



Creating equitable learning opportunities in inclusive mathematics classrooms: Lecturers' instructional practices in Ghanaian teacher education

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Abstract

Creating equitable learning opportunities in mathematics classrooms is essential for inclusive education and addressing disparities in student participation and achievement. However, limited empirical evidence exists on how mathematics lecturers in teacher education institutions implement equity-oriented instructional practices in the Ghanaian context. This study examined the instructional practices mathematics lecturers engage themselves in Creating Equitable Learning Opportunities in inclusive mathematics classrooms in Ghanaian Colleges of Education. The study adopted a sequential explanatory mixed-methods design, where quantitative data were collected and analyzed first, followed by qualitative data to explain the results. Survey data were collected from 40 mathematics lecturers and 480 pre-service mathematics teachers from eight public Colleges of Education in the Ashanti Region of Ghana and analyzed using descriptive statistics and independent samples t-tests. Follow-up interviews with selected lecturers provided deeper insights into the quantitative findings. Results showed that lecturers frequently connect mathematics to real-life contexts but less often engage students' diversity and collaborative learning as instructional resources. Structural constraints such as large class sizes, rigid curricula, and limited professional development were found to influence these practices. The findings highlight the need for institutional support to strengthen equitable and inclusive mathematics instruction.

Keywords: Culturally responsive pedagogy; Equitable learning opportunities; Equity; Inclusion; Mathematics teacher education; Social justice

1. Introduction

Mathematics education in contemporary classrooms is increasingly expected to reflect principles of equity, inclusion, and social justice (Aguirre et al., 2021; Bartell et al., 2017; Olawale, 2025; Panthi et al., 2025). As societies become more culturally and linguistically diverse, mathematics educators face the challenge of ensuring that all learners, regardless of background, experience meaningful engagement and equitable learning opportunities (Ferreira & Richetto, 2025; Lee & Herner-Patnode, 2025). In Ghana, where classrooms are microcosms of diverse social, cultural, and religious identities, the need to promote equity in mathematics education has become particularly urgent. Every Ghanaian child is entitled to access quality education, and this right underpins the implementation of the Inclusive Education Policy (Ministry of Education [MoE], 2013). The policy emphasizes the removal of learning barriers and calls for teaching approaches that recognize learners' varied needs while ensuring their full participation in classroom activities.

In alignment with Sustainable Development Goal [SDG] 4, which advocates inclusive and equitable quality education for all, Ghana has reformed its teacher education programmes to strengthen inclusivity and diversity in instructional practices (Abreh, 2025). The National Teacher Education Curriculum Framework (MoE, 2017) mandates that inclusivity and equity become cross-cutting themes across teacher preparation programmes. As a result, mathematics lecturers in Colleges of Education are expected to model equitable pedagogical practices and develop pre-service teachers' competencies to address learner diversity. According to UNESCO (2021), teacher education institutions play a critical role in fostering inclusive classroom practices by equipping teachers with the knowledge and skills to respond to diverse learners effectively.

Despite these policy efforts, several studies (Lapidot-Lefler, 2025; Nketsia, 2016; Reyes, 2025; Sabella, 2015) indicate that many teacher educators struggle to translate inclusive and equitable principles into classroom practice. In Ghana, limited resources, overloaded curricula, and

insufficient professional training have constrained lecturers' ability to integrate culturally responsive and equitable instructional strategies (Takyi-Mensah, 2025). Research in mathematics education further suggests that when equitable practices are inadequately implemented, students from marginalized or underrepresented groups often experience limited participation, lowered expectations, and reduced achievement (Askew, 2015; Gutiérrez, 2009; Kyeremeh et al., 2025). Hence, the success of inclusive education depends not only on access to schooling but also on how mathematics lecturers engage in instructional practices that create equitable learning opportunities [CELO] for all learners.

To bridge this gap, Ghana's Colleges of Education introduced Professional Development Sessions [PDS] in 2018 to equip lecturers with strategies for teaching mathematics through inclusive pedagogies. These initiatives aimed to reshape lecturers' instructional beliefs and practices and to promote awareness of cultural, cognitive, and gender diversity in mathematics classrooms. However, empirical evidence on how mathematics lecturers have adopted and engaged in these equitable instructional practices remains limited. As Davis et al. (2012) and Muñoz (2020) argue, preparing teachers to close the achievement gap in mathematics requires both pedagogical expertise and deep understanding of learner diversity.

Therefore, this study examines the extent to which mathematics lecturers in Ghanaian Colleges of Education engage in instructional practices that promote equitable learning opportunities in inclusive mathematics classrooms. By focusing on lecturers' actual practices and pre-service teachers' perceptions, this study contributes to the ongoing discourse on inclusive mathematics education and offers insights for policy and curriculum reforms aimed at achieving equitable mathematics learning for all.

1.1. Problem Statement

Although Ghana's inclusive education policy and curriculum reforms have emphasized equity and diversity as core values in teacher preparation, the extent to which mathematics lecturers in Colleges of Education translate these principles into classroom practice remains unclear. Existing research in Ghana and other developing contexts highlights persistent disparities in how teachers engage learners with different abilities, socio-cultural backgrounds, and learning styles (Nketsia, 2016; Reyes, 2025). Many mathematics lecturers continue to rely on traditional pedagogies that privilege uniform instruction over differentiated and responsive teaching (Egara, & Mosia, 2025; Ituma, 2025). Consequently, pre-service teachers often graduate with limited exposure to equitable instructional practices, undermining their ability to implement inclusive pedagogy in their future classrooms.

Furthermore, while international research has outlined frameworks for equitable mathematics instruction (Aguirre et al., 2021; Bartell et al., 2017; Ferreira & Richetto, 2025), few studies have empirically examined how these frameworks are enacted in African teacher education contexts. There is limited data on the extent and frequency of mathematics lecturers' engagement in creating equitable learning opportunities in inclusive mathematics classrooms in Ghana. This knowledge gap constrains both curriculum development and the professional preparation of teacher educators. Therefore, understanding the current instructional practices of mathematics lecturers is essential for informing policy and designing targeted professional development to promote inclusive and equitable mathematics teaching.

1.2. Purpose of the Study

The purpose of this study is to examine the extent to which mathematics lecturers in Ghanaian Colleges of Education engage in instructional practices that promote equitable learning opportunities in inclusive mathematics classrooms. Specifically, the study seeks to identify the types of equitable instructional practices lecturers employ, determine the frequency of their engagement in these practices, and analyze pre-service teachers' perceptions of their lecturers' inclusivity in teaching. The findings aim to provide empirical evidence to inform teacher education programmes, support professional development initiatives, and contribute to achieving equitable

and inclusive mathematics education aligned with Sustainable Development Goal 4.

This study was guided by the following research questions:

RQ 1) What instructional practices do mathematics lecturers in Ghanaian Colleges of Education employ to create equitable learning opportunities in inclusive mathematics classrooms?

RQ 2) Are there significant differences between lecturers' and students' perceptions of lecturers' engagement in CELO practices?

2. Literature Review

2.1. Theoretical Framework

This study is grounded in Social Justice Theory [SJT] and Culturally Responsive Pedagogy [CRP], which together provide a robust foundation for understanding equity and inclusion in mathematics education.

Social Justice Theory emphasizes fairness, participation, and access in educational systems, ensuring that teaching practices dismantle barriers that perpetuate inequality (Kato Bukenya, 2025; Küçüksüleymanoğlu, 2025; Shaked, 2025). Within mathematics education, social justice-oriented teaching involves creating classroom environments that value all learners' experiences and promote equitable participation in mathematical discourse (Aguirre et al., 2021).

Culturally Responsive Pedagogy, originally advanced by Ladson-Billings (1995), asserts that teachers must recognize, respect, and build upon students' cultural backgrounds as resources for learning. In mathematics classrooms, CRP requires lecturers to link abstract mathematical ideas to learners' real-world experiences, languages, and community knowledge systems (Gay, 2018; Gbormittah et al., 2025; Ladson-Billings, 1995). CRP and social justice approaches converge in their call for teachers to position all learners as capable contributors to mathematical thinking and problem-solving.

In the Ghanaian context, where classrooms reflect a rich diversity of social and linguistic backgrounds, these frameworks provide critical guidance for mathematics lecturers in Colleges of Education. The Inclusive Education Policy (MoE, 2013) and the National Teacher Education Curriculum Framework (MoE, 2017) emphasize lecturers' responsibility to create equitable learning opportunities by addressing learner diversity. Hence, this study draws on these theoretical lenses to explore how mathematics lecturers' instructional practices embody principles of equity, inclusion, and responsiveness in their classroom engagement.

2.2. Empirical Review

Research on equitable and inclusive mathematics instruction underscores that teacher practices play a decisive role in shaping learning opportunities. Bartell et al. (2017) identified nine equitable teaching practices, including attending to students' mathematical thinking, establishing inclusive classroom norms, positioning students as capable, and using multiple forms of discourse. These practices align with the notion that equitable teaching extends beyond differentiated instruction to include transforming classroom norms and power structures.

Recent studies (Aguirre et al., 2021; Kyeremeh et al., 2025; Nketsia, 2016) have reinforced these ideas. Aguirre et al. (2021) and Kyeremeh et al. (2025) emphasized that mathematics teaching for equity requires teachers to integrate cultural knowledge and community experiences into classroom instruction. Similarly, Abdulrahim and Orosco (2020) found that when teachers design mathematics lessons that connect with learners' lived experiences, students' participation and conceptual understanding improve significantly. In sub-Saharan Africa, Nketsia (2016) and Takyi-Mensah (2025) reported that despite policy reforms, many teacher educators lack sufficient training and pedagogical flexibility to adapt to learner diversity in inclusive settings.

In the context of Ghana, Gbormittah et al. (2025) and Nketsia (2016) observed that the rigid and overloaded teacher education curriculum often limits lecturers' ability to modify teaching practices to meet individual learning needs. This results in limited classroom engagement that truly reflects equity and inclusivity. More recent evidence by Benmer (2022) showed that while teachers may value inclusive practices conceptually, practical implementation often falls short due to inadequate

resources, time constraints, and limited institutional support.

Globally, research points to the importance of professional development and reflective practice in promoting equitable teaching. Muñiz (2020) highlighted that effective inclusive teaching depends on teachers' ability to reflect on biases, integrate students' cultural perspectives, and design assessments that recognize diverse learning strengths. Li et al. (2025) further noted that equity-oriented mathematics instruction is associated with teachers' pedagogical content knowledge and their ability to adapt lessons to students' contexts. Akosah et al. (2022) also demonstrated that teacher efficacy and instructional quality mediate the relationship between inclusive practices and students' mathematics achievement.

Collectively, these studies reveal a consistent gap between policy intentions and classroom realities, particularly in developing contexts where inclusive mathematics education is emerging. However, empirical studies focusing specifically on mathematics lecturers in Colleges of Education in Ghana are scarce. This study therefore fills a critical gap by examining how lecturers engage in equitable instructional practices and how frequently such practices occur in inclusive mathematics classrooms.

2.3. Conceptual Framework

The conceptual framework guiding this study is adapted from Bartell et al.'s (2017) Framework for Equitable Mathematics Teaching, which identifies instructional dimensions that promote fairness, inclusion, and academic success for all learners. In this framework, equitable teaching is conceptualized as a dynamic process involving four key dimensions:

1) *Use of Students' Diversity for CELO* – Recognizing and drawing upon learners' cultural, linguistic, and experiential backgrounds to design relevant mathematical tasks (Askew, 2015; Muñiz, 2020).

2) *Establishing Inclusive Classroom Norms* – Creating participatory structures where every learner's voice and contribution are valued, reducing power imbalances in discourse (Bartell et al., 2017).

3) *Positioning Students as Mathematical Resources* – Encouraging peer learning and collaboration that leverages individual strengths and capabilities (Aguirre et al., 2013).

4) *Connecting Mathematics to Real-World Experiences* – Linking abstract mathematical concepts to students' everyday contexts to enhance understanding and engagement (Abdulrahim & Orosco, 2020).

In this study, these four dimensions represent the core components of instructional practices for creating equitable learning opportunities in inclusive mathematics classrooms. The framework assumes that the more mathematics lecturers engage in these practices, the higher the likelihood of achieving equitable participation and learning outcomes among pre-service teachers.

This conceptual framing guided the development of the research instruments, data analysis, and interpretation of findings, providing a structure for assessing how lecturers' engagement in CELO practices reflects the broader goals of inclusive mathematics education in Ghana.

3. Methodology

3.1. Research Design

This study employed a mixed-methods sequential explanatory research design to examine how mathematics lecturers engage in instructional practices that promote Creating Equitable Learning Opportunities in inclusive mathematics classrooms within Ghanaian Colleges of Education. This design was particularly suitable for the current study, as it allows for the comparison of perceptions between lecturers and pre-service teachers regarding the extent of lecturers' engagement in equitable instructional practices. The choice was also justified by its efficiency in obtaining data from a relatively large population across multiple Colleges of Education within a limited period. They are widely used in mathematics education research to explore teachers' instructional practices, beliefs, and perceptions (Li et al., 2025).

The sequential explanatory design involves two distinct phases: an initial quantitative phase, followed by a qualitative phase aimed at explaining and elaborating on the quantitative findings (Creswell & Plano Clark, 2017). In the first phase, quantitative data were collected through structured questionnaires administered to mathematics lecturers and pre-service mathematics teachers. This phase aimed to identify the types and frequency of instructional practices used by lecturers to create equitable learning opportunities in mathematics classrooms. Descriptive statistics were used to summarize participants' responses, while independent samples t-tests were conducted to examine differences between lecturers' and students' perceptions of CELO practices. In the second phase, qualitative data were collected through semi-structured interviews with selected mathematics lecturers. The purpose of this phase was to provide deeper insights into the quantitative results by exploring lecturers' perspectives on the factors influencing their implementation of equitable instructional practices. The qualitative findings helped to clarify perception gaps identified in the quantitative phase and provided contextual explanations for patterns observed in the survey data. The integration of the quantitative and qualitative findings occurred during the interpretation stage of the study. By combining statistical results with participants' explanatory insights, the sequential explanatory design enabled a more comprehensive understanding of how equitable instructional practices are enacted within mathematics teacher education contexts. This approach was particularly appropriate for the study because it allowed the researcher to not only measure lecturers' engagement in CELO practices but also explore the contextual and institutional factors that shape their implementation.

3.2. Population and Sampling

The population of the study comprised all mathematics lecturers and pre-service mathematics teachers in public Colleges of Education in Ghana. The target population included 45 mathematics lecturers and 11,600 pre-service teachers from level 100 to 300 in the eight (8) public Colleges of Education located in the Ashanti Region. A stratified random sampling technique was employed to ensure proportional representation of both lecturers and pre-service teachers across the institutions. Stratified sampling was deemed appropriate because it enhances representativeness and reduces sampling bias by dividing the population into homogenous subgroups (Creswell & Plano Clark, 2017). From this population, a total of 40 mathematics lecturers and 480 pre-service mathematics teachers were selected. The Ashanti Region was purposively chosen due to the researcher's familiarity with its educational environment and the region's diversity in institutional settings. The inclusion of both lecturers and pre-service teachers allowed for a multi-perspective evaluation of CELO practices, aligning with recommendations by Aguirre et al. (2013) that equity-oriented research should capture both teacher and learner experiences.

3.3. Instrumentation

Data were collected using two structured questionnaires, one for mathematics lecturers and another for pre-service mathematics teachers. The instruments were designed based on constructs drawn from Bartell et al.'s (2017) Framework for Equitable Mathematics Teaching and relevant literature on inclusive and culturally responsive pedagogy (Askew, 2015; Muñiz, 2020).

The questionnaire consisted of 24 Likert-scale items organized into four subscales reflecting the dimensions of Creating Equitable Learning Opportunities adapted from Bartell et al. (2017). Each subscale contained six items measuring lecturers' engagement in specific equity-oriented instructional practices. Responses were measured using a five-point Likert scale ranging from: 1 – Never; 2 – Rarely; 3 – Sometimes; 4 – Often and 5 – Always. Higher scores indicated a higher frequency of engagement in equitable instructional practices. The four CELO subscales were structured as follows.

3.3.1. Use of Students' Diversity for CELO (6 items)

This subscale examined how lecturers incorporate students' cultural, linguistic, and experiential backgrounds into mathematics instruction. Sample items included:

- I incorporate examples from students' cultural or community experiences when explaining mathematical concepts.
- I encourage students to share how mathematics is used in their communities or daily lives.

3.3.2. *Establishing Inclusive Classroom Norms (6 items)*

This subscale measured how lecturers create classroom environments that promote equitable participation and respect for diverse perspectives. Sample items included:

- I create classroom rules that ensure every student has the opportunity to contribute during mathematics discussions.
- I encourage respectful listening when students express different mathematical ideas.

3.3.3. *Positioning Students as Mathematical Resources (6 items)*

This subscale assessed the extent to which lecturers promote peer learning and collaborative problem solving. Sample items included:

- I organize students into groups to solve mathematical problems collaboratively.
- I encourage students to explain their mathematical reasoning to their peers.

3.3.4. *Connecting Mathematics to Students' Daily Experiences (6 items)*

This subscale examined how lecturers contextualize mathematics concepts using real-world situations familiar to students. Sample items included:

- I use examples from everyday activities such as markets, transportation, or household budgeting when teaching mathematics.
- I design mathematics tasks that reflect real-life situations students may encounter outside the classroom.

In addition to the Likert-scale items, the questionnaire included two open-ended questions designed to capture participants' deeper reflections on equitable teaching practices. These questions allowed lecturers and pre-service teachers to elaborate on their experiences and provide contextual explanations that could not be captured through closed-ended items. The open-ended items included:

- In what ways do mathematics lecturers incorporate students' cultural or social backgrounds into mathematics lessons?
- What challenges do lecturers face when attempting to create inclusive mathematics classrooms in Colleges of Education?

3.4. **Validity and Reliability of Instruments**

To ensure content and construct validity, the instruments were reviewed by two senior lecturers specializing in mathematics education and inclusive pedagogy from the University of Education, Winneba. Their feedback informed revisions to item phrasing and alignment with the CELO dimensions. According to Gay (2018), expert validation enhances the accuracy and appropriateness of research instruments. A pilot test was subsequently conducted with a small group of mathematics lecturers and pre-service teachers who were not part of the main study. The pilot data were analyzed to assess the internal consistency of the instruments. The Cronbach's alpha coefficients for the four CELO categories ranged between .78 and .86, indicating high reliability (George & Mallery, 2019). This ensured that the questionnaire items were both stable and consistent across administrations.

3.5. **Data Collection Procedures**

Prior to data collection, official permission was obtained from the selected Colleges of Education and the relevant authorities within the Ghana Tertiary Education Commission. Participants were informed about the study's purpose, assured of confidentiality, and participation was strictly voluntary. Data collection was conducted in person by the researcher with the assistance of trained research assistants, ensuring standardization and accuracy in questionnaire administration.

3.6. Data Analysis

Quantitative data were analyzed using the Statistical Package for Social Sciences version 25. Descriptive statistics such as means and standard deviations were computed to determine the level and frequency of lecturers' engagement in CELO instructional practices. To examine differences between lecturers' and pre-service teachers' perceptions, independent samples t-tests were performed. This analytical approach is appropriate for comparing mean scores across independent groups (Field, 2013). Open-ended responses were analyzed thematically to supplement the quantitative findings. The integration of descriptive and inferential statistics allowed for a comprehensive interpretation of how mathematics lecturers' instructional practices align with the goals of inclusive and equitable mathematics education.

3.7. Ethical Considerations

The study adhered to standard ethical protocols for educational research. Participants provided informed consent prior to participation, and anonymity was maintained throughout the data collection and reporting processes. Ethical clearance was obtained from the researcher's affiliated institution, and the study followed the ethical principles outlined by the American Educational Research Association [AERA] (2000) regarding voluntary participation, confidentiality, and respect for participants' rights.

4. Results

This section presents findings from the analysis of data collected from 40 mathematics lecturers and 480 pre-service mathematics teachers in eight public Colleges of Education in the Ashanti Region of Ghana. The results are organized according to the two research questions that guided the study.

4.1. Mathematics Lecturers' Instructional Practices for Equity in Inclusive Classrooms

Descriptive statistics were computed to determine how lecturers and students rated the lecturers' engagement in the four categories of Creating Equitable Learning Opportunities practices. Table 1 presents the mean ratings of lecturers' engagement in instructional practices aimed at creating equitable learning opportunities in inclusive mathematics classrooms.

Table 1

Mean Ratings of Lecturers' Engagement in Instructional Practices for CELO

<i>Category of CELO Practices</i>	<i>Lecturers' Mean</i>	<i>SD</i>	<i>Students' Mean</i>	<i>SD</i>
Use of students' diversity for CELO	3.46	0.93	2.67	0.45
Establishing classroom norms to ensure inclusivity	3.72	0.80	3.50	0.56
Positioning students to use one another as mathematical resources	3.37	0.94	3.00	0.58
Connecting content knowledge to students' daily lives	4.22	0.52	4.24	0.51
Overall Mean	3.73	0.71	3.41	0.34

Table 1 presents the mean ratings of lecturers' and students' perceptions of lecturers' engagement in instructional practices aimed at creating equitable learning opportunities in inclusive mathematics classrooms. The overall mean scores indicate that lecturers rated their own engagement in CELO practices relatively highly ($M = 3.73$, $SD = 0.71$), whereas students' ratings were somewhat lower ($M = 3.41$, $SD = 0.34$). This pattern suggests that, although lecturers generally perceive themselves as engaging in equity-oriented instructional practices, students experience these practices less strongly. Variations across the four CELO categories further highlight important differences in how specific instructional practices are perceived by the two groups.

Among the four categories, connecting content knowledge to students' daily lives received the highest ratings from both lecturers ($M = 4.22$, $SD = 0.52$) and students ($M = 4.24$, $SD = 0.51$). The close similarity in these scores indicates a strong convergence in perceptions, suggesting that relating mathematical concepts to real-life situations is a well-established instructional practice in the observed context. This finding implies that lecturers frequently contextualize mathematics using familiar examples from students' everyday experiences, thereby making instruction more meaningful and accessible in inclusive classrooms. Relatively high ratings were also reported for establishing classroom norms to ensure inclusivity, with lecturers assigning a mean score of 3.72 ($SD = 0.80$) and students 3.50 ($SD = 0.56$). These findings suggest that lecturers make noticeable efforts to create classroom environments that encourage participation, respect, and inclusion. However, the slightly lower student rating indicates that some learners may still perceive limitations in the extent to which these inclusive norms are consistently enacted in practice.

In contrast, more pronounced discrepancies emerged in the categories of use of students' diversity for CELO and positioning students to use one another as mathematical resources. For the use of students' diversity, lecturers reported a mean of 3.46 ($SD = 0.93$), whereas students reported a notably lower mean of 2.67 ($SD = 0.45$). This gap suggests that lecturers may believe they are drawing on students' diverse cultural, linguistic, or experiential backgrounds more frequently than students themselves perceive. A similar, though less marked, difference appeared in relation to positioning students as mathematical resources, where lecturers reported a mean of 3.37 ($SD = 0.94$) and students 3.00 ($SD = 0.58$). This finding points to a moderate level of engagement in peer-oriented and collaborative instructional strategies, while also indicating that such practices may not always be sufficiently visible, structured, or effective from the students' perspective.

The pattern of results reveals a consistent tendency for lecturers to rate their engagement in CELO practices higher than students do. This divergence in perceptions is important because it suggests that the implementation of equitable instructional practices may not always be experienced by students in the same way it is intended by lecturers. In particular, while contextualizing mathematics in students' daily lives appears to be a clear strength, greater attention may be needed in leveraging student diversity and promoting peer-based mathematical learning. These findings underscore the importance of reflective instructional practice and the use of student feedback in strengthening equity-oriented teaching in inclusive mathematics classrooms.

4.2. Qualitative Findings on Mathematics Lecturers' Instructional Practices for Equity in Inclusive Classrooms

To complement the quantitative findings, responses from the open-ended questionnaire items were analyzed thematically to gain deeper insight into how mathematics lecturers implement instructional practices that promote equitable learning opportunities in inclusive classrooms. Three dominant themes emerged: *contextualization of mathematics*, *inclusive classroom norms*, and *challenges in leveraging diversity and collaboration*.

4.2.1. Contextualization of mathematical concepts

Consistent with the high mean scores reported for connecting mathematics to students' daily experiences, many participants described lecturers' frequent use of real-life examples when explaining mathematical concepts. Pre-service teachers noted that lecturers often related mathematics topics to everyday activities such as market transactions, transportation costs, and household budgeting. One student commented that "our lecturers often explain mathematical ideas using examples from the market or daily activities, which makes the lessons easier to understand" (S1, M). Similarly, a lecturer stated, "When teaching topics like percentages or ratios, I try to use examples from everyday life so students can see the relevance of mathematics" (L1, M). These responses reinforce the quantitative finding that contextualization is the most frequently practiced equitable instructional strategy.

4.2.2. Inclusive classroom norms

Participants also reported that many lecturers attempted to create inclusive classroom environments by encouraging student participation and respecting diverse viewpoints. Some pre-service teachers indicated that lecturers invited students to share their ideas during discussions and allowed multiple solution strategies when solving mathematical problems. For example, one respondent explained that “our lecturer encourages us to explain our answers and allows different methods to solve a problem” (S2, F). Such responses support the moderately high mean ratings observed for establishing inclusive classroom norms.

4.2.3. Challenges in leveraging diversity and collaboration

Despite the presence of inclusive participation strategies, several participants indicated that the use of students’ cultural diversity and structured peer collaboration was less common. Some pre-service teachers reported that group activities were occasionally assigned but not always effectively facilitated. One student remarked that “sometimes we are asked to work in groups, but the lecturer does not always guide the discussion, so a few students dominate” (S3, F). Another participant noted that cultural backgrounds were rarely integrated into mathematical discussions, stating that “lecturers sometimes mention local examples, but they do not often ask students to share experiences from their own communities” (S1, M). These qualitative insights provide further explanation for the lower mean ratings in the CELO domains of use of diversity and positioning students as mathematical resources, highlighting the challenges lecturers face in fully implementing culturally responsive and collaborative instructional practices. In summary, the qualitative findings corroborate the quantitative results by revealing that although mathematics lecturers frequently contextualize mathematics instruction and attempt to create inclusive classroom environments, the integration of cultural diversity and structured peer collaboration remained relatively limited.

4.3. Lecturer–Student Differences in Perceptions of CELO Practice Engagement

An independent samples *t*-test was used to compare lecturers’ and students’ mean ratings to determine whether their differences in perception were statistically significant. Table 2 shows the results of the independent samples *t*-test comparing lecturers’ and students’ perceptions of lecturers’ engagement in CELO practices.

Table 2

Independent Samples t-Test Results for Lecturers’ and Students’ Mean Ratings

CELO Category	Group	N	Mean	SD	<i>t</i> (<i>df</i>)	<i>p</i>
Use of students’ diversity for CELO	Lecturers	40	3.46	0.93	-5.30 (42)	<.001
	Students	480	2.67	0.45		
Establishing classroom norms for inclusivity	Lecturers	40	3.72	0.80	-1.75 (44)	.087
	Students	480	3.50	0.56		
Positioning students as mathematical resources	Lecturers	40	3.37	0.94	-2.70 (43)	.010
	Students	480	3.00	0.58		
Connecting content to students’ daily lives	Lecturers	40	4.22	0.52	0.59 (518)	.553
	Students	480	4.24	0.51		

Table 2 presents the results of the independent samples *t*-test comparing lecturers’ and students’ mean ratings of lecturers’ engagement in instructional practices aimed at creating equitable learning opportunities in inclusive mathematics classrooms. The results show that statistically significant differences existed in some, but not all, CELO categories. A statistically significant difference was found in the use of students’ diversity for CELO, with lecturers reporting higher levels of engagement ($M = 3.46$, $SD = 0.93$) than students ($M = 2.67$, $SD = 0.45$), $t(42) = -5.30$, $p < .001$. This result indicates a clear divergence in perception between the two groups, suggesting that lecturers view themselves as making greater use of students’ diverse backgrounds and experiences than students perceive in classroom practice. For establishing

classroom norms for inclusivity, the difference between lecturers' ratings ($M = 3.72$, $SD = 0.80$) and students' ratings ($M = 3.50$, $SD = 0.56$) was not statistically significant, $t(44) = -1.75$, $p = .087$. This finding suggests that both groups held broadly similar perceptions regarding lecturers' efforts to establish inclusive classroom norms.

A statistically significant difference was also observed in positioning students as mathematical resources, where lecturers again rated their engagement higher ($M = 3.37$, $SD = 0.94$) than students ($M = 3.00$, $SD = 0.58$), $t(43) = -2.70$, $p = .010$. This result implies that lecturers may perceive themselves as using peer interaction and collaborative learning opportunities more frequently than students actually experience them. In contrast, connecting content to students' daily lives showed no statistically significant difference between lecturers ($M = 4.22$, $SD = 0.52$) and students ($M = 4.24$, $SD = 0.51$), $t(518) = 0.59$, $p = .553$. The close similarity in mean scores indicates strong agreement between the two groups that lecturers frequently relate mathematical content to students' everyday experiences. This category also recorded the highest mean ratings overall, suggesting that contextualization is the most visible and consistently recognized CELO practice.

The findings indicate that lecturers and students differed significantly in their perceptions of lecturers' engagement in two CELO practices: using students' diversity and positioning students as mathematical resources. However, no significant differences were found for establishing classroom norms for inclusivity and connecting content to students' daily lives. These results suggest that while some equity-oriented instructional practices are similarly recognized by both groups, others are perceived more positively by lecturers than by students, pointing to possible gaps between instructional intention and student experience.

The quantitative findings indicate that mathematics lecturers demonstrate moderate to high engagement in practices that promote equitable learning opportunities in inclusive classrooms. The overall mean scores reported by lecturers ($M = 3.73$) and students ($M = 3.41$) suggest that while lecturers perceive themselves as actively implementing equity-oriented instructional practices, students experience these practices at a slightly lower level. This difference reflects the complexity of translating inclusive pedagogical intentions into observable classroom experiences. In particular, the relatively lower mean scores recorded for the use of students' diversity and peer collaboration practices suggest that lecturers may prioritize content delivery and contextualization over participatory instructional strategies that explicitly leverage learners' diverse backgrounds. Qualitative responses further illuminate these patterns. Several pre-service teachers noted that lecturers frequently provide real-life examples to explain mathematical concepts but rarely invite students to share culturally grounded problem-solving approaches. One respondent noted that although group work occasionally occurs, it is not always structured to ensure that every learner contributes meaningfully. These insights indicate that while lecturers recognize the importance of inclusive teaching, structural factors such as large class sizes, time constraints, and rigid curriculum expectations may limit the full implementation of equitable instructional practices.

5. Discussion

The purpose of this study was to examine how mathematics lecturers in Ghanaian Colleges of Education engage in instructional practices that promote Creating Equitable Learning Opportunities in inclusive mathematics classrooms. Specifically, the study explored the types of instructional practices lecturers employ and the frequency with which they engage in these practices. The findings are discussed in relation to the theoretical frameworks underpinning the study, existing empirical literature, and the broader goals of equity and inclusion in mathematics education.

5.1. Engagement in Instructional Practices for CELO

The findings revealed that mathematics lecturers in Ghanaian Colleges of Education engage in several instructional practices that support equitable learning opportunities, particularly practices that connect mathematical concepts to students' everyday experiences and real-life contexts. This dimension recorded the highest mean scores among both lecturers and pre-service teachers,

indicating that contextualization represents the most visible and frequently implemented equity-oriented strategy in mathematics instruction.

This result is consistent with the principles of Culturally Responsive Pedagogy, which emphasizes the importance of linking academic content to learners' cultural and social experiences in order to enhance engagement and understanding (Bartell et al., 2017; Ladson-Billings, 1995). When mathematical concepts are situated within familiar contexts, learners are better able to relate abstract ideas to their lived realities, thereby strengthening conceptual understanding and participation. Similar findings have been reported in recent studies showing that the use of real-world contexts in mathematics instruction enhances engagement and improves learning outcomes among diverse student populations (Abdulrahim & Orosco, 2020; Li et al., 2025). In addition, Askew (2015) argued that contextualized teaching promotes a sense of belonging in mathematics classrooms, which is an essential condition for equitable participation.

Despite this positive trend, the study revealed relatively low engagement in instructional practices that actively leverage students' diversity or position learners as resources in the learning process. In other words, while lecturers often make mathematics relevant to students' lives, they less frequently restructure classroom interactions in ways that allow students to contribute their diverse perspectives, experiences, and ways of thinking to the learning process. This finding suggests that equitable teaching practices in the Ghanaian context may still be largely teacher-centered, with limited opportunities for collaborative knowledge construction.

This observation aligns with previous studies conducted within the Ghanaian education system. For instance, Nketsia (2016) reported that teacher educators often face challenges implementing inclusive pedagogies due to structural factors such as large class sizes, rigid curricula, and limited professional preparation in inclusive instructional strategies. Similarly, Buabeng and Amo-Darko (2025) found that although teacher educators acknowledge the importance of inclusive education policies, translating these policies into classroom practice remains difficult due to institutional and pedagogical constraints.

From the perspective of Social Justice Theory, equitable mathematics instruction requires more than improving access to learning materials or contextualizing content. It also involves redistributing power within the classroom by enabling all learners to actively participate in mathematical reasoning and decision-making processes. Scholars in mathematics education argue that equitable teaching must create spaces where students' voices, experiences, and identities are recognized as legitimate contributors to mathematical knowledge (Aguirre et al., 2013; Gutiérrez, 2009). The relatively low engagement in diversity-based practices observed in this study therefore suggests that lecturers may be achieving partial equity by improving accessibility but may not yet be fully transforming classroom power relations to support participatory and collaborative learning environments.

5.2. Frequency and Perception of Engagement

The results of the independent samples t-test revealed significant differences between lecturers' and pre-service teachers' perceptions in two CELO categories: the use of students' diversity and peer collaboration as mathematical resources. In both cases, lecturers rated their level of engagement higher than students did, indicating the presence of a perception gap between teaching intentions and students' classroom experiences.

Such discrepancies between teachers' self-perceptions and students' experiences have been documented in previous educational research. Benmer (2022), for example, found that teachers often perceive their classrooms as more inclusive than students report experiencing them. This gap may arise because instructors evaluate their practices based on intentions or planned strategies, whereas students evaluate inclusivity based on their lived classroom experiences. Without systematic opportunities for feedback or reflective practice, educators may remain unaware of these differences in perception.

Another possible explanation for this perception gap is the tendency to equate equity with fairness in treatment rather than differentiated instructional support. Muñoz (2020) noted that

educators frequently interpret equitable teaching as treating all students equally, rather than adapting instruction to address diverse needs and learning styles. Consequently, practices that genuinely promote equitable participation such as collaborative problem solving, peer explanation, and culturally grounded discussions may not be implemented consistently.

Interestingly, both lecturers and students reported similarly high levels of engagement in the practice of connecting mathematics to real-life experiences. The absence of a significant difference in this category suggests that students clearly recognize lecturers' efforts to contextualize mathematical concepts. This convergence highlights contextualization as a particularly strong component of equitable mathematics teaching within the Ghanaian Colleges of Education.

Nevertheless, the overall findings indicate that lecturers' engagement in CELO practices remains moderate. This result aligns with earlier research suggesting that teachers in inclusive classrooms often experience difficulty implementing equity-focused pedagogies consistently due to limited training and insufficient institutional support (DeSimone & Parmar, 2006; Sabella, 2015). These findings suggest that although lecturers demonstrate awareness of inclusive teaching strategies, sustained professional development and institutional support may be necessary to strengthen the implementation of equitable instructional practices.

5.3. Relationship to Theoretical Frameworks

The findings of this study provide empirical support for the theoretical perspectives underpinning the research, particularly Social Justice Theory and Culturally Responsive Pedagogy.

From a social justice perspective, equitable education requires addressing structural and pedagogical barriers that restrict participation and achievement for marginalized learners (Gutiérrez, 2009). While the lecturers in this study demonstrated efforts to create inclusive learning environments through contextualized instruction, systemic constraints such as rigid curricula and limited institutional flexibility appear to hinder the full realization of equitable teaching practices. These constraints highlight the importance of institutional and policy-level support in promoting socially just mathematics education.

With respect to Culturally Responsive Pedagogy, the findings suggest partial implementation of its central principles. The frequent use of real-life examples indicates that lecturers recognize the importance of connecting mathematics to students' experiences. However, the limited integration of students' cultural, linguistic, and experiential diversity into classroom discussions suggests that the broader transformative potential of culturally responsive teaching has not yet been fully realized. Previous studies have emphasized that effective culturally responsive teaching involves not only contextualizing content but also validating students' identities and positioning them as active contributors to the learning process (Aguirre et al., 2013; Bartell et al., 2017).

Taken together, these findings indicate that while mathematics lecturers in Ghanaian Colleges of Education are taking important steps toward equitable instruction, further efforts are needed to deepen the integration of inclusive pedagogical strategies. Strengthening collaborative learning opportunities, encouraging student voice, and leveraging cultural diversity as a learning resource could significantly enhance the implementation of equitable mathematics education.

5.4. Comparison with Previous Studies

The findings of this study both converge with and diverge from previous empirical research on equitable mathematics instruction. Consistent with earlier studies, the strong emphasis on contextualizing mathematical concepts within real-life situations aligns with research demonstrating that practical applications of mathematics enhance student engagement and support inclusive learning environments (Li et al., 2025). Similarly, the moderate overall implementation of inclusive practices reflects findings from Ghanaian studies indicating that although teacher educators recognize the importance of inclusive education policies, practical implementation remains constrained by institutional and structural factors (Buabeng & Amo-Darko, 2021; Nketsia, 2016).

The influence of structural barriers such as overloaded curricula and limited instructional

flexibility also reflects broader systemic challenges identified in teacher education research. Reyes (2025), for example, argued that highly prescriptive teacher education systems often restrict educators' ability to implement innovative or inclusive pedagogical approaches.

At the same time, some findings diverge from those reported in other contexts. For instance, Benmer (2022) found relatively high implementation of equitable teaching practices among teachers in the Philippines, whereas the present study identified only moderate engagement among Ghanaian lecturers. These differences may reflect variations in institutional support, professional development opportunities, and resource availability across educational systems. Furthermore, while previous research has highlighted teachers' active positioning of students as capable mathematical thinkers (Bartell et al., 2017), the current findings suggest that this practice remains relatively limited in the Ghanaian teacher education context.

Overall, these similarities and differences underscore the importance of examining equitable mathematics instruction within specific socio-cultural and institutional contexts.

6. Conclusion

The study investigated mathematics lecturers' engagement in instructional practices for creating equitable learning opportunities in inclusive mathematics classrooms across Colleges of Education in Ghana. The findings reveal that lecturers demonstrate strong engagement in contextualizing mathematical concepts through real-life examples, indicating growing awareness of culturally responsive teaching practices. However, practices that leverage students' cultural diversity and promote collaborative peer learning were implemented less frequently. These results highlight the need for deeper integration of inclusive pedagogical strategies within mathematics teacher education.

The study contributes to the growing body of research on equity and inclusion in mathematics education by providing empirical evidence from a sub-Saharan African teacher education context. By operationalizing the CELO framework within Ghanaian Colleges of Education, the study demonstrates how equity-oriented teaching practices can be assessed and strengthened in teacher preparation programs. The findings suggest that enhancing lecturers' capacity for inclusive instruction requires institutional support, flexible curricula, and sustained professional development.

Within the scope of journals focusing on mathematics education, teacher education, and inclusive pedagogy, this study provides important insights into how teacher educators model equitable teaching practices for future mathematics teachers. As teacher education institutions play a critical role in shaping classroom practices, strengthening inclusive instructional approaches at this level has significant implications for improving equity and participation in mathematics learning across the broader education system.

7. Theoretical Implications

The findings of this study offer important implications for theory, practice, and policy in the promotion of equitable learning opportunities in mathematics teacher education. These implications are grounded in the empirical results of the study, particularly the moderate implementation of CELO practices, the strong emphasis on contextualizing mathematics through real-life experiences, and the perception gaps identified between lecturers and pre-service teachers. Collectively, these insights contribute to ongoing scholarly and policy discussions on advancing equity, inclusion, and digital justice in education, which aligns with the scope of the journal.

From a theoretical perspective, the study extends the application of Social Justice Theory and Culturally Responsive Pedagogy within the context of sub-Saharan African mathematics teacher education. The findings demonstrate that while lecturers attempt to contextualize mathematical concepts using real-life examples, the integration of students' cultural, linguistic, and experiential diversity remains limited. This suggests that the enactment of culturally responsive pedagogy may often remain at a surface level, emphasizing contextual relevance without fully incorporating learners' identities and experiences into mathematical reasoning and classroom discourse.

Consequently, the study contributes to theoretical discussions by highlighting how equity-oriented pedagogical frameworks are interpreted and implemented within resource-constrained educational contexts. It also suggests that effective equitable pedagogy requires balancing contextualized instruction with participatory classroom structures that empower learners to contribute actively to knowledge construction.

In terms of pedagogical practice, the findings highlight the need for mathematics lecturers to strengthen instructional strategies that actively engage students as contributors to the learning process. Although the study found high levels of engagement in connecting mathematical concepts to students' everyday experiences, practices that leverage students' diversity and promote peer collaboration were implemented less frequently. Mathematics lecturers should therefore move beyond contextualizing mathematical content and intentionally design learning activities that incorporate students' cultural and experiential backgrounds. Strategies such as culturally relevant problem-solving tasks, collaborative learning structures, and student-led mathematical discussions can help transform classrooms into inclusive spaces where diverse perspectives are recognized as valuable resources for learning.

The perception gaps identified between lecturers and students also point to the importance of reflective teaching practices. Lecturers may benefit from engaging in systematic feedback processes that allow them to better understand how their instructional approaches are experienced by students. Mechanisms such as peer observation, student evaluations, and reflective teaching portfolios can support lecturers in identifying areas where inclusive practices may need further strengthening. Through reflective practice, lecturers can better align their instructional intentions with students' classroom experiences, thereby enhancing equitable participation in mathematics learning.

At the institutional and policy levels, the findings suggest the need for stronger structural support for inclusive teaching practices in Colleges of Education. Teacher education institutions should integrate inclusive pedagogy as a core professional competency within lecturer development programs and performance evaluation systems. Continuous professional development initiatives that focus on equity-oriented teaching strategies, collaborative learning, and inclusive classroom management can help lecturers develop the skills necessary to support diverse learners effectively.

In addition, curriculum structures within teacher education programs should provide greater flexibility to allow lecturers to adapt instructional approaches to the needs of diverse learners. Rigid curriculum frameworks may limit opportunities for lecturers to implement innovative or culturally responsive teaching strategies. Institutional policies that encourage pedagogical experimentation and reflective teaching practices can therefore play an important role in advancing equitable learning environments.

Finally, the study highlights the importance of aligning teacher education reforms with broader national and global educational priorities, including Sustainable Development Goal 4 (SDG 4), which emphasizes inclusive and equitable quality education for all learners. Strengthening equitable instructional practices in mathematics teacher education contributes not only to improving classroom learning experiences but also to preparing future teachers who can promote equity, inclusion, and digital justice within their own classrooms. As such, the findings underscore the critical role of teacher education institutions in shaping more inclusive and socially just educational systems.

8. Recommendations for Future Research

Future research may extend the present study in several important ways. First, researchers could adopt mixed-methods designs to examine not only the extent of lecturers' engagement in creating equitable learning opportunities practices but also the beliefs, experiences, and contextual factors that shape such instructional decisions. Such approaches would provide a deeper understanding of how equity-oriented practices are interpreted and enacted in inclusive mathematics classrooms. Second, longitudinal studies would be valuable in examining how lecturers' equitable teaching

practices develop over time, particularly in response to professional development initiatives and institutional support. Third, comparative research across regions, institutions, or subject areas could offer broader insights into how equity and inclusion are understood and implemented in different teacher education contexts within Ghana and beyond. Finally, further studies could investigate pre-service teachers' self-efficacy and readiness to apply equitable instructional strategies in their own future classrooms, thereby extending the focus from lecturers' practices to the potential influence of CELO on teaching preparedness and educational outcomes.

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