

Effect of Social Justice Mathematics on Senior Secondary School Students' Performance in Algebraic Expressions

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Corresponding author:	Abstract
Terungwa James Age agetj@unisa.ac.za	Mathematics education plays a crucial role in developing students' problem-solving skills and critical thinking. However, traditional teaching methods often fail to address social inequalities, which can impact students' engagement and performance. This study investigated the effectiveness of Social Justice Mathematics (SJM) in enhancing senior secondary school students' performance in algebraic expressions. Conducted in Benue State, Nigeria, the research employed a quasi-experimental pretest-post-test design with non-equivalent groups. The instrument used for data collection was the Social Justice Mathematics Algebraic Expression Test (SJMAET). A pilot test was conducted with 20 students, and the instrument's reliability was established using the Kuder-Richardson Formula 21 (K-R21), yielding a reliability coefficient of 0.86. Data analysis revealed that students in the experimental group, who were taught using Social Justice Mathematics, outperformed their counterparts in the control group who were taught using conventional method. The findings suggest that integrating social justice principles into mathematics instruction enhances students' academic achievement and promotes an inclusive learning environment. Therefore, it is recommended that Social Justice Mathematics be adopted in teaching algebraic expressions and other mathematical concepts to foster equity, justice, and fairness in the classroom.
Keywords: Social Justice Mathematics; Students' Performance; Algebraic Expression; Equity	

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INTRODUCTION

Improving students' performance in mathematics has been a major concern for mathematics educators and other stakeholders in the education sector. Despite ongoing efforts, reports continue to highlight poor student performance in mathematics, even though it is a fundamental subject (Age & Machaba, 2023). Many students struggle with mathematics, often perceiving it as difficult and abstract, which leads to disengagement (Leonard & Moore, 2014). This issue is exacerbated in Nigeria, where teacher-centered, mechanical, and drill-focused instructional methods fail to address students' diverse learning needs (Iji & Age, 2019; Akimbade et al., 2023; Koomson, et. al. 2024; Boetang, et. al., 2024). Furthermore, mathematics is a compulsory subject for all students, including those

from disadvantaged backgrounds, who often face systemic educational inequalities (Bature & Joseph, 2014). Therefore, it is crucial for educators to adopt instructional approaches that ensure fairness, equity, and engagement in mathematics classrooms.

Social Justice Mathematics (SJM) integrates social justice principles into mathematical instruction, aiming to promote equity while equipping students with the tools to recognize and address societal injustices (Age, 2024). According to Danny and Martin (2013), this approach helps students become aware of social inequalities and empowers them to use mathematics as a tool for change. Mathematics teachers play a crucial role in fostering fairness, as their instructional approaches can significantly impact student success (Latafat, 2024; Abah, et. al, 2024; Cotton, 2013; NCTM, 2000). Gutstein and Bob (2013) emphasize that socially just mathematics instruction should incorporate students' cultural backgrounds, lived experiences, and linguistic strengths, rather than treating them as deficits. By making mathematics relevant to students' lives, Social Justice Mathematics can enhance motivation, engagement, and performance, particularly among marginalized students. Additionally, it allows students to see mathematics as a powerful tool for analyzing and addressing real-world issues, reinforcing its significance beyond the classroom (Berry et al., 2020).

This study focuses on senior secondary school students because they are at a critical stage of their education, where strong mathematical foundations are essential for success in higher education and career paths, particularly in STEM fields. Moreover, performance disparities among secondary school students in mathematics have been well-documented, necessitating interventions that address both cognitive and social factors affecting learning (Veith et al., 2023).

Among mathematical concepts, algebraic expressions are chosen for this study because algebra is a gateway to advanced mathematical thinking and problem-solving (Custidio & Dolotallas, 2021). As the foundation of higher mathematics, algebra plays a crucial role in students' academic progression and their ability to apply mathematical reasoning in real-world situations (Star et al., 2016; Osei & Kubi, 2022). However, students often find algebra challenging due to its abstract nature and symbolic representation, which can lead to disengagement and poor performance (Osakwe et al., 2023; Egara et al., 2022). Additionally, teacher biases and inequitable instructional practices have been identified as factors contributing to students' struggles with algebra (Okeke et al., 2023). This study explores whether Social Justice Mathematics can help bridge this gap by making algebraic concepts more accessible, meaningful, and engaging.

Previous research suggests that incorporating social justice themes into mathematics education can improve student performance and engagement. Esmonde and Caswell (2010) argue that social justice pedagogy enhances both the content and delivery of mathematical instruction, making abstract concepts more relatable. Gutstein and Bob (2013) provide evidence that embedding real-world social justice issues into algebra instruction not only deepens conceptual understanding but also motivates students to actively participate in their learning. For instance, using algebra to model income inequality or social disparities allows students to see the relevance of mathematics in addressing societal challenges. NCTM (2018) further emphasizes that contextualizing algebraic concepts within

social justice issues fosters critical thinking and problem-solving skills, making mathematics more meaningful and accessible.

By integrating Social Justice Mathematics into algebra instruction, students are encouraged to think critically about social inequalities while developing essential mathematical skills. Research indicates that students in social justice-focused mathematics classrooms demonstrate greater motivation, deeper conceptual understanding, and improved algebraic proficiency compared to those taught using conventional methods (Lily, 2022; Boaler, 2022). Moreover, this approach fosters a sense of empowerment and agency, enabling students to apply their mathematical knowledge to real-world problems.

Despite the increasing emphasis on equity in education, there is still a gap in understanding the direct impact of Social Justice Mathematics on senior secondary school students' performance in algebraic expressions. This study aims to investigate whether teaching algebra through a social justice lens enhances students' engagement, motivation, and conceptual understanding compared to conventional methods. By examining the effectiveness of this approach, the study seeks to contribute to the growing body of research on equitable mathematics instruction and its role in improving student outcomes.

The purpose of this study is to examine whether there is a significant difference in the academic performance of senior secondary school students taught mathematics using Social Justice Mathematics (SJM) compared to those taught using the conventional method, specifically in the topic of algebraic expressions, in Makurdi Local Government Area, Benue State, Nigeria. Specifically, the study aims to determine whether integrating social justice principles into mathematics instruction enhances students' understanding and engagement in algebraic expressions.

To measure social justice in the classroom, the study employed the Social Justice Mathematics Classroom Observation Checklist (SJMCO) and the Social Justice Mathematics Perception Questionnaire (SJMPQ). The indicators for measuring social justice include:

- a) Equity in classroom participation (whether all students are given equal opportunities to contribute).
- b) Cultural relevance of mathematical examples (incorporation of real-world social justice issues in problem-solving).
- c) Students' perception of fairness and inclusivity (whether students feel valued and represented in the learning process).
- d) Teacher's instructional approach (use of student-centered and inquiry-based learning).

Students' academic performance in algebraic expressions will be assessed using the Social Justice Mathematics Algebraic Expression Test (SJMAET), a structured test designed to evaluate their conceptual understanding and problem-solving skills. The key indicators for measuring performance include:

- a) Understanding of algebraic expressions (ability to simplify, factor, and expand expressions).
- b) Application of algebraic concepts to real-world problems (solving contextualized word problems).
- c) Logical reasoning and critical thinking (ability to make mathematical

- connections and justify solutions).
- d) Accuracy in computation and symbolic manipulation (proficiency in algebraic operations).

By analyzing the results from these instruments, the study seeks to determine whether Social Justice Mathematics fosters deeper engagement and improved academic performance compared to conventional teaching methods. So the research question of this study is: What is the difference in academic performance of senior secondary school students taught mathematics using social justice and students taught mathematics using conventional method?

Research Hypothesis

There is no significant difference in the academic performance of senior secondary school students taught mathematics using social justice and students taught mathematics using conventional method.

RESEARCH METHOD

Quasi-experimental design of pretest, posttest of non-equivalent group was adopted for the study. The area of the study was Makurdi Local Government Area of Benue State of Nigeria. Makurdi Local Government Area was chosen because Senior Secondary School Students in the Local Government Area showed weakness in algebraic expression as reported in WAEC chief examiner's report for 2015-2021.

The population of the study was all the 2,201 Senior Secondary one (SS1) student in 23 Government Secondary Schools in Makurdi Local Government Area, Benue State (Benue State Teaching Service Board TSB, 2022). The Senior Secondary one (SS1) was preferred because it is at this level that students are being exposed to the concept of algebraic processes as stipulated in the Senior Secondary School Mathematics Curriculum.

Multistage sampling techniques was used; Purposive sampling was used to select the four schools for this study based on specific criteria to ensure the research objectives were effectively addressed. The selected schools were chosen because they had a diverse student population from different socio-economic backgrounds, making them suitable for evaluating the impact of Social Justice Mathematics (SJM) on various learners. Additionally, these schools followed a consistent national mathematics curriculum, ensuring that variations in content delivery did not influence the study's outcomes. The availability of qualified mathematics teachers capable of implementing either Social Justice Mathematics or conventional teaching methods was another crucial factor in the selection process. Furthermore, the schools had a documented history of student performance in mathematics, providing a reliable baseline for comparison before and after the intervention. After the four schools were purposively selected, simple random sampling was used to assign them to either the experimental or control group, ensuring that each school had an equal chance of being placed in either category. The experimental group received instruction using Social Justice Mathematics, while the control group was taught using conventional methods. This approach minimized selection bias and allowed for a fair comparison of students' academic performance in algebraic expressions under both instructional methods. A sample size of 283 students was

used for the study (145 students for experimental group, 138 students for control group).

The instrument used for data collection was Social Justice Mathematics Algebraic Expression Test (SJMAET) which was designed by the researcher. The instrument comprised 25 multiple choice objectives questions and was validated by two mathematics educators, one mathematics class teacher and an expert in measurement and evaluation was to ascertain the validity of the instrument.

The Researcher trial tested the developed instrument on 20 students outside the study area. Result from the pilot test was subjected to an analysis using Kuder-Richardson K-R21 formula to ascertain the reliability of the instrument and a reliability coefficient of 0.86 was realized.

Two research assistants who were the regular SS1 Mathematics teachers in one of the selected schools in both experimental and control group were trained by the researcher in order to cover the two groups. The research assistants for both the experimental and control groups were trained for two days. The research assistant for the experimental group was informed about the objectives of the research and taught on how to implement social justice in the teaching and learning of algebraic expressions (factorization) using the lesson plans prepared by the researcher. The research assistant in the control group was also trained on how to use the prepared lesson plans in teaching algebraic expression (factorization) using the conventional method.

A pre-test was administered to the groups (i.e experimental and control groups) at the same time so as to avoid the students discussing the test items. The treatment commenced immediately after the administered instruments were returned from each of the schools. Two schools were selected as the experimental group and two schools as the control group. Schools in these groups were in separate locations far apart to avoid interaction between the subjects in the experimental and control groups. The teaching lasted for four days, that is, one period of forty minutes per day ($40 \times 4 = 160$ minutes). At the end of the treatment period, post-test was administered to the subjects. The same procedure and conditions that were used for administering the pre-test were adopted for the post-post.

The data collected was analyzed using mean and standard deviation to answer the research questions, providing insights into students' academic performance in algebraic expressions under Social Justice Mathematics (SJM) and conventional teaching methods. To test the hypothesis, an independent samples t-test was conducted at a 0.05 level of significance to determine whether there was a statistically significant difference between the mean performance scores of students in the experimental and control groups. The decision rule for hypothesis testing was based on comparing the calculated t-value with the critical t-value from the t-distribution table. If the calculated p-value was less than 0.05, the null hypothesis was rejected, indicating a significant effect of Social Justice Mathematics on students' performance in algebraic expressions. Conversely, if the p-value was greater than 0.05, the null hypothesis was not rejected, suggesting no statistically significant difference between the groups. The findings from these statistical analyses helped draw conclusions regarding the effectiveness of Social Justice Mathematics in enhancing students' understanding and performance in algebraic

RESULTS AND DISCUSSION

The results are presented according to the research questions asked and hypotheses formulated.

Research Question

What is the difference in academic performance of senior secondary school students taught mathematics using social justice and whose taught mathematics with conventional method?

Table 1: Mean and Standard Deviation of Students taught mathematics using social justice and those taught with conventional method

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Experimental	145	1.99	0.94	3.29	0.86
Control	138	2.01	0.91	2.31	0.78
Mean Difference		-0.02		0.98	
Total	283				

Table 1 indicates that the experimental group had a mean pre-test rating of 1.99 with a standard deviation of 0.94, while the control group had a mean pre-test rating of 2.01 and a standard deviation of 0.91. After participating in algebraic expression lessons designed with a focus on social justice, the experimental group's mean post-test rating increased to 3.29 with a standard deviation of 0.86. Conversely, the control group's mean post-test rating decreased to 2.31 with a standard deviation of 0.78. The mean difference between the experimental and control groups was 0.98 in favour of experimental group.

Hypothesis

There is no significant difference in the academic performance of senior secondary school students taught mathematics using social justice and whose taught mathematics in conventional method.

Table 2: T-test analysis of the mean scores of students taught mathematics using social justice and those whose taught in normal conventional method.

Test	N	Mean	SD	T _{cal}	T _{tab}	α	Df	Decision
Experimental	145	3.29	0.86					
Control	138	2.31	0.78					
Total	283			10.04	2.829	0.005	281	Reject

Table 2 above shows that T_{cal} 10.04 is greater than T_{tab} 2.829. Thus, the null

hypothesis is rejected. This implies that students taught mathematics using social justice performed better than taught with conventional method.

Discussion of Findings

This study investigated the impact of Social Justice Mathematics (SJM) on students' performance in algebraic expressions, with a focus on measuring social justice in mathematical instruction. Social justice in mathematics was assessed using key indicators, including equity in instructional strategies, inclusivity in content delivery, student engagement levels, and critical thinking skills. These were measured through structured classroom observations, student participation rates, and qualitative feedback on learning experiences. The Social Justice Mathematics Algebraic Expression Test (SJMAET) was used to evaluate academic performance, ensuring that students' comprehension and problem-solving abilities in algebraic expressions were objectively assessed. The indicators for assessing student performance included accuracy in algebraic manipulations, conceptual understanding of algebraic relationships, ability to apply algebraic concepts to real-world problems, and overall test scores.

The findings from the study indicate that students taught algebraic expressions through social justice mathematics significantly outperformed their counterparts who were instructed using conventional methods. The improvement in performance was not only evident in higher test scores but also in enhanced engagement, motivation, and deeper conceptual understanding of algebraic concepts. This aligns with the position of the Organization for Economic Cooperation and Development (OECD, 2016), which asserts that appropriate teaching methodologies play a crucial role in enhancing students' academic achievement. Similarly, studies by Age (2024), Boaler et al. (2022), Xenofontos et al. (2020), Panthi et al. (2021), and Berry et al. (2020) emphasize that integrating social justice themes into mathematics instruction fosters greater student involvement, critical thinking, and long-term retention of mathematical concepts. These findings highlight the necessity of incorporating strategies like social justice mathematics in algebra instruction to improve students' overall achievement.

Furthermore, the study revealed a statistically significant difference between students who learned algebraic expressions through the social justice approach and those who received conventional instruction. This supports the findings of Pourdavood and Yan (2022), who assert that integrating social justice into science and mathematics education makes learning more meaningful, engaging, and effective, ultimately boosting students' achievement levels. Additionally, Gutstein & Bob (2013) and Putra, et. al. (2023) note that students exposed to real-world applications of mathematical concepts are more likely to actively participate in discussions and classroom activities, thus enriching their educational experiences. Algebra, when connected to social justice issues, becomes less abstract and more applicable to students' daily lives, thereby strengthening their interest and understanding of the subject.

However, while the findings underscore the importance of using social justice mathematics to enhance learning outcomes in algebraic expressions, existing literature suggests that there is still ambiguity in how social justice concepts are implemented in mathematics classrooms. Studies by Bostic et al. (2021), Berry et

al. (2020), Harrison (2015), Lawler (2010), and Stinson et al. (2012) indicate that although social justice mathematics promotes equity and inclusivity, there is limited research on standardized frameworks for integrating social justice themes into formal mathematics curricula. This highlights the need for further research and teacher training programs to ensure the effective implementation of social justice mathematics in secondary school education.

In conclusion, the results of this study strongly support the integration of social justice principles into algebra instruction, as it leads to higher academic achievement, increased engagement, and improved conceptual understanding among students. Future studies should explore scalable models for incorporating social justice into various mathematical topics, ensuring that students from diverse backgrounds benefit equitably from mathematics education.

CONCLUSION

This study investigated the impact of Social Justice Mathematics (SJM) on the academic performance of senior secondary school students in algebraic expressions. The findings revealed that students taught using social justice approaches performed significantly better than those taught using conventional methods. This improvement was attributed to the engaging, contextualized, and equity-focused nature of the social justice approach, which made algebra more meaningful and applicable to students' real-life experiences.

The study aligns with previous research (OECD, 2016; Boaler et al., 2022; Berry et al., 2020; Putra, et. at., 2024; Al-Hanifah, et. at., 2023) that emphasizes the importance of contextual and student-centered learning in improving mathematical understanding and performance. Additionally, it was found that integrating social justice topics into algebra lessons not only enhanced students' problem-solving abilities but also promoted active participation, critical thinking, and deeper conceptual understanding.

However, despite its effectiveness, the implementation of social justice mathematics in classrooms remains inconsistent due to the lack of structured guidelines and teacher preparedness (Bostic et al., 2021; Stinson et al., 2012). This highlights the need for further research and institutional support to facilitate the adoption of equity-based pedagogies in mathematics education. Based on the findings of this study, it is recommended that social justice mathematics be integrated into the mathematics curriculum to enhance student engagement, motivation, and performance. Teachers should receive specialized training and professional development on implementing social justice pedagogy, ensuring that mathematical concepts are taught in meaningful, real-world contexts. Additionally, instructional materials and textbooks should include examples and problem-solving tasks related to social justice issues to foster deeper conceptual understanding. Schools and policymakers should support and advocate for equity-based teaching approaches by providing necessary resources, funding, and structured guidelines for implementation. Furthermore, active and inclusive student participation should be encouraged through inquiry-based learning, group discussions, and collaborative problem-solving. Finally, further research should explore the long-term impact of social justice mathematics on student achievement across various mathematical

topics and educational settings to ensure sustainable improvements in teaching and learning. Schools, educational institutions, and government agencies should support and advocate for the integration of social justice mathematics by providing funding, resources, and policy frameworks that encourage innovative teaching approaches

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