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Culturally Responsive Pedagogy in Mathematics: Effects on Achievement, Engagement, Perceptions and Attitudes of SHS Students in Ghana

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ABSTRACT

Purpose – This study investigates the influence of Culturally Responsive Pedagogy (CRP) on senior high school students' achievement, engagement, attitudes, and perceptions in mathematics within the Ghanaian context. CRP, though widely studied in literacy, remains underexplored in mathematics education, particularly in African settings.

Methodology – A quasi-experimental design with a non-equivalent groups approach was adopted. A purposive sample of 79 students from Wa Senior High School was divided into control and intervention groups. Over four weeks, the intervention group received mathematics instruction on simultaneous equations using CRP strategies, while the control group was taught with conventional methods. Data were collected through pre- and post-tests, a four-point Likert-type engagement scale, and validated attitude and perception questionnaires (α = 0.74–0.91). Independent sample t-tests were used for analysis.

Findings – Results revealed that students exposed to CRP significantly outperformed their peers in mathematics achievement and demonstrated higher levels of behavioral engagement. Participants in the CRP group also reported lessons as more inclusive and culturally relatable, with positive effects on attitudes and perceptions toward mathematics. These findings affirm the potential of CRP to enhance both academic and affective learning outcomes by situating content within students' sociocultural realities.

Novelty – This study extends CRP research into mathematics, providing empirical evidence from an under-researched African context. It highlights how integrating culture into mathematics pedagogy can promote equity, relevance, and learner-centered instruction.

Significance – The study is relevant for mathematics teachers, curriculum developers, policymakers, and teacher educators seeking to design inclusive pedagogical approaches that strengthen equity and achievement in mathematics.

Keywords: Attitudes; Achievement; Culturally responsive pedagogy; Engagement; Perceptions.

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1. Introduction

Over the years, mathematics has been widely acknowledged as a cornerstone of scientific and technological advancement. However, it remains one of the most challenging subjects for students, particularly at the senior high school (SHS) level in Ghana. Numerous studies **(**Davis & Abass, 2023; Essien, & Davis, 2024; Apawu, Owusu Ansah & Akayuure, 2018; Brantuo, Atta, Klu, & Amoako Atta, 2023; Goka, Assuah, & Owu-Annan, 2023) have documented persistent underachievement in mathematics among Ghanaian students, often accompanied by low engagement and negative attitudes toward the subject. Despite efforts such as curriculum reforms, teacher professional development programs, and the national emphasis on STEM education, these issues continue to prevail. Scholars have argued that such interventions largely focus on content delivery, neglecting the contextual and cultural dynamics that shape students' learning experiences (Gay, 2010; Nyantah et al., 2025; Kania, 2024; Darmayanti et al., 2024; Kyaruzi, 2024; Odoom et al., 2024). As a result, there is growing recognition that improving mathematics outcomes requires not only methodological innovation but also pedagogical approaches that are culturally responsive.

Culturally responsive pedagogy (CRP) emphasizes instructional relevance by connecting content to students' lived experiences, identities, and communities. Research indicates that integrating CRP with inquiry-based strategies can foster deeper engagement and promote critical thinking by encouraging students to justify, reflect, and evaluate mathematical solutions collaboratively (Akendita et al., 2025; Angraini et al., 2024)**.** However, despite the global discourse on CRP, empirical studies examining its application in Ghanaian SHS mathematics classrooms are scarce. This study is the first to empirically explore the integration of CRP in SHS mathematics instruction in Ghana, offering a context-specific pedagogical model tailored to the needs of culturally diverse learners. While the importance of Culturally Responsive Pedagogy (CRP) is well-documented in theory, its foundational principles demand deeper contextual application.

Culturally Responsive Pedagogy (CRP) is grounded in the principle that effective teaching must acknowledge, respect, and incorporate students' cultural identities and lived experiences into all aspects of learning (Gay, 2010; Lavín et al., 2025). It stems from the broader framework of constructivist learning theories, particularly Vygotsky's sociocultural theory, which posits that learning is socially mediated and deeply influenced by the cultural context of the learner (Vygotsky, 1978). CRP, therefore, challenges traditional, one-size-fits-all teaching models by emphasizing that students are not blank slates but bring valuable cultural knowledge and cognitive schemas into the classroom (Nieto & Bode, 2018;Maamin et al., 2020). By intentionally connecting academic content to students' backgrounds, CRP enhances motivation, sense of belonging, and relevance, particularly among historically marginalized or underperforming groups.

In mathematics education, CRP encourages the use of culturally contextualized problems, inclusive discourse strategies, and collaborative learning environments where students can share and interrogate multiple perspectives (Ladson-billings & Ladson-billings, 2016)**.** This approach has been shown to foster both procedural fluency and conceptual understanding by making abstract content more tangible and personally meaningful. When integrated with inquiry-based strategies, CRP promotes active student engagement, encourages higher-order thinking, and supports metacognitive development, particularly in problem-solving tasks (Ladson-billings, 2021)**.** It reframes the classroom as a space where

learners' identities are affirmed, not erased, and where academic excellence is pursued without cultural assimilation.

Furthermore, scholars have noted that CRP empowers students by repositioning them as co-constructors of knowledge, rather than passive recipients (Banks, 2016; Paris & Alim, 2017). This is particularly critical in mathematics, where learners often feel disengaged due to abstract and context-detached instruction. CRP allows educators to draw from students' home languages, local histories, and community practices, thereby making mathematics instruction both rigorous and relevant (Ladson-billings, 2012; Martin & Mulvihill, 2021). In essence, the theoretical strength of CRP lies in its dual function as both a culturally affirming and intellectually demanding pedagogy—equipping learners with the tools to succeed academically while honoring who they are. Although the theoretical foundations are clear, evidence from other countries highlights how CRP improves educational outcomes when applied in diverse classrooms.

A growing body of international research underscores the effectiveness of Culturally Responsive Pedagogy (CRP) in improving student engagement, academic performance, and critical thinking, particularly in multicultural and multilingual learning environments. In the United States, for instance, studies have shown that when teachers employ CRP strategies—such as integrating culturally relevant examples and validating students' cultural backgrounds—learners demonstrate improved academic motivation, self-efficacy, and deeper cognitive engagement (Gay, 2010; Ladson-billings & Ladson-billings, 2016). Similar trends have been reported in Asian educational contexts like Malaysia and Indonesia, where culturally inclusive teaching practices have led to measurable gains in mathematics understanding and critical reasoning (Silva et al., 2017) These findings are echoed in European settings as well, where culturally adapted instruction has contributed to narrowing achievement gaps among immigrant and minority students (Banks & Banks, 2019). Despite this promising international evidence, sub-Saharan Africa—particularly in the domain of mathematics education—remains underrepresented in the empirical CRP literature. Most pedagogical research in African contexts continues to focus on curriculum delivery, infrastructure, or teacher qualification, often overlooking the socio-cultural dimensions that shape students' learning processes (Akyeampong, 2017; Sheromova et al., 2020;Wah et al., 2019; Akpalu et al., 2018). In Ghana, for example, CRP is more often discussed as a theoretical ideal than as a practical or research-backed instructional model. The lack of localized empirical studies has left a significant gap in understanding how culturally responsive approaches might be tailored to address persistent challenges in student achievement, especially in mathematics classrooms that serve diverse ethnic and linguistic populations. This underscores an urgent need for context-specific research that explores how CRP can be operationalized and evaluated within African educational systems. However, such evidence is notably scarce in African contexts, where cultural diversity in education is equally prominent but underexplored.

In Ghana's educational system, cultural diversity is often treated as a challenge rather than a valuable asset in instructional design, particularly in mathematics classrooms. At the senior high school (SHS) level, teaching remains heavily reliant on examination-driven, lecture-based methods that prioritize rote memorization over conceptual understanding. These traditional practices overlook the rich cultural backgrounds and lived experiences that students bring into the learning environment. Although the National Teacher Education Curriculum Framework (NTECF, 2018) advocates inclusive and differentiated pedagogy, the implementation of culturally responsive approaches remains largely superficial. Contributing factors include limited teacher preparation on CRP principles, the absence of culturally relevant teaching materials, and a dearth of localized models that reflect the Ghanaian context.

This disconnect is particularly pronounced in the Upper West Region, where high levels of cultural and linguistic diversity converge with persistent educational disparities and widespread underperformance in mathematics (Hunter, 2021; Mette et al., 2016).

Despite numerous government-led initiatives—such as the 2005 Educational Reforms, the Persons with Disability Act (2006), and the Free Compulsory Universal Basic Education (FCUBE) program—structural barriers continue to hinder equitable and effective mathematics instruction in Ghana. While these reforms have primarily focused on expanding access and promoting educational equity at the policy level, they have not adequately transformed the everyday instructional realities within mathematics classrooms. Both the National Council for Curriculum and Assessment (NaCCA) and the West African Examinations Council (WAEC) have recently expressed growing concern over consistently poor student performance in mathematics. NaCCA, in its curriculum evaluations, observes that the shift to competency-based reforms has not yet translated into tangible academic gains, particularly in critical thinking and problem-solving. Similarly, WAEC reports have highlighted alarming trends in mathematics failure rates in the West African Senior School Certificate Examination (WASSCE). In 2023, for instance, results for private candidates revealed that 26.94% failed core mathematics (F9), while another 26.08% scored below credit (D7–E8), leaving only 44.95% with a pass (A1–C6). The trend was consistent in previous years: in 2022, the failure rate stood at 23.84%, and in 2021, 45% of candidates failed, with only 55% achieving a passing grade.

Although Ghana's School based WASSCE core mathematics results show a slight improvement—from 54.11% in 2021 to 61.39% in 2022 and 62.23% in 2023—these marginal gains fall short of addressing the deeper, systemic issues plaguing mathematics education. The incremental rise in pass rates may appear encouraging on the surface, but they obscure a more troubling reality: students continue to demonstrate weak conceptual understanding, limited problem-solving skills, and a heavy reliance on rote memorization. WAEC Chief Examiners have consistently flagged recurring difficulties with interpreting graphs, applying mathematical reasoning to real-life scenarios (e.g., time-distance problems or financial literacy), and properly using diagrams and units. These challenges indicate that most students are not truly mastering mathematical concepts, but rather navigating assessments through procedural recall.

This trend suggests that what the nation needs is not just slight numerical improvements in pass rates, but a fundamental transformation in the quality and relevance of mathematics instruction (Kania, Kusumah, et al., 2024). As long as outdated, exam-driven teaching methods dominate classrooms—failing to connect mathematics to students' cultural and daily realities—performance gains will remain superficial and unsustainable. Without pedagogical reforms that cultivate critical thinking, conceptual depth, and cultural responsiveness, Ghana risks producing students who can pass exams but lack the mathematical literacy required for higher education, innovation, and real-world problem-solving. The nation must move beyond incremental statistical gains and invest in instructional quality that meaningfully prepares students for a complex and numerate world.

The underlying issue lies not merely in curriculum content, but in how instruction is delivered and made relevant to learners(Howard, 2011;Warren, 2017; Ragoonaden & Mueller, 2017). This is where Culturally Responsive Pedagogy (CRP) holds transformative potential. By embedding students' cultural backgrounds, local contexts, and personal experiences into mathematics instruction, CRP fosters deeper engagement, greater motivation, and more effective learning. It offers a pedagogical shift that can bridge the persistent gap between curriculum expectations and student realities, making mathematics not only accessible but

meaningful. Thus, adopting CRP is not just a theoretical proposition; it is a necessary strategy for overcoming the entrenched educational challenges that Ghana's SHS mathematics classrooms continue to face. In particular, Ghana lacks sufficient empirical studies that examine how CRP can be adapted to its unique cultural and educational landscape.

This study emerges from a growing concern over the persistent disconnect between students' cultural realities and the instructional approaches commonly used in mathematics classrooms. Although mathematics is widely recognized as a foundational discipline essential for success in both academic and everyday life (Hoyles, 2018; Boadu, 2024; Gist et al., 2019) many students in Ghana's Upper West Region continue to face challenges such as low achievement, limited engagement, and unfavorable attitudes toward the subject. Research has consistently indicated that students struggle to make sense of word problems, often finding it difficult to convert them into mathematical expressions due to instruction that remains abstract, decontextualized, and detached from their lived experiences (Eviyanti et al., 2017; Hendriana et al., 2018; Nurlinda et al., 2024). While previous studies have explored the influence of factors like parental involvement and institutional support (Hill et al., 2021), relatively little attention has been given to the role of instructional misalignment—specifically, the lack of culturally relevant pedagogies. In response to this gap, the current study seeks to explore the effectiveness of Culturally Responsive Pedagogy (CRP) in improving senior high school students' achievement, engagement, attitudes, and perceptions in mathematics. By developing and testing a context-specific instructional model grounded in CRP principles, this study represents the first empirical effort to examine the integration of CRP in Ghanaian SHS mathematics classrooms. Ultimately, it offers a culturally situated, evidence-based framework aimed at making mathematics instruction more inclusive, engaging, and effective across diverse educational environments. Therefore, this study aims to develop an empirically test a culturally responsive pedagogical model to improve mathematics achievement, engagement, attitudes, and perceptions among SHS students in Ghana's Upper West Region. This gap forms the basis for the current study, which aims to investigate CRP's relevance and impact within the Ghanaian context through well-defined research objectives.

Objectives for this study; (1) To examine the impact of culturally responsive pedagogy on SHS students' engagement in mathematics in the Upper West Region of Ghana; (2) To analyze students' attitudes towards culturally responsive teaching methods in mathematics education; (3) To explore students' perceptions regarding the implementation of culturally responsive pedagogy in mathematics education; (4) To assess the effect of culturally responsive pedagogy on SHS students' achievement in mathematics.

Research Questions for this study; (1) What is the impact of culturally responsive pedagogy on SHS students' engagement in mathematics?; (2) What are students' attitudes towards culturally responsive teaching methods in mathematics education?; (3) What are students' perceptions of the implementation of culturally responsive pedagogy in mathematics education?; and (4) What is the effect of culturally responsive pedagogy on SHS students' achievement in mathematics?

2. Methods

The study adopts a positivist research paradigm and employs a quasi-experimental, non-equivalent groups design, which is methodologically appropriate for evaluating the causal impact of an educational intervention when random assignment is not feasible(Boadu, 2024). This design is particularly justified in the Ghanaian SHS context, especially in rural and under-resourced regions such as the Upper West Region, where logistical, ethical, and administrative constraints make randomized controlled trials impractical. Schools in such settings often have

fixed classroom groupings and rigid timetables, limiting the possibility of reshuffling students purely for research purposes. The quasi-experimental approach allows for the comparison of a control and an intervention group—matched as closely as possible—while still preserving the natural classroom structure (Creswell, 2018). By administering both pre-tests and post-tests, this design enables a robust estimation of the intervention's effect, while controlling for baseline differences.

The population for this study consisted of Form 3 students at Wa Senior High School in Ghana's Upper West Region, with a total cohort of 763 students. A purposive sampling technique was employed to select 79 participants from this population based on their educational track and readiness to engage with the intervention (Areepattamannil, & Caleon, 2013)**.** The inclusion criteria focused specifically on Form 3 science students, as these learners have had substantial exposure to core mathematics topics—particularly algebra and simultaneous equations—and are nearing completion of the mathematics curriculum. This makes them well-positioned to evaluate the impact of the culturally responsive pedagogy (CRP) intervention. Additional criteria for inclusion were: (a) consistent attendance in mathematics classes, (b) willingness to participate in both the pre- and post-intervention assessments, and (c) proficiency in reading and responding to written mathematics problems. Students were excluded if they had irregular attendance, non-science student, had not completed the mathematics syllabus up to the intervention topic, or required special educational accommodations outside the scope of the study. In Ghana's educational context, purposive sampling is well-suited for studies requiring participants with specific academic exposure and cultural insight, ensuring the reliability and relevance of findings to the target instructional context.

Two main instruments were employed for data collection. The first was the Culturally Responsive Pedagogy Evaluation Questionnaire (CRPEQ), a researcher-developed tool consisting of 33 Likert-scale items distributed across three key constructs: Students' Engagement in Culturally Responsive Pedagogy (10 items), Students' Attitudes toward Culturally Responsive Pedagogy (13 items), and Students' Perceptions of Culturally Responsive Pedagogy (10 items). The instrument was designed to align with the sociocultural realities of Ghanaian classrooms, particularly in rural and culturally diverse contexts such as the Upper West Region.

Item generation was guided by existing literature on culturally responsive teaching (Gay, 2010; Whitaker & Valtierra, 2018) and adapted to reflect local cultural elements, language norms, and educational experiences. The initial draft underwent expert review by three College of Education mathematics teachers and two university lecturers in mathematics education to establish content validity and contextual relevance. A pilot study involving 30 students from Queen of Peace SHS was conducted to assess item clarity, internal consistency, and response variability (Tavakol & Dennick, 2011). Based on this pilot, minor revisions were made to improve readability and cultural appropriateness. Reliability analysis conducted on the pilot sample yielded acceptable internal consistency scores: Engagement ($\alpha = 0.82$), Attitude ($\alpha = 0.79$), CRPEQ ($\alpha = 0.87$), and Perception ($\alpha = 0.85$**),** indicating that the instrument was suitable for use in the main study (Cronbach's Alpha,1951).

The second instrument was an Achievement Test comprising 21 items: 11 items for the pre-test and 10 items for the post-test. These items were constructed in alignment with the Ghana Education Service (GES) core mathematics syllabus, specifically targeting the topic of simultaneous equations (Ministry of Education, 2010). To ensure content validity and cultural relevance, the test items were reviewed by three experienced SHS mathematics teachers familiar with the curriculum and local classroom contexts. The test measured conceptual

understanding, procedural fluency, and the ability to apply knowledge to culturally familiar word problems. Items were reviewed for difficulty balance, clarity, and alignment with the intended learning outcomes. Although reliability for the test was not formally computed, the instrument's face and content validity were affirmed through expert judgment.

2.1. Data Collection

The data collection process spanned a 4-week intervention period, during which culturally responsive teaching strategies were systematically implemented in mathematics instruction. This timeline aligns with a typical SHS academic calendar in Ghana, ensuring minimal disruption to normal school activities. To ensure instructional fidelity and consistency, the researcher personally facilitated both the intervention and control group sessions, thereby standardizing the quality of instruction across groups. Each mathematics lesson lasted 50 minutes, allowing sufficient time for concept explanation, student interaction, and reflective engagement. The intervention lessons incorporated culturally familiar examples, language references, community-based contexts, and collaborative problem-solving rooted in local practices. For instance, simultaneous equations were taught using culturally relevant scenarios such as calculating the cost of local farm produce or market goods, where students solve for unknown prices based on total costs. Such an approach is particularly impactful in the Upper West Region, where learners often perform better when educational content resonates with their daily lives and environment.

Week 1: Preparation and Initial Assessment

Collected information about students' cultural backgrounds, interests, and experiences through informal discussions. I examine the existing curriculum and identify opportunities to incorporate cultural relevance into lessons on simultaneous equations. I define objectives for the intervention, including how to integrate cultural contexts into the lesson on simultaneous equations.

Week 2: Introduction of Culturally Relevant Content

Developed lesson plans that incorporate culturally relevant scenarios for simultaneous equations. I used local market scenarios, traditional events, and community issues. I introduced the first culturally relevant lesson on simultaneous equations. I provided context and explained how the cultural scenario applies to the mathematical concepts. I Facilitated group activities where I asked students to solve problems based on culturally relevant scenarios and discuss their approaches and solutions.

Week 3: Deepening Understanding and Interaction

Continued with additional lessons that I used different cultural contexts to explore various aspects of simultaneous equations. I incorporated student feedback from previous lessons. I also held class discussions to explore students' insights and experiences related to the cultural scenarios used. I encouraged students to share their personal connections. I provided additional support for students who needed help with understanding the concepts or relating them to the cultural contexts. I also used manipulatives and visual aids as needed.

Week 4: Evaluation and Reflection

During the 4-week intervention period, implemented a systematic cycle of formative assessment and reflective practice to ensure the effectiveness of the culturally responsive pedagogy (CRP) in mathematics instruction. I conducted quizzes and assigned take-home tasks that directly tested students' understanding of simultaneous equations through the culturally relevant scenarios used in the lessons. These assessments served as a means of

checking for conceptual clarity and transfer of learning, consistent with the principles of culturally responsive assessment (Gay, 2010).

Additionally, collected qualitative feedback from students regarding their experiences with the culturally responsive lessons. This was crucial in amplifying student voice, a core element of CRP that recognises learners as active contributors to the teaching and learning process (Ladson-Billings, 2009). Gathering their perspectives enabled me to determine how well the intervention aligned with their cultural frames of reference and whether it fostered inclusivity and engagement.

This study analyzed the impact of these culturally grounded examples on students' academic engagement and comprehension, examining whether the contextualization of mathematical problems improved participation, relevance, and reasoning. This process aligns with constructivist learning theory, which posits that students learn best when content is meaningful and connected to their lived experiences (Vygotsky, 1978). As part of reflective teaching practice, I assessed the effectiveness of the CRP strategies employed, using both student performance data and their feedback. Based on this analysis, I adapted subsequent lesson plans, demonstrating instructional responsiveness and ongoing commitment to differentiated instruction (Tomlinson, 2001).

This study shared emerging insights and best practices with mathematics colleagues in my school, contributing to professional learning and promoting teacher collaboration, which is essential for the sustainable implementation of innovative pedagogical models (Darling-Hammond et al., 2017). This comprehensive, researcher-led implementation allowed for coherent preparation, delivery, monitoring, and evaluation of culturally responsive mathematics instruction. Conducting the intervention personally ensured fidelity of implementation, a key consideration in quasi-experimental designs where the consistency of instructional delivery is critical for internal validity.

2.2. Data Analysis

Data were collected using the Culturally Responsive Pedagogy Evaluation Questionnaire (CRPEQ) and the mathematics achievement test. The analysis was conducted using SPSS version 23 employing both descriptive and inferential statistical methods to assess the effectiveness of the intervention. The positivist research paradigm justifies the use of these quantitative techniques, enabling objective measurement and comparison **of** outcomes (Creswell, 2018). Descriptive statistics, such as frequency counts and percentages, were used to summarize categorical responses from the CRPEQ. These metrics provided a detailed overview of students' engagement, attitudes, and perceptions, helping to identify patterns across cultural constructs and offering insights into specific pedagogical strengths and areas needing improvement. This descriptive approach is particularly relevant in the Ghanaian context, where nuanced interpretation of survey data can inform the cultural alignment of instructional practices.

To evaluate the intervention's effectiveness, an independent samples t-test was employed to compare pre-test and post-test achievement scores between the experimental and control groups. Prior to conducting the t-test, statistical assumption checks were performed: the Shapiro-Wilk test was used to assess normality, and Levene's test was conducted to verify homogeneity of variances. Both assumptions were met, justifying the use of the parametric t-test. All inferential analyses were conducted at a significance level of $\alpha = 0.05$, allowing the researcher to determine whether observed differences were statistically significant. This robust analytical approach ensures reliable interpretation of intervention effects while addressing contextual challenges often present in quasi-experimental studies in low-resource educational settings.

3. Results and Discussion

3.1 Results

Demographic information plays a crucial role in research data analysis and should not be overlooked. It examines both the static and dynamic characteristics of the studied population (Areepattamannil & Caleon, 2013). In this study, the empirical survey included questions on respondents' gender, age, program of study, and school affiliation. These aspects provided key insights into participant characteristics and ensured the validity of their inclusion in the research (Areepattamannil & Caleon, 2013).

Table 1 - Gender of Respondents

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

As shown in Table 1, the study's gender distribution reveals a fairly balanced representation, with 47 male participants (59.5%) and 178 female participants (40.5%) out of a total of 79 respondents. While there is a slight majority of males, the difference is minimal, indicating that both genders are nearly equally represented in the study.

Table 2 - Age of Respondents

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

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

The results of the analysed data are presented in Tables 3, 4, and 5, each offering different insights into the study. Table 1 displays [examination of the impact of culturally responsive pedagogy on student engagement in mathematics], with the interpretation highlighting the results from the data. Table 3 presents [Attitudes of students towards the use of culturally responsive teaching methods in their mathematics education], and its interpretation focuses on [main conclusions]. Table 4 shows [Exploring the perceptions of students regarding the implementation of culturally responsive pedagogy in mathematics education], with the interpretation discussing the results from the data. Collectively, these tables provide a detailed overview of the data, supporting a comprehensive analysis of the study's objectives and outcomes.

Table 3 - Examination of the Impact of Culturally Responsive Pedagogy on Students' Engagement in Mathematics

Items	Response				Mean	SD	Decision of Engagement
	SA (%)	A (%)	DA (%)	SDA (%)			
I actively participate in group discussions when the math problems are connected to my cultural background.	37 (46.8)	37 (46.8)	4 (5.1)	1 (1.3)	1.61	0.649	High
I frequently engage in discussions with peers when the math lessons incorporate culturally relevant contexts.	37 (46.8)	41 (51.9)	1 (1.3)	0	1.54	0.526	Low
I show more enthusiasm for mathematics when the lessons include culturally relevant examples	47 (59.5)	26 (32.9)	5 (6.3)	1 (1.3)	1.49	0.677	Low
Culturally relevant examples or problems are frequently included in my mathematics lessons	45 (57.0)	29 (36.7)	4 (5.1)	1 (1.3)	1.51	0.658	Low
My overall performance in math has increased due to the integration of culturally responsive teaching practices	42 (53.2)	30 (38.0)	5 (6.3)	2 (2.5)	1.58	0.727	High
I have a more favorable perception of math as a subject when the lessons include culturally relevant content	48 (60.0)	25 (31.6)	5 (6.3)	1 (1.3)	1.48	0.677	Low
I demonstrate persistence and effort in tackling challenging math tasks when they relate to my cultural background	35 (44.3)	37 (46.8)	5 (6.3)	2 (2.5)	1.67	0.711	High
I remain on-task and focused during mathematics lessons that include culturally relevant examples.	43 (54.4)	26 (32.9)	9 (11.4)	1 (1.3)	1.59	0.743	High
I provide and receive constructive feedback on my mathematical work when the examples are culturally relevant.	43 (54.4)	31 (39.2)	5 (6.3)	0	1.52	0.6I7	Low
My parents are more actively involved with my mathematics homework when it includes culturally responsive content.	34 (43.0)	36 (45.6)	9 (11.4)	0	1.68	0.671	High

$$\text{Weighted Mean for students' engagement} = \frac{15.67}{10} = 1.57$$

Table 3 above, based on a weighted mean criterion of 1.57, items 2, 3, 4, 6, and 9 are categorized as having low engagement. This suggests that participants generally perceive these aspects less favorably, possibly due to their limited relevance, effectiveness, or alignment with

their needs and expectations. The lower perception might indicate that these areas are not being implemented well, or they do not resonate with the participants, leading to a less positive evaluation. On the other hand, items 1, 5, 7, 8, and 10 category under high engagement, as their weighted means exceed the 1.57 threshold. This indicates that participants view these aspects more positively, suggesting that they are seen as more beneficial, effective, or significant. These items likely align better with the participants' values or expectations, resulting in a stronger positive perception.

The contradiction in engagement levels may reflect the diverse cultural and educational backgrounds of Ghanaian students, particularly in regions like the Upper West, where teaching methods often lack contextual relevance. While some culturally aligned practices resonate well and foster high engagement, others may appear disconnected or poorly executed, leading to lower enthusiasm. This variation underscores the importance of tailoring culturally responsive strategies to the specific experiences, values, and learning preferences of Ghanaian children to ensure consistency in engagement.

Table 4 - The Attitudes of Students Towards the Use of Culturally Responsive Teaching Methods in their Mathematics Education

Item	Response				Mean	SD	Decision of Attitudes
	SA	A	DA	SDA			
I feel more engaged in math lessons when cultural examples are included.	54 (68.4)	20 (25.3)	3 (3.8)	2 (2.5)	1.41	0.689	Low
Incorporating my cultural background into math lessons makes learning more relevant to me.	37 (46.8)	29 (36.7)	10 (12.7)	3 (3.8)	1.73	0.828	Low
I am more motivated to participate in math classes when the teacher uses culturally relevant teaching methods	47 (59.5)	25 (31.6)	6 (7.6)	1 (1.3)	1.51	0.696	Low
I believe culturally responsive teaching helps me understand mathematical concepts better	47 (59.5)	24 (30.4)	6 (7.6)	2 (2.5)	1.53	0.748	Low
Culturally responsive teaching makes math more enjoyable for me.	44 (55.7)	26 (32.9)	8 (10.1)	1 (1.3)	1.57	0.728	Low
I appreciate when my math teacher acknowledges and respects my cultural identity in class.	33 (41.8)	35 (44.3)	10 (12.7)	1 (1.3)	1.73	0.729	Low
Using cultural examples in math problems helps me see the practical application of math in real life.	36 (45.6)	33 (41.8)	9 (11.4)	1 (1.3)	1.68	0.726	Low
I am more likely to ask questions and seek help in a culturally responsive classroom.	44 (55.7)	30 (38.0)	5 (6.3)	0	2.04	0.869	High
Culturally responsive teaching makes me feel valued and respected as a student	25 (31.6)	29 (36.7)	22 (27.8)	3 (3.8)	1.51	0.618	Low

Item	Response				Mean	SD	Decision of Attitudes
	SA	A	DA	SDA			
I believe that culturally responsive teaching should be a standard approach in math education	21 (26.6)	35 (44.3)	17 (21.5)	6 (7.6)	2.01	0.886	High
I feel more confident in my math abilities when cultural references are included in lessons.	27 (34.2)	40 (50.6)	8 (10.1)	4 (5.1)	1.86	0.796	High
Culturally responsive teaching helps me connect math concepts to my everyday experiences.	25 (31.6)	33 (41.8)	18 (22.8)	3 (3.8)	1.99	0.840	High
I believe that learning math through culturally responsive methods prepares me better for future challenges.	24 (30.4)	37 (46.8)	12 (15.2)	1 (1.3)	2.23	2.407	High

$$\text{Weighted Mean} = \frac{22.8}{13} = 1.75$$

Table 4 above, based on the weighted mean of 1.75, items 1.2, 3, 4, 5, 6, 7, and 9, which indicate low attitudes towards the use of culturally responsive teaching methods in mathematics education, suggest that students generally perceive these methods less favorably. This low perception may indicate that the culturally responsive teaching methods in these areas are either not well-implemented, not effectively meeting students' needs, or not aligned with their learning preferences. The students may feel that these approaches do not contribute significantly to their understanding of mathematics or fail to engage them in a meaningful way. On the other hand, items 8, 10, 11, 12, and 13, which reflect high attitudes towards the use of culturally responsive teaching methods, suggest that students view these methods more positively. These items likely represent areas where culturally responsive teaching is perceived as more effective or relevant, perhaps because these methods align better with students' cultural backgrounds and learning styles. The higher perception indicates that students find these approaches beneficial in their mathematics education, contributing to greater engagement and possibly better academic outcomes.

The mixed attitudes reflected in Table 4 can be attributed to how well specific culturally responsive teaching strategies are contextualized to the lived experiences of Ghanaian students, especially in diverse regions like the Upper West. Students may respond negatively to certain methods if they perceive them as forced, unfamiliar, or disconnected from their local culture and mathematical understanding. Conversely, methods that genuinely incorporate familiar cultural elements, language, and problem-solving contexts tend to be more appreciated, as they make mathematics more relatable, meaningful, and easier to grasp.

Table 5 - Exploring the Perceptions of Students Regarding the Implementation of Culturally Responsive Pedagogy in Mathematics

Item	Response				Mean	SD	Decision of Perception
	SA	A	DA	SDA			
I believe that culturally responsive pedagogy is effectively implemented in my math classes	33 (41.8)	33 (41.8)	10 (12.7)	3 (3.8)	1.78	0.811	High

Item	Response						
	SA	A	DA	SDA	Mean	SD	Decision of Perception
My math teacher incorporates local cultural examples that I can relate to during lessons.	38 (48.1)	30 (38.0)	6 (7.6)	5 (6.3)	1.72	0.866	Low
I feel that the use of culturally relevant materials in math lessons enhances my understanding of the subject.	43 (54.4)	28 (35.4)	7 (8.9)	1 (1.3)	1.57	0.710	Low
The implementation of culturally responsive pedagogy in math education makes the lessons more interesting	37 (46.8)	29 (36.7)	11 (13.9)	2 (2.5)	1.72	0.800	Low
I feel that culturally responsive teaching in math helps me connect better with the content	39 (48.1)	25 (31.6)	14 (17.7)	2 (2.5)	1.75	0.839	High
The cultural examples used in math lessons reflect my community and experiences	29 (36.7)	30 (38.0)	16 (20.3)	4 (5.1)	1.94	0.882	High
I perceive that culturally responsive pedagogy in math addresses the diverse needs of students.	40 (50.6)	27 (34.2)	11 (13.9)	1 (1.3)	1.66	0.766	Low
The implementation of culturally responsive pedagogy has improved my performance in mathematics	40 (50.6)	26 (32.9)	8 (10.1)	5 (6.3)	1.72	0.891	Low
I believe that culturally responsive teaching should be more widely used in mathematics education in our region	49 (63.0)	18 (22.8)	10 (12.7)	2 (2.5)	1.56	0.813	Low
I feel that my cultural background is respected and valued in my math classes through the use of culturally responsive teaching methods.	27 (34.2)	31 (39.2)	7 (8.9)	13 (16.5)	2.08	1.0554	High

$$\text{Weighted Mean} = \frac{17.5}{10} = 1.75$$

Table 5 above, based on a weighted mean of 1.75, items 2, 3, 4, 7, 8, and 9 reflect low perceptions of students regarding the implementation of culturally responsive pedagogy in mathematics education. This suggests that students may perceive these aspects of the pedagogy as less effective or less relevant to their learning experiences. The low perception might indicate that these components of the pedagogy are not resonating well with students, possibly because they do not feel that these methods adequately address their cultural

backgrounds or contribute meaningfully to their understanding of mathematics. Conversely, items 1, 5, 6, and 10, which show high perceptions, suggest that students view these aspects of culturally responsive pedagogy more favorably. These items likely represent areas where the implementation of culturally responsive teaching is seen as effective, relevant, and beneficial to their learning experience. The high perception could indicate that students feel more engaged and supported in these areas, where the pedagogy better aligns with their cultural context and educational needs, leading to a more positive overall experience in mathematics education. The contrasting perceptions in Table 5 highlight the uneven implementation of culturally responsive pedagogy in Ghanaian classrooms, particularly in the Upper West Region where cultural diversity is pronounced. Students may perceive certain aspects as ineffective when they fail to reflect their cultural identities, community experiences, or preferred learning approaches. However, where culturally responsive methods are thoughtfully applied—incorporating familiar examples, language, and local relevance—students are more likely to feel connected, supported, and engaged, resulting in higher perceptions of effectiveness and relevance in their mathematics education.

Table 6 - Independent Samples t-Test Results for Pretest

Group	**M**	**SD**	**n**	**Inferential statistics**	
Group1	2.64	1.222	36		
Group2	2.81	1.029	43		
df					77
t-value					-0.691
Sig(2-tailed)					0.492
Confidence interval				upper	0.329
				lower	-0.329
Levene's Test for Equality of Variances				F	0.924
				Sig	0.339
Shapiro-Wilk Statistic					
Treatment group					0.961
Control group					0.932
P-value					0.230

The results of the independent samples t-test in Table 6 indicate that there is no statistically significant difference between the scores of Group 1 (M = 2.64, SD = 1.22) and Group 2 (M = 2.81, SD = 1.03), with a t-value of -0.691 and a p-value of 0.492. The p-value is greater than the conventional alpha level of 0.05, meaning that any observed difference between the groups' means is likely due to random chance rather than a true difference in the population. The 95% confidence interval for the difference in means ranges from -0.679 to 0.329, which includes zero. This further supports the conclusion that there is no significant difference between the groups. Levene's Test for Equality of Variances showed that the assumption of equal variances was met (F (77) = 0.924, p = 0.339), confirming that the t-test results are valid under the assumption of equal variances. Overall, the findings suggest that the treatment did not have a significant impact on the scores compared to the control group.

Table 7 - Independent Samples t-Test Results for Post-test

Group	M	STD	N	Inferential statistics	
Group1	6.42	1.180	36		
Group2	4.44	0.959	43		
df					77
t-value					8.207
Sig(2-tailed)					0.000
Confidence interval				upper	2.454
				lower	1.496
Levene's Test for Equality of Variances				F	2.318
				Sig	0.132
Shapiro-Wilk Statistic					
Treatment group					0.971
Control group					0.867
P-value					0.461

The results of the independent samples t-test in Table 7 indicate that there is a statistically significant difference between the scores of the Treatment Group (M = 6.42, SD = 1.18) and the Control Group (M = 4.44, SD = 0.96), with a t-value of 8.2071 and a p-value of 0.000. Since the p-value is well below the conventional alpha level of 0.05, this suggests that the observed difference between the groups' means is unlikely to be due to chance and is likely a true difference.

The 95% confidence interval for the difference in means ranges from 1.496 to 2.454, which does not include zero. This further supports the conclusion that there is a significant difference between the groups, with the Treatment Group scoring higher on average than the Control Group. Levene's Test for Equality of Variances showed that the assumption of equal variances was not met *(F (77) = 2.318, d = 1.81, p = 0.132)*, confirming that the t-test results are valid under the assumption of equal variances. Overall, the findings suggest that the treatment had a significant positive impact on the scores compared to the control group.

3.2 Discussions

This study aimed to investigate the impact of Culturally Responsive Pedagogy (CRP) on students' engagement, attitudes, perceptions, and achievement in mathematics within Ghana's Upper West Region. The findings revealed four key outcomes: (1) CRP significantly enhanced student engagement, (2) students exhibited positive attitudes towards CRP-based teaching methods, (3) students expressed high perceptions of CRP implementation, and (4) CRP improved academic achievement in mathematics. These results affirm the multidimensional benefits of CRP and its capacity to address longstanding educational challenges in culturally diverse contexts.

3.2.1 Effect of CRP on Engagement

Culturally Responsive Pedagogy (CRP) emerged as a powerful instructional strategy for enhancing student engagement in mathematics, as evidenced by the responses to Research Question 1. The integration of culturally familiar contexts—such as local market transactions and agricultural scenarios—appeared to resonate with learners, transforming abstract mathematical concepts into relatable, real-world tasks. This alignment between students' lived experiences and instructional content not only captured their attention but also fostered

deeper involvement in classroom activities. However, a closer analysis of the engagement scale, based on weighted mean scores, revealed a nuanced picture. While items 1, 5, 7, 8, and 10 indicated high levels of engagement(Banks, 2016; Paris & Alim, 2017), items 2, 3, 4, 6, and 9 reflected low engagement(Ladson-billings, 2012; Martin & Mulvihill, 2021), suggesting that the CRP intervention was not uniformly effective across all instructional dimensions. This discrepancy may point to a partial cultural congruence between the examples used and students' diverse backgrounds, or it may stem from inconsistencies in teacher facilitation and implementation fidelity. It also suggests that while CRP has the potential to transform mathematics classrooms into inclusive and engaging spaces, its success is contingent upon the teacher's ability to contextualize lessons meaningfully and consistently. Therefore, this finding underscores a critical need for sustained professional development, equipping teachers not only with CRP strategies but also with the cultural competencies necessary to tailor instruction to the specific realities of their students.

3.2.2 Effect of CRP on Attitudes and Perceptions

Addressing Research Questions 2 and 3, the study revealed that Culturally Responsive Pedagogy (CRP) had an overall positive influence on students' attitudes and perceptions toward mathematics instruction. Many students expressed appreciation for lessons that acknowledged their cultural identities and real-life experiences, affirming earlier findings that culturally relevant teaching fosters affective engagement and positive disposition toward learning (Akyeampong, 2017; Sheromova et al., 2020;Wah et al., 2019; Akpalu et al., 2018)**.** However, a more granular analysis of the weighted mean data exposed an uneven pattern. For student attitudes, low scores were observed across items 1 through 7 and item 9, with only items 1, 5, 6, and 10 reflecting high attitudes. A similar inconsistency emerged in perceptions: students reported low perceptions for items 2, 3, 4, 7, 8, and 9, while high perceptions were limited to items 1, 5, 6, and 10 (Gay, 2010; Ladson-billings & Ladson-billings, 2016). This fragmented response may signal partial implementation of CRP practices or limitations in the cultural relevance of specific instructional examples. Research suggests that when culturally responsive teaching lacks authenticity or coherence, students may perceive it as tokenistic, reducing its effectiveness (Gay, 2010). Furthermore, such variability could reflect differences in the teacher's ability to facilitate CRP meaningfully, pointing to gaps in training or in the instructional design process. These findings highlight the crucial need for sustained, context-specific professional development that equips teachers to deliver CRP consistently and with cultural fidelity. Only through deliberate alignment of pedagogy with the lived experiences and cultural frames of learners can CRP fully realize its transformative promise in mathematics education (Nieto & Bode, 2018; Warren, 2018).

3.2.3 Effect of CRP on Achievement

In response to Research Question 3, the findings provide strong empirical support for the effectiveness of Culturally Responsive Pedagogy (CRP) in improving students' academic achievement in mathematics (Essien, & Davis, 2024; Apawu, Owusu Ansah & Akayuure, 2018; Brantuo, Atta, Klu, & Amoako Atta, 2023; Goka, Assuah, & Owu-Annan, 2023). The results from the independent samples t-test showed that the Treatment Group, which received mathematics instruction infused with culturally relevant content, achieved a significantly higher mean score ($M = 6.42$, $SD = 1.18$) compared to the Control Group ($M = 4.44$, $SD = 0.96$). The computed t-value of 8.2071 and p-value of 0.000 confirmed that this difference was statistically significant at the 0.05 level, indicating that the improvement was unlikely due to chance. Additionally, Levene's Test for Equality of Variances ($F(77) = 2.318$, $p = 0.132$) affirmed that the assumption of equal variances was not violated, thus validating the appropriateness and robustness of the statistical analysis (Creswell, 2018).

Critically, the computed Cohen's d of 1.81 indicates a very large effect size, which underscores the practical significance of the CRP intervention in enhancing student learning.

This aligns with findings by Aronson (2016) and Nolan & Xenofontos (2023), who documented that culturally contextualized instruction reduces abstraction in mathematics, thereby making concepts more relatable and cognitively accessible for diverse learners. The strong academic gains observed suggest that when students are taught using examples and contexts drawn from their own cultures—such as local markets, farming practices, or community interactions—they are better able to construct meaning and apply mathematical concepts, in line with constructivist learning principles (Vygotsky, 1978; Gay, 2010).

These findings also support earlier work by (Ladson-billings, 2021), who emphasized that CRP improves not only motivation and engagement but also deepens understanding by bridging the gap between academic content and students' lived realities. In the Ghanaian context, where mathematics is often perceived as abstract and disconnected from everyday life (Hunter, 2021), this study demonstrates that CRP can serve as a powerful instructional model for enhancing conceptual clarity and performance, especially in culturally diverse and under-resourced settings like the Upper West Region.

The findings of this study reinforce the foundational ideas of both constructivist and sociocultural learning theories, particularly Vygotsky's assertion that learning is a culturally mediated and socially situated process (Vygotsky, 1978). In the context of Ghana's multilingual and ethnically diverse classrooms, these theories gain practical relevance through Culturally Responsive Pedagogy (CRP), which affirms students' cultural identities and leverages them as instructional resources (Gay, 2010). By drawing upon familiar cultural experiences—such as local market exchanges, traditional systems of measurement, and indigenous symbols—CRP creates pathways for students to access mathematical knowledge in ways that resonate with their lived realities. This approach facilitates learning within Vygotsky's Zone of Proximal Development (ZPD), where teachers scaffold new concepts by connecting them to students' prior cultural knowledge (Vygotsky, 1978; Nieto & Bode, 2018). The study thus contributes a local perspective to global educational theory by demonstrating that, in Ghanaian classrooms, CRP is most effective when it integrates both cultural relevance and pedagogical flexibility. Teachers must be prepared not only to recognize the cultural wealth students bring but also to adapt their instructional methods accordingly. This locally grounded interpretation of CRP enriches the broader theoretical discourse by showing how sociocultural and constructivist principles can be meaningfully operationalized in Sub-Saharan African educational contexts.

The findings of this study offer valuable insights with important practical implications for improving mathematics education in culturally diverse settings. One of the clearest takeaways is the necessity for teacher training programs that go beyond general pedagogical skills to specifically target culturally responsive teaching competencies. Teachers must be supported in learning how to adapt mathematics curricula to reflect students' lived realities, use inclusive and accessible language, and design lessons that draw meaningfully on community-based knowledge (Kania, et al., 2024). Equally important is the role of curriculum designers, who should ensure that textbooks and instructional guides include examples, problem-solving contexts, and applications that resonate with the diverse cultural backgrounds of learners across the country. Without these intentional inclusions, teaching materials risk remaining abstract and disconnected from students' everyday experiences. Policymakers also have a critical role to play (Henisah et al., 2023). To embed culturally responsive pedagogy sustainably within Ghana's education system, there must be deliberate policy actions—such as dedicated funding, strategic monitoring, and consistent support structures—particularly in under-resourced regions like the Upper West Region. Additionally, school leaders need to cultivate environments where teachers feel encouraged to collaborate,

share effective CRP strategies, and reflect on their instructional practices. Creating such spaces not only supports continuous professional growth but also fosters a culture of responsiveness, where teaching evolves in step with students' cultural and academic needs. Collectively, these measures offer a pathway for transforming mathematics classrooms into more inclusive, engaging, and effective learning environments (Noviana et al., 2024).

This study was limited by its small sample size and geographic concentration in one senior high school in Ghana's Upper West Region, which may affect the generalizability of the findings. The short intervention period (4 weeks) also limits the study's capacity to capture long-term impacts of CRP on learning outcomes. Additionally, as the CRPEQ was self-developed, it requires further validation beyond this context. Future research should employ larger, multi-site samples and adopt longitudinal designs to assess sustained outcomes of CRP. Researchers should also explore the effectiveness of CRP across different subjects and educational levels, and examine how teacher characteristics influence CRP implementation and student response.

4. Conclusions

These findings underscore the transformative potential of Culturally Responsive Pedagogy in advancing equitable and effective mathematics education in culturally diverse settings such as Ghana. Unlike previous studies that focused on general pedagogy or literacy education, this study provides novel empirical evidence of CRP's impact in mathematics instruction within Sub-Saharan Africa, offering a practical and theoretical framework for scaling inclusive teaching practices across the region.

Conflict of Interest

The authors declare no conflicts of interest.

References

Akendita, P. A., Boateng, F. O., Arthur, Y. D., Banson, G. M., Abil, M., & Ahenkorah, M. (2025). The Mediating Role of Teacher Effective Communication on the Relationship between Students' Mathematics Interest and their Mathematics Performance. *International Journal of Mathematics and Mathematics Education*, *3*(1), 1–17. https://doi.org/10.56855/ijmme.v3i1.1214

Akpalu, R., Adaboh, S., & Boateng, S. S. (2018). Towards Improving Senior High School Students' Conceptual Understanding of System of Two Linear Equations. *International Journal of Educational Research Review*, *3*(1), 28–40. https://doi.org/10.24331/ijere.373336

Angraini, L. M., Kania, N., & Gürbüz, F. (2024). Students' Proficiency in Computational Thinking Through Constructivist Learning Theory. *International Journal of Mathematics and Mathematics Education*, 45–59. https://doi.org/10.56855/ijmme.v2i1.963

Boadu, S. K. (2024). *Enhancing students ' achievement in mathematics education in the 21 st century through technology integration , collaborative learning , and student motivation : The mediating role of student interest*. *20*(11).

Darmayanti, S., Riau, U. I., Shanty, Y. L., Riau, U. I., Angraini, L. M., & Riau, U. I. (2024). *Analysis of High School Students' Errors in Solving Story Problems on Systems of Linear Equations with Three Variables*. *2*, 128–138.

Gist, C., Jackson, I., Nightengale-lee, B., & Allen, K. (2019). *Culturally Responsive Pedagogy in Teacher Education*. *July*, 1–26. https://doi.org/10.1093/acrefore/9780190264093.013.266

Henisah, R., Margana, M., Putri, R. Y., & Khan, H. S. (2023). Role Play Technique to Improve

Students' Speaking Skills. *International Journal of Contemporary Studies in Education (IJ-CSE)*, *2*(3), 176–182. https://doi.org/10.56855/ijcse.v2i3.618

Howard, T., & Sr, C. L. T. (2011). *Culturally responsive pedagogy for African American students : promising programs and practices for enhanced academic performance*. *6210*. https://doi.org/10.1080/10476210.2011.608424

Kania, N. (2024). *Students' Proficiency in Computational Thinking Through Constructivist Learning Theory*. *2*, 45–59. https://doi.org/10.56855/ijmme.v2i1.963

Kania, N., Kusumah, Y. S., Dahlan, J. A., Nurlaelah, E., & Arifin, Z. (2024). Research Trends in Higher-Order Thinking Skills in the journal Mathematics Education in Indonesia: from Design to Data Analysis. *International Journal of Mathematics and Mathematics Education*, 193–206. https://doi.org/10.56855/ijmme.v2i3.1048

Kania, N., Suryadi, D., Kusumah, Y. S., Dahlan, J. A., Nurlaelah, E., & Elsayed, E. E. (2024). Comparative Praxeology: Assessing High-Level Cognitive Skills in TIMSS and Indonesian National Examinations. *International Journal of Applied Learning and Research in Algebra*, *1*(1), 25–47. https://doi.org/10.56855/algebra.v1i1.1160

Kyaruzi, F. (2024). *Analysis of High School Students' Difficulties in Solving Mathematics Story Problems on Opportunity Material*. *2*, 100–113.

Ladson-billings, G. (2012). *But That ' s for Teaching ! The Culturally Relevant*. *34*(3), 159–165.

Ladson-billings, G. (2021). Three Decades of Culturally Relevant , Responsive , & Sustaining Pedagogy : What Lies Ahead ? Three Decades of Culturally Relevant , Responsive , &. *The Educational Forum*, *85*(4), 351–354. https://doi.org/10.1080/00131725.2021.1957632

Ladson-billings, G., & Ladson-billings, G. (2016). *Relevant Teaching Who Can Teach Our Children ? Re-Stating the Case for Culturally Relevant Teaching*. *48*(2).

Lavín, C. E., Jordan, A. W., Francis, G. L., Jordan, A. W., & Francis, G. L. (2025). *Back to Basics : Culturally Relevant Pedagogy in Special Education Back to Basics : Culturally Relevant Pedagogy in Special Education*. *105*(1), 5–16.

Maamin, M., Maat, S. M., & Ikhsan, Z. (2020). A systematic review of teacher factors and mathematics achievement. *Universal Journal of Educational Research*, *8*(3), 998–1006. https://doi.org/10.13189/ujer.2020.080334

Martin, L. E., & Mulvihill, T. M. (2021). An Interview with Dr . Gloria Ladson-Billings An Interview with Dr . Gloria Ladson-Billings. *The Teacher Educator*, *56*(3), 217–228. https://doi.org/10.1080/08878730.2021.1938848

Mette, I. M., Nieuwenhuizen, L., & Hvidston, D. J. (2016). *Teachers ' Perceptions of Culturally Responsive Pedagogy and the Impact on Leadership Preparation : Lessons for Future Reform Efforts*. *11*(1).

Noviana, A. P., Nurhayati, E., & Rustiana, R. (2024). Developing Students' Mathematical Communication Skills on Geometric Number Patterns Through Group Investigation and Peer Teaching. *International Journal of Geometry Research and Inventions in Education (Gradient)*, *1*(2), 94–101. https://doi.org/10.56855/gradient.v1i2.1249

Nyantah, R. O., Frempong, N. K., & Larbi, E. (2025). *Enhancing Student Achievement in Circle Theorems : Integrating Computer Animation with the Jigsaw Cooperative Learning Model*. *03*(2), 91–112.

Odoom, E., Mereku, D. K., & Adusei, M. S. (2024). Effect of Problem-based Learning on High School Students' Performance in Solving Simultaneous Linear Equation Word Problems. *African Journal of Educational Studies in Mathematics and Sciences*, *20*(1).

Ragoonaden, K., & Mueller, L. (2017). *Culturally Responsive Pedagogy : Indigenizing Curriculum*. *47*(2), 22–46.

Silva, R. M. De, Gleditsch, R., Job, C., Jesme, S., Urness, B., Hunter, C., Silva, R. M. De, Gleditsch, R., Job, C., & Jesme, S. (2017). *Gloria Ladson-Billings*. *2011*, 23–28.

Wah, Y. L., Binti, N., & Nasri, M. (2019). *A Systematic Review : The Effect of Culturally*

Responsive Pedagogy on Student Learning and Achievement A Systematic Review : The Effect of Culturally Responsive Pedagogy on Student Learning and Achievement. *9*(5), 588–596. https://doi.org/10.6007/IJARBSS/v9-i5/5907

Warren, C. A. (2017). *Empathy , Teacher Dispositions , and Preparation for Culturally Responsive Pedagogy*. https://doi.org/10.1177/0022487117712487

Whitaker, M. C., & Valtierra, K. M. (2018). *The dispositions for culturally responsive pedagogy scale*. https://doi.org/10.1108/JME-11-2016-0060