

Teaching mathematics for social justice: The challenges and the prospects in the Ghanaian senior high schools

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ABSTRACT

The study aimed to explore the prospects and challenges of teaching mathematics for social justice at Ghanaian senior high schools (SHSs). A non-random sample of seven respondents, including two experienced mathematics educators and five SHS students, were interviewed and analyzed qualitatively using thematic analysis. The analysis revealed seven themes: individual differences, students' mathematics interests, participatory lessons, extracurriculars, non-interactive teaching, technology use, and cultural diversity. These thematic findings are related to technical, practical, and emancipatory knowledge constituent interests in schools and Ghanaian social, cultural, and historical settings. A teacher should utilize egalitarian pedagogy so that the students will gain practical and emancipatory skills.

Keywords: ethnomathematics, social justice, critical pedagogy, critical thinking, problem-solving skills, egalitarian pedagogy

INTRODUCTION

Ethnomathematics explores how cultures calculate (Alangui, 2017). Many children find school mathematics useless because it lacks context and history (Meaney et al., 2021). Studies have shown that Greek and European mathematics are prioritized over indigenous knowledge; however, students need complete, integrated studies (Meaney et al., 2021). Ethnomathematics and mathematics education scholars recommend teaching students culturally appropriate arithmetic (Rosa, 2020). Cultural relevance and personal experiences should inform mathematics education to help students understand reality, culture, society, and themselves to change political and social dynamics. Joo (2021) asserts that the two most significant challenges of society are ethnic diversity and environmental degradation. Ethnomathematics teaches innovative ecological solutions and democratic values like patriotism, loyalty, and tolerance. Training, experience, education, communicative ability, and cultural awareness are needed to handle competing factors within sociocultural norms (Meeran & Van Wyk, 2022). Perfectly adapting sociocultural communication standards, fosters societal cohesiveness, serenity, and tranquility in interpersonal communication at home, job place, and elsewhere. Appropriate use of language can foster national development, peace, and productivity and even in volatile situations. Cultural materialism employs science to explore how technical, economic, and demographic forces shape society.

Ghana, a middle-income nation, lags in physical, economic, and social development. Humans have equal opportunities, according to (Hunter & Rackley, 2022); however, believing in their social-cultural norms and values is the best method to develop. Teaching mathematics in context promotes growth by teaching pupils about their country's values, ideals, history, and culture. Researchers like Aksu and Colak (2021), Huinker (2018), and Kepner (1974) observed that, China, Finland, the United States, and United Kingdom, among others have developed, partly as a result of their contextual mathematics instruction. Since mathematics is used worldwide for national development, several research are being carried out periodically to keep the teaching of school mathematics abreast with time (Japelj Pavesic et al., 2022; Rizqika & Shofyan, 2021).

Researchers have proposed pedagogies to improve pre-tertiary mathematics teaching. Among them are critical pedagogy (Freire, 2020a; Giroux, 2020), mathematics for social justice (Stinson et al., 2012), realistic mathematics education (Barnes, 2005; Rizqika & Shofyan, 2021), problem-solving approach (Aksu & Colak, 2021; Turgut, 2021), and others. These mathematical learning methods promote inquiry, problem-solving, critical thinking, and investigation. All these strategies are based on the constructivist learning theory. The teacher is only a coach, facilitator, or curator, as pupils actively construct knowledge from past experiences (Belbase et al., 2022). Learning occurs only when new content is relevant to what students already know, therefore culture affects mathematics learning (Amoako Atta & Asiedu-Addo, 2021).

It is instructive to note that pupils who are taught mathematics using native-language outperform those who receive their mathematics instruction in a second-language (Martin et al., 2017; Zou, 2019). According to research, mathematics is best taught using hands-on and mind-on activities to make it more of a fun and as a way of life (Baah-Duodu et al., 2020). Mereku (2000) recalls a conference of African education ministers tasked to revitalize and restructure the colonial mathematics curriculum to suit African culture and the subsequent hiring of local publishers to produce the new mathematics for primary schools (NMPS), modern mathematics for elementary schools, book 1 to book 8, West African school mathematics (AWAM) for middle forms 3 and 4 just to ensure that the school was culturally relevant. Mathematics achievements in Ghana has not been satisfactory (Mills & Mereku, 2016). There is therefore the need for critical pedagogy that promotes mental freedom and social justice.

Teaching mathematics for social justice (TMfSJ) is a pedagogy that believes that all children should have access to rich, rigorous mathematics that equips them to understand and use mathematics in their lives (Stinson et al., 2012). TMfSJ requires several considerations. These include teachers teaching mathematics with a social justice focus or students using mathematics to solve social inequities. TMfSJ must address inequality in society and mathematical programs in schools. TMfSJ involves more than studying social issues and solving injustices with mathematics. However, students must be empowered by using cultural settings and submitting their concerns about complex equity issues (Ayoub Mahmoudi et al., 2014; Chang & Cochran-Smith, 2022). It therefore proves the importance of instructional strategies and a classroom culture that fosters equitable participation if education becomes the practice of freedom through which people learn how to transform their world. Teachers and students must therefore collaborate to balance power (Freire, 2020b).

The challenges in teaching social justice includes social and political issues, which may replace rich, rigorous mathematics. Some teachers fear TMfSJ because it encourages students to question authority and think critically (Chang & Cochran-Smith, 2022). Planning, incorporating social justice, and covering mathematics also take time. Despite these limitations, research demonstrates that TMfSJ can help diverse students thrive academically while addressing cultural competency and critical consciousness if instructors are supported. The principle of multiple intelligences (Gardner, 2010) concluded that paper-and-pen tests like the intelligent quotient are not the best approach to assess intelligence. Mathematics may spark student creativity. The mathematics curriculum must accommodate students who excel in languages, music, theatre, or interpersonal skills among others. Gardner (2010) found eight multi-linkages. Linking mathematics to these intelligences helps teachers build the three Hs (head, hand, and heart) (Yidana et al., 2022).

Social justice makes school mathematics a doorway, democratizing participation and maximizing education advancement for all children. Social justice mathematics is dynamic, political, historical, relational, and cultural (Bautista et al., 2020). Identity and power dominate this encounter. Mathematical and social justice education enables instructors to develop their professional knowledge and instructional practice (Chang & Cochran-Smith, 2022). More than mathematical content knowledge is needed for 21st-century mathematics teaching. Mathematics educators need research-based professional development on the sociopolitical turn of mathematics education and fair, culturally responsive mathematical pedagogies. Studies continue to show that egalitarian rules, high standards, high-quality content, and strong community linkages increase mathematics learning and achievement (Ltd, 2020). Developing appropriate cultural and social identities demands grounding mathematics instruction in students' languages, cultures, and communities while offering them mathematical tools to succeed in the dominant society (Parker et al., 2017). Reading the mathematical word, academic accomplishment, and influencing students' (and teachers') mathematics orientation were Gutstein's (2012) mathematics educational goals (Gutstein, 2012). Mathematical power is creative problem-solving, mathematical generalizations, and social critique (Bartell, 2011).

Problem Statement

Traditional mathematics academic achievement entails passing standardized examinations, graduating high school, excelling in college, and enrolling in advanced mathematics courses (if they so choose). Changing students' (and teachers') attitudes toward mathematics requires seeing it as an analytical tool for comprehending complicated, real-world phenomena (Andamon & Tan, 2018; Berger et al., 2020). Deficit views of historically marginalized children, their families, and communities because of race, class, language, and culture persist in educational conversations and research (Beal et al., 2010; Shin, 2021). In mathematics education, this deficit thinking happens in at least two ways. First is the continuous labelling of children's readiness to learn mathematics via standardized tests and other institutional tools that position and sanction specific forms of mathematics knowledge. Creating meaningful and relevant experiences for students in mathematics is essential. When students are provided opportunities to pose questions relevant to their lives, contest injustices, and challenge how the world is shaped, the actual utility of mathematics becomes visible, and students are active parts of the solution (Bush & Cook, 2019).

Interestingly most of the studies in the field of mathematics are focused on mathematics interest and achievement in tests. Little is done in the area of mathematics skills that will propel and liberate the learner from oppression. This current study seeks to investigate how school mathematics should be done to promote leadership qualities, loyalty, resilience and democratic values in addition to critical thinking and problem-solving skills. This way, the individual learner is not oppressed under the stress of the formal school assessment (written tests). However, he or she is developed physically, emotionally, and socially, hence the need for this study.

Objectives of the Study

The objective of the study was to explore the challenges and prospects of teaching mathematics for social justice at the SHSs in Ghana.

METHODOLOGY

This study was based on the interpretivism paradigm (Frambach et al., 2013). Interpretivism study is a kind of study that considers cultures, circumstances, and times that shape social realities. It seeks rich insights rather than universal laws that can be applied to everyone regardless of critical variables and factors. The research is based on the idea that reality is perceived through inter-subjectivity, meanings, social and experiential understandings (Hu & Chang, 2017). The interpretivism paradigm, therefore, provides in-depth knowledge of specific contexts, such as cross-cultural studies, factors influencing development, and deep insight and conclusions through qualitative data collection and interpretation. The qualitative method adopted for data collection was personal interview. An interview guide was developed to elicit responses from participants on the prospects and challenges of teaching mathematics for social just in the Ghanaian SHSs. Since the issues bothers on individual experiences, the interview was comparatively better since it could provide better insights that any other tool (Cohen et al., 2017).

This study was non-experimental, which means that no intervention took place (Johnson, 2001; Kothari, 2017). Two mathematics educationists and five SHS students were purposefully selected from the Bekwai Municipality. A semi-structured interview was used in gathering data based on the interview guide. The questions asked were about social justice in mathematics classes. Classroom equity, learning opportunities, student treatment, and mathematics support. Interviews were recorded to aid analysis and interpretation.

Ethical Considerations

Data-gathering involves informed consent, voluntary involvement, the option to withdraw, no harm to participants, and participant confidentiality (De Costa et al., 2019). The study's goal and volunteers' rights were explained. They were told they might quit the research if they were uncomfortable. Credibility, transferability, dependability, and conformity were used to ensure the data's trustworthiness (Frambach et al., 2013). The researcher supplied interview transcripts to confirm participation.

Data-Interview Analysis

Professional transcribers were hired to aid in the coding and transcribing the interview tapes. The themes generated expressed participants' ideas on social justice in mathematics classrooms and consolidated literature-supported issues. Layered coding helped localize findings and reduce researcher bias (Frambach et al., 2013). Individual differences, students' mathematics interests, participatory lessons, extracurriculars, non-interactive teaching, technology use and culture diversity were the themes that emerged through data analysis.

The interviews were conducted in both Akan and English but were later translated, analyzed, and interpreted in English. Interview fragments formed participant narratives. For anonymity's sake, the actual names of the respondents were not used. However, pseudonyms have been generated (Hoft, 2021; Vorhölter, 2021). For the mathematics educationist (Pablo and Santo) and the students (Okodie and Rozy, both females and Joe, Ken and Sethoo, all males).

RESULTS

Background of Responders

Two educationists who interviewed were both retired. Pablo was a mathematics teacher at senior high school (SHS). He was head of the department (HOD) for mathematics for ten years and became assistant headmaster for five years until he retired in February 2022. Santo taught maths at both junior high and SHSs. He moved to college of education to teach maths after earning his MPhil in mathematics education and retired in July 2022. Okodie is a form two home economics student at the SHS. Rozy is a general arts student at SHS form three. Joe is a form two science student and a leading member of their school's national maths and science quiz (NMSQ) team. Ken is a visual arts student at SHS three and Sethoo was a form 2 business students. There was a review of relevant existing literature to support responses elicited.

What is Your View on Culture Diversity?

When asked about culture diversity in relation to TMFSJ, both respondents agreed that TMFSJ in cultural heterogeneity is difficult since cultural diversity affects emotions. Thus, culture affects students' actions.

When the teacher is familiar with the cultural background of the students, it goes well, especially when one culture dominates (Santo, retired maths tutor).

Students dominate based on religion and culture. Cultural background affects how teachers interact with students. Some teachers like it when one set of students dominates another (Pablo, retired educationist).

Culturally relevant pedagogy uses students' prior knowledge to teach math (Alangu, 2017). White (2021) believes teachers should use culturally responsive teaching strategies to improve students' math skills. Social justice in math courses seems to be challenged by student diversity. Students have cultural, economic, social, geographical, academic, and non-academic backgrounds. Student culture, language, and history are different.

How Do You See Individual Differences?

On the issue of individual differences in the TMFSJ, the responses of Pablo and Santo was evident that individual difference exists in the classrooms.

Each class has diverse cultural, economic, social, and geographical backgrounds. They are multilingual. Students' backgrounds were a concern for integrating social justice into math instruction. Some students have high cognition rates, varied retention rates and diverse opinions from various individual entering behaviors (Pablo, retired educationist).

Some are quiet and others are passive. Some students irritate their classmates; teachers, therefore, need to allow all of them to practice and provide an equal and conducive atmosphere for the students to learn (Santo, retired maths tutor).

I do not find it comforting in mathematics lessons structured in a manner that favors the high cognitions, due to inability to comprehend the language used and the faster rate at which the lesson is delivered. I only sit down and watch in order not to annoy my colleagues nor the teacher (Ken, form 3 visual arts).

It is worth noting that individual differences exist in mathematics classrooms, and teachers must adapt their lessons across the classes to suit the needs of the students. A strategy that will work best in home economics class may not work in science or arts class. In terms of socio-economic background and cultural background, what seems funny may vary, and what seems to be the best example may be abhorred in another jurisdiction. It is, therefore, imperative for teachers to adapt their lessons to individual needs since there is no one-size fit approach to TMfSJ. More studies have proven that putting the learner at the center of learning always yields the best results. Researchers have recommended that mathematics teachers be aware of the history and culture of the learners in order to use more practical and realistic examples in their lessons. Even though it is not easy, as indicated by Pablo:

When I was the HOD, I realized that most of my teachers found it challenging to construct their examples to suit their learner's needs. They mostly use textbook questions, you know, the textbook is national, and its problems are not culturally specific. Therefore, non-routine questions generated by the teachers will help build learners' imaginative and creative skills as well as communication skills, yea (Pablo).

The participant's narrative focuses on teasing, diversity, and student habits. These ideas characterize maths classrooms with poor social fairness. If they are passive, disruptive, or teasing, diverse children may have classroom management issues. These signs imply that the classroom is not using socially appropriate pedagogy or that the teacher is not balancing activities, learning, and reflections. Connecting arithmetic, for instance, to real-life situations is a problem contextualizing math based on students' experience and prior knowledge. The traditional mathematics classroom approaches normally do not engage students in critical thinking and establish a community of learners for change and progress; there was a lack of critical pedagogy (Freire, 1970) as cited in (Apple, 2011). Brahier et al. (2014) believe a mathematics classroom should stimulate interaction, idea-sharing, and problem-solving. Teachers may require a social justice lens to teach arithmetic. Teachers should build on students' original cultures and languages. Students have cultural, economic, social, geographical, and linguistic origins. Due to this diversity, the same thing may have numerous meanings depending on their history and language, making it challenging to maintain social justice in the classroom. In Ghana, social and cultural background best predicts mathematics and academic abilities (NaCCA, 2019).

What Triggers Students' Mathematics Interest

On student mathematics interest, all five respondents (students) indicated that they become highly elated when they are involved in discussions.

I do not like answering questions in class, but if I can answer one correctly, I become delighted, especially when I can explain my answer to my colleagues (Okodie, form 2 home economics).

I normally get bored when I am not involved in the mathematics lessons since I am a slow learner in terms of Maths. Not been involved in the buildup becomes difficult to grasp, which cause disinterest (Sethoo, form 2 business).

Expressing self in the English Language during maths lessons is not something I find pleasing. Although I could have a contribution and be needing a clarification but sometimes find it difficult since I do not want to embarrass. Once the teacher accepts the local dialect, I become fully involved in the lesson and my interest is aroused (Ken, form 3 visual arts).

Studies have indicated that apart from academic achievement, mathematics anxiety has a negative impact on quality of life. Indicators of math anxiety in daily life include being frequently confused while shopping, taking the change without counting most of the time, being unable to perform mathematical calculations while being observed in public, worrying about calculating time, and avoiding mathematical discussions (Berger et al., 2020; Hashim et al., 2021). This condition of anxiousness might result in forgetfulness and a loss of self-confidence. Self-efficacy is an individual's confidence in his or her ability to attain the desired degree of learning and behavior (Ahmed et al., 2022). Self-efficacy boosts interest, and student mathematics interest predicts academic success (Arthur, 2019; Hashim et al., 2021). Realistic individual interests can support an emerging one, and managing their aspirations are hard to nurture, which may promote classroom injustice.

How Do You See Participatory Mathematics Lessons?

When quizzed on participatory lessons, the five students had this to say:

I have conditioned my mind to think that mathematics is complicated. I would not say I like maths, and a teacher once told me that I need to struggle if I want to excel in maths, which put fear in me. I manage to pass anyway but usually do not perform well. The only time I enjoy maths is when the class is interactive, and more especially when I am able to contribute to class discussions (Okodie, form 2 home economics).

I enjoy mathematics lessons when we are involved in discussions and other activities. Sometimes we are given a task in a group, and we do it and present it to the class. It makes maths more practical, very easy and enjoyable (Rozy, form 3 general arts).

When I came to form one, I was shy, I did not like answering questions in class, but with time I have overcome that; my Maths teachers always try to make us talk in class. His lessons are practical; we give many examples from our day-to-day activities. I did not know maths was so close to us. I enjoy it, and my performance has also picked up (Sethoo, form 2 business).

I am not good at memorizing formulas, but my teacher tries to let us derive the formulas that I do not forget, and it helps, sometimes I can solve specific problems that I have not met before; not all teachers have those skills to make maths so practical that made me hate maths but now I have realized that Maths is with us, almost everything we do there is mathematics application in it (Ken, form 3 visual arts).

My maths teacher wastes much time explaining issues, he makes maths look simpler, but it looks boring to me. I need the formulas to work faster, I always learn ahead, and when I come to class, it is like I do not get enough; there is too much talking; my mates argue and argue about simple things, and we solve a few problems. The other classes are always ahead of us (Joe, form 2 science).

Mathematics is a practical subject that requires student engagement. Engaged learning is underestimated. The curriculum must be altered based on students' expectations, culture, and political context to enhance inclusion and access to high-quality mathematics and teaching (Pablo, retired educationist).

Using a variety of teaching strategies and pedagogical strategies can accommodate the diversity of students' learning styles and developmental stages and enhance the development of all-encompassing and transferable mathematical skills (Arthur, 2019).

Extracurriculars

In ascertaining the impact of extra curricula on TMFSJ, it was revealed that,

What student does at home mostly depends on their background. I remember when I was young, I wanted to study Maths at home, but many household chores do not permit me to do my assignments, let alone my private studies. My parents were in the village, and I moved to town to stay with a close relative during secondary school days; my parents could not afford Boarding (Santo, retired maths tutor).

Students' interests vary based on their backgrounds and goals. Some students prefer reading to maths. Their homes and hobbies impede socially just maths instruction. Interests affect social equity in the math classroom. Some students dislike maths (Pablo, retired educationist).

On the part of the students, Okodie, Rozy, and Ken indicated that they do not usually study maths at their leisure. However, Sethoo and Joe worked maths on their own most of the time.

I am a science student, and maths is essential to me. I always try to work ahead of the class. I am a border; I use the library when school is in session, and during vacation, I have a marker board at home. My father always makes sure I learn, so he provides for me (Joe, form 2 science).

Non-Interactive Teaching

When asked how non-interactive teaching affects the successful implementation of TMFSJ; the study realized that,

Traditional mathematics instruction may hinder social justice. Some teachers teach maths aloud while using a marker; some cannot offer different homework to their many students. Conventional teaching does not allow students to do multiple tasks. Social justice challenges are typical classroom routines (Pablo, retired educationist).

Some of the issues have to do with time constraints, the curriculum is packed, and teachers want to catch up so the students can pass exams. The final exam is an external examination; teachers have no control and are primarily mechanical. It does not take into consideration student emotions, attitudes and values (Santo, retired maths tutor).

It also came up that large class size is a challenge to TMfSJ and a breed of teacher-centred teaching. Large classes prevent teachers from focusing on each student's learning and participation. Participants said that large class size does not encourage practical activities to promote equity, access, and critical thinking. The traditional lecture methods prevent teachers from engaging students in active learning and student-centered social justice teaching. Socially equitable mathematics teaching-learning is student-centered, interactive, and question-based.

Teachers cannot quickly adopt a participatory approach due to classroom difficulties (Moscardini, 2014). Conventional maths education emphasizes getting the correct answer and remembering facts and procedures, leaving students unprepared for creative problem-solving, thereby putting the students under oppression. Non-participatory teaching hinders classroom social fairness since it is not learner-friendly.

How Does Technology Use Impact on the Teaching of Mathematics?

On technology use in achieving TMfSJ that technology-savvy teachers are needed. Insufficient math skills are another issue. Technology is difficult for all teachers. Participants reiterated that,

In Ghanaian classrooms, technology issues in mathematics teaching and learning as a social justice faces obstacles due to limited access to the internet and other digital devices. It, therefore, boils down to access, time, support, resources, and training as extrinsic challenges (Santo, retired maths tutor).

Teachers need training in new technology despite mastering most applications, videos, and tools, some maths teachers are even not prepared to use technology (Pablo, retired educationist).

It is unclear whether teachers are willing to learn new technical tools and seek school and government support. It also raises the question of how well teachers know new technological tools to promote math learning in and out of the classroom. Technology in the classroom promotes impartiality. Maths education requires digital technologies. Technology-based math instruction may appeal to many youngsters.

COVID-19 had teachers using ICT to teach math during lockdowns and school closures but in our case, it was not possible since the school neither had the needed technological tools nor parents could afford such gadgets for their wards (Rozy, form 3 general arts).

The use of ICT tools is very appealing of which when incorporated into the teaching and learning of maths will help arouse and sustain interest and promote comprehension since it will bring practicality to the lessons. The absence of the needed tools is worrying to most of us (Joe, form 2 science).

CONCLUSION

The study's seven themes and interpretations highlight the benefits of social justice in mathematics classrooms and how teachers face obstacles in teaching, learning, and student performance. It offers ideas for altering curricula and fostering social justice in the classroom. The study illustrates how classroom procedures can be used elsewhere. It has also shown how high school mathematics teachers view social justice and classroom issues. All study themes have pedagogical relevance. Cultural diversity, individual difference, non-interactive lessons are all issues that can have adverse effect on student mathematical interest if not handled properly. On the other hand, interactive learning, technology use can impact positively on student's mathematics interest and can be a means of promoting socially just classroom practices.

Notions like; equity and fairness are more prominent, since they are socially, politically, and culturally influenced and, teachers have less control over them. Different student interests, a high number of students, non-participatory teaching, and insufficient technology abilities are related to pedagogy within teachers' duties and obligations to promote socially just classroom practices. These thematic findings are related to technical, practical, and emancipatory knowledge constituent interests (Habermas, 1971) in schools and Ghanaian social, cultural, and historical settings.

A teacher should utilize egalitarian pedagogy so that the students will gain practical and emancipatory skills. Curriculum developers can also alter the content of the mathematics syllabus to focus more on social cultural context so that the students will have better view of the diverse nature of human needs and aspirations. Finally, the focus of the examining bodies must be skewed towards solving issues relating political, social, cultural, and other realities that affect the learner directly.

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