and attitude-related barriers in Ghanaian classrooms, where training in inclusive teaching methods is often inadequate (Mónico, Mensah, Grünke, Garcia, Fernández, & Rodríguez, 2020). Still, what stands out is the resilience and adaptive strategies of the learners: seeking help from peers, asking for things to be repeated, and using self-directed study methods. These actions demonstrate the development of self-regulation skills and support the effectiveness of combining experiential with collaborative models to enhance learner agency.

Globally, the findings link to a growing body of research that stresses the need for inclusive, learner-centered methods in deaf education (Aguis, 2024). Studies from the United States, the United Kingdom, and South Africa also show how experiential and collaborative strategies boost math outcomes and motivation among students with hearing impairments (Bashir, Batool, & Amjad, 2024). This study adds to the global conversation by providing context-specific insights from Ghana, where culturally relevant teaching, preparedness of teachers, and resource limitations affect the realities of deaf education. It also strengthens the argument for adapting proven global practices, like differentiated instruction, multi-modal engagement, and social learning, to fit local educational systems.

This study further reinforces the idea that motivation in mathematics for deaf learners is not a fixed quality; it is a changing result of instructional design, social support, and learner engagement.

When deaf learners have the tools to experience mathematics, the support to reflect on it, and the space to collaborate meaningfully, their intrinsic motivation and self-confidence grow. For Ghana and similar low-resource settings, this calls for a focused effort to invest in teacher training, classroom resources, and inclusive curriculum strategies that prioritize experiential and collaborative learning, not just as methods, but as essential approaches for fairness and quality in education.

**Limitations of the Study**

This study offers valuable insights into the motivational experiences of deaf learners in mathematics through experiential collaborative teaching, but it has some limitations. First, it is limited to specific schools in Ghana, so the findings may not apply to other educational settings with different resources or policies. The purposive sample, while detailed, limits broader representation.

Second, communication challenges may have influenced data interpretation because some nuances might have been lost in sign language translation. Thirdly, even though thematic analysis was conducted carefully, researcher subjectivity could introduce interpretive bias, despite validation methods like member checking.

**Conclusion**

This study looked at the motivational experiences of deaf learners in mathematics classrooms that used hands-on learning and collaborative teaching in both inclusive and non-inclusive settings. The results showed that engaging, real-life learning activities, along with organized peer and teacher collaboration, greatly improved learners' motivation, self-confidence, and involvement with mathematical ideas. Experiential learning made abstract concepts easier to understand, provided emotional satisfaction, and built confidence, especially when challenges were met with collaborative support. Although some learners struggled with motivation due to unclear instruction or negative peer interactions, these issues were often reduced through active participation and support, which led to greater learner independence and resilience. Based on Kolb's Experiential Learning Theory and Vygotsky's Sociocultural Theory, the study confirms that motivation is influenced by meaningful, social, and reflective learning experiences. The findings highlight the need for policymakers and educators, especially in Ghana, to make experiential and collaborative methods a key part of deaf education. This approach will help ensure fair, inclusive, and empowering mathematics teaching.

**Implications of the Study**

This study shows that experiential learning and collaborative teaching significantly improve motivation, engagement, and self-efficacy in mathematics among deaf learners in both inclusive and non-inclusive classrooms. By connecting instruction to real-world examples and hands-on activities, learners could relate abstract concepts to meaningful experiences. This reflects Kolb's Experiential Learning Theory, especially the stages of concrete experience and active experimentation. The important role of peer and teacher collaboration supports Vygotsky's Sociocultural Theory, emphasizing the value of scaffolding within the Zone of Proximal Development to build competence and maintain motivation.

The findings suggest that experiential and collaborative strategies should be at the heart of mathematics instruction rather than just an addition. Feedback cycles, where learners fix errors and find success, were shown to boost motivation. Teacher clarity, tone, and communication style, especially the effective use of sign language, were crucial in promoting engagement.

For curriculum design, experiential activities should be intentionally arranged from concrete to abstract reasoning and clearly linked to learning goals. Collaborative structures need to be designed to ensure fair participation and avoid disengagement due to unproductive group dynamics.

Policy implications include the need for adequate resources such as manipulatives and relevant materials, along with professional development in experiential teaching, collaborative methods, and peer-assisted learning aimed at meeting deaf learners' linguistic and cognitive needs.

For learner development, repeated success in experiential and collaborative settings was connected to greater resilience, confidence, and leadership in peer learning roles. Mathematics instruction can therefore be a platform for developing not only cognitive skills but also problem-solving, self-regulation, and mentoring abilities.

These insights build on existing research by showing that blending experiential and collaborative methods benefits deaf learners across different environments, providing a strong framework for improving mathematics achievement in linguistically diverse educational settings.

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