THE ROLE OF MATHEMATICS EDUCATION IN FOSTERING SECONDARY SCHOOLSTUDENTS' ETHICAL VALUES AND MANAGEMENT SKILLS FOR SUSTAINABLE NATIONAL DEVELOPMENT IN CALABAR METROPOLIS IN CROSS RIVER STATE, NIGERIA

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Abstract

This study adopted ex post facto design to established the relationship exiting in the role of Mathematics Education in Fostering secondary school students' ethical values and management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria .. It was guided by two research questions and two null hypotheses. A sample of 470 students out of 2,432 SS 2 students in 24 public secondary schools in Calabar Metropolis in Cross River State, Nigeria were selected through multi-stage sampling techniques. .One instrument titled "Role of Mathematics Education in Fostering students' ethical values and management skills for sustainable national development(RMEFSEVMSQ)was used for data collection. The reliability of the questionnaire, established using Cronbach Alpha which ranges from .83 to .97. The hypotheses were tested using Pearson Product Moment correlation Coefficient at .05 level of significance. The findings of the study revealed thatMathematics Education significantly relate with secondary school students' ethical values and management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria.It was concluded students' ethical values and management skills for sustainable national development depend on effective mathematics education.. It was recommended amongst others that educators should Incorporate real-world management problems and ethical dilemmas into mathematics teaching to promote practical management skills and ethical awareness among students.

Keywords: *Mathematics Education, ethical values, management skills, sustainable national development*

Introduction

Mathematics education has long been recognized as a foundational discipline pivotal to national development. Mathematics education involves the processes of teaching and learning mathematical concepts, skills, and reasoning. It aims to develop students' logical thinking, problem-solving, and analytical abilities necessary for personal and societal development. It aims to develop students' numerical literacy, problem-solving abilities, logical thinking, and the capacity to apply mathematical knowledge to real-world situations. It also fosters critical thinking, analytical skills, and quantitative reasoning essential for various professional and everyday activities. (Li & Wang, 2020 ;Masor, Ibok, & Etura, 2023). Traditional perspectives emphasize its role in cultivating logical reasoning, analytical skills, and quantitative competence necessary for scientific progress and economic growth (OECD, 2019). However, emerging global challenges—such as climate change, resource scarcity, and social inequalities—necessitate that mathematics education extends beyond procedural knowledge to encompass the cultivation of ethical values and management skills among learners (Uche & Ijeoma, 2020).

The integrating ethical and management dimensions into mathematics curricula to produce responsible citizens and effective managers capable of making morally sound decisions within complex societal contexts and sustainable national development (Khan et al., 2020). For instance,

mathematical prolem-solving can be contextualized to reflect issues of social justice, environmental sustainability, and resource management, thereby fostering ethical consciousness and management competencies aligned with sustainable development goals (SDGs) (UNESCO, 2021). Moreover, developing ethical values such as honesty, integrity, fairness, and social responsibility within mathematics classrooms can influence students' attitudes towards societal issues and empower them to become agents of positive change (Akinola, 2020). Managing resources ethically, evaluating data responsibly, and making management-informed decisions are vital skills that can be nurtured through innovative pedagogical approaches that embed moral reasoning in mathematical contexts.

Mathematics education is universally recognized as a cornerstone of national development, fostering critical skills such as problem-solving, analytical thinking, and data literacy, which are essential for sustainable growth. In an era marked by rapid technological advancement, economic fluctuations, and environmental challenges, the role of mathematics extends beyond classroom learning, becoming a pivotal tool in addressing complex societal issues and promoting sustainable development (Li & Wang, 2020). Effective mathematics instruction equips students with the capacity to interpret data, make informed decisions, and innovate solutions relevant to their communities and nations. Furthermore, the integration of mathematics with sustainable development goals (SDGs) is increasingly emphasized, underpinning efforts towards poverty reduction, environmental conservation, and economic resilience. Countries investing in quality mathematics education aim to produce a competent workforce that can navigate and resolve the challenges associated with sustainable development (Mishra & Raghav, 2021). Despite the acknowledged importance of mathematics education, many developing nations still struggle with underachievement and inadequate curriculum implementation that limits students' capacity to apply mathematical concepts to real-world sustainable development challenges (Akarsu & Çetin, 2020). This gap hampers the realization of national development objectives dependent on innovative, data-driven decision-making. Additionally, a lack of emphasis on integrating ethical and management skills within mathematics education constrains students' ability to participate responsibly in sustainable development initiatives, thus impairing long-term progress.According to Nzengwa, and Komakech (2022), sustainability of national development refers to the capacity of a nation to pursue economic growth, social equity, and environmental protection simultaneously, ensuring that progress today does not compromise future generations' ability to meet their needs. It emphasizes balanced growth with ecological preservation, social inclusion, and economic resilience. There is an urgent need to investigate how mathematics education can be reoriented to better support sustainable national development, ensuring that learners acquire relevant skills, values, and knowledge necessary for addressing global and local development issues. In many contexts, mathematics curricula remain largely detached from moral and management dimensions, focusing predominantly on rote learning and procedural knowledge (Akinola, 2020). This disconnection limits students' capacity to apply mathematical reasoning ethically in real-world situations such as resource management, environmental issues, and social equity. Furthermore, many educational systems face challenges in integrating values-based pedagogy into mathematics teaching due to rigid curricula, lack of teacher training in ethics-based approaches, and inadequate emphasis on the socio-cultural relevance of mathematics for sustainable development (Ojo & Olaleye, 2021; UNESCO, 2019).. Consequently, students may develop high mathematical competence but lack the ethical awareness and management skills necessary to address societal challenges decisively and responsibly. Hence, the critical issue is that without deliberate efforts to embed ethical and management principles within mathematics education, the potential of mathematics as a tool for promoting sustainable development remains underutilized(Uche & Ijeoma, 2020).

Also the integration of ethical and management education within mathematics remains underexplored and often limited by curriculum inadequacies, lack of teacher training, and culturally contextual challenges (Ojo & Olaleye, 2021). Addressing these gaps is critical to harnessing mathematics as a tool for promoting sustainable national development by shaping a generation equipped with both technical expertise and moral judgment. In conclusion, re-envisioning mathematics education to embed ethical values and management skills is imperative for achieving sustainable development. It calls for systemic curriculum reform, teacher capacity building, and pedagogical

innovation steps essential for nurturing responsible and management-savvy citizens capable of steering nations towards sustainability (UNESCO, 2021).Mathematics education is not only about numerical skills but also plays a crucial role in fostering ethical values such as honesty, integrity, responsibility, and fairness among students. Embedding ethical considerations within mathematical problem-solving and decision-making processes encourages learners to develop moral consciousness, which is vital for sustainable national development. An ethical approach to mathematics education promotes responsible citizenship equipped to address societal challenges ethically and sustainably (Akarsu & Çetin, 2020; Ibok, Ogar, & Unoh, 2025;Ibok, Unoh, & Asuquo, 2024). As nations strive for sustainable growth, integrating ethical values into mathematics curricula helps cultivate morally upright individuals capable of making decisions that benefit both society and the environment. Mathematics education play a significant role in promoting ethical values among students, which is vital for fostering sustainable national development. Ethical values are moral principles that guide individuals and organizations to act responsibly and justly. They include honesty, integrity, fairness, respect, and accountability, which influence decision-making and behavior, ensuring actions benefit both society and the environment. While traditional mathematics instruction primarily emphasizes procedural proficiency, a growing body of research advocates for integrating ethics and values-based pedagogy to nurture responsible citizens. Khan et al. (2020) conducted a mixed-methods study in Pakistan, revealing that contextualized mathematics problem-solving activities emphasizing social justice and environmental concerns effectively enhanced students' ethical awareness. Their findings suggest that when students solve real-world problems rooted in social issues, they internalize values such as fairness and social responsibility. Similarly, in Australia, Williams and Miller (2021) found that incorporating ethical dilemmas in mathematics lessons increased students' appreciation for moral reasoning and ethical decision-making. They argue that embedding values within mathematical contexts encourages learners to consider the societal implications of data use, resource management, and mathematical modeling. In Singapore, Lee and Tan (2022) evaluated a curriculum reform that integrated moral reasoning with mathematical problem-solving. The study demonstrated improvements in students' capacity for ethical judgment, particularly relating to sustainability and equitable resource distribution, highlighting the potential of mathematics to serve as a platform for moral development.

In Nigeria, Oladipo and Adebayo (2021) explored how ethics-driven mathematics projects influence students' moral development. Their qualitative study indicated that students exposed to community-based mathematics activities demonstrated increased awareness of social responsibility, honesty, and collaboration. The researchers emphasized that locally relevant contextualization is critical for fostering ethical values through mathematics .

Similarly, Ojo and Olaleye (2021) reviewed curriculum reforms aimed at embedding ethical considerations into mathematics teaching in Nigeria. They found that teachers trained in the ethics-based approach reported higher student engagement in moral reasoning activities, and students exhibited greater concern for societal issues, including sustainability and resource management. Across diverse educational contexts, empirical evidence suggests that mathematics education can serve as an effective conduit for fostering ethical values such as social justice, honesty, responsibility, and sustainability. When mathematics instruction incorporates moral dilemmas, real-world issues, and community relevance, students are more likely to develop not only cognitive skills but also moral virtues necessary for sustainable development (UNESCO, 2021). Nonetheless, the implementation of such pedagogical strategies requires curriculum restructuring, teacher training, and culturally contextualized materials to realize their full potential.

Mathematics education is integral to developing critical management skills such as decision-making, strategic planning, resource management, and problem-solving. These competencies are essential for students to effectively contribute to sustainable national development. When mathematics is contextualized within real-world management challenges, it enhances students' analytical thinking and ethical reasoning, key elements for responsible leadership in promoting sustainability (Li & Wang, 2020). As nations aim to achieve sustainable development goals, fostering management skills through mathematics education becomes crucial in preparing a competent workforce capable of addressing environmental, economic, and social challenges (Mishra & Raghav, 2021). According to Mishra, and

Raghav (2021), management skills refer to the abilities required to effectively plan, organize, lead, and control resources (people, time, materials), to achieve organizational or societal goals efficiently. These skills include decision-making, leadership, communication, problem-solving, and strategic thinking, vital for driving sustainable development processes. Kirkland, and Bonder (2020) found that integrating real-world management problems into mathematics curricula improves students' decision-making, strategic thinking, and leadership skills crucial for sustainable development. Yusuf, and Singh (2021) examines *Mathematics modeling and entrepreneurship skills among university students in developing countries and found* that project-based mathematical modeling enhances entrepreneurial and management skills, vital for entrepreneurship-driven sustainable development. Smith, and Lee,(2019) conducted a study on *embedding management principles in mathematics education to foster sustainability competencies and found* integrating management theories into mathematics lessons to better prepare students for leadership roles in sustainable development. Adebayo, and Oladipo (2020) conducted a study on *Mathematics skills and management competencies among Nigerian secondary school students and found* that students with higher proficiency in mathematics demonstrated better project management, resource utilization, and decision-making skills linked to community development. Femi, and Adedeji (2022) conducted a study on *Impact of curriculum enhancement on Nigerian students' management skills and sustainable development and found* a positive correlation between improved mathematics curriculum content and the development of management skills aligned with Nigeria's sustainable growth strategies.

Statement of the Problem

Mathematics education has predominantly been viewed as a vehicle for developing analytical, quantitative, and problem-solving skills necessary for economic and technological advancement. However, a limited focus on the ethical and management dimensions within mathematics curricula remains a significant gap in many educational systems. This narrow emphasis neglects the crucial role that mathematical literacy can play in shaping responsible citizens and effective managers, capable of making decisions that promote sustainable development. Despite the evidence suggesting that mathematical reasoning and ethical decision-making are interconnected, most curricula lack explicit frameworks for cultivating ethical values such as integrity, fairness, and social responsibility through mathematical problem-solving or project-based activities. This deficiency is compounded by inadequacies in teacher training; many mathematics educators are not equipped with pedagogical strategies to embed moral and management principles into their teaching practices. Furthermore, in many developing nations, the disconnect between mathematics education and the socio-economic needs of society hampers efforts to develop management competencies related to resource allocation, environmental sustainability, and social equity—areas critically linked to national development goals . As a result, students often graduate with strong computational skills but lack the ethical consciousness and management capabilities necessary to contribute meaningfully to sustainable national development. Without deliberate curriculum reforms and professional development initiatives that integrate ethical and management perspectives into mathematics education, the potential of mathematics as a transformative tool remains underexploited. This shortfall could hinder the development of a citizenry equipped with the moral judgment and management skills essential for addressing complex societal challenges, thereby impeding sustainable development at the national level.

Purpose of the study

The main purpose of this study is to established the relationship exiting in the tole of Mathematics Education in Fostering secondary school students' ethical values and management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria . Specifically, the study seek to established

i). the relationship between Mathematics Education and secondary school students' ethical values for sustainable national development in Calabar Metropolis in Cross River State, Nigeria .

ii). the relationship between Mathematics Education and secondary school students' management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria

Research Questions

To direct the investigation, the following research questions are posed:

i) To what extent does the Mathematics Education relate with secondary school students' ethical values for sustainable national development in Calabar Metropolis in Cross River State, Nigeria ?

ii). To what extent does Mathematics Education relate with secondary school students' management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria ?

Research Hypotheses

i.) There is no significant relationship between Mathematics Education and secondary school students' ethical values for sustainable national development in Calabar Metropolis in Cross River State, Nigeria .

ii). There is no significant relationship between Mathematics Education and secondary school students' management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria

Methodology

The study area was Calabar Metropolis in Cross River State, Nigeria which consisted of Calabar South and Calabar Municipality. The research design used for this study was the ex-post facto design. The researcher used this design because the variables of study which are Mathematics education, ethical value and management skills have occurred already and the researcher had no direct control over them but only established the relationship between the variables. The population for the study consisted of all 2,432 SS 2 students in 24 public secondary schools in Calabar Metropolis in Cross River State, Nigeria. A multi-stage sampling technique involving stratified, simple random technique and proportional sampling technique were adopted in selecting 470 students for the study. . The schools were stratified based on gender and local government area. Out of a total of 24 public secondary schools, 6 (25%) of schools were randomly selected for the study, from the selected schools in each of local government , 19.3% of the total number of SS2 students were selected using proportional sampling technique giving a total sample of 470 students for the study.

The instrument used for data collection was the questionnaire titled "Role of Mathematics Education in Fostering students' ethical values and management skills for sustainable national development(RMEFSEVMSQ) ". The instrument was developed by the researcher with the help of the two expert in the Department of Mathematics and Computer Science Education and two experts in Educational Administration Department, both from University of Calabar. The questionnaire contained 26 items based on four points scale designed to measure the sub-variables of the study. Each item required the respondent to indicate the frequency of his or her various opinions under strongly agree, agree, disagree and strongly disagree. The face and content validity were established by using two experts in Test, Measurement and Evaluation; in the faculty of Education, and two expert in two expert in the Department of Mathematics and Computer Science Education both from University of Calabar. The expert certified that the instrument (questionnaire), was face and content validity and could be used for the study. To established the reliability of the instrument (questionnaire) through Cronbach Alpha Reliability, a trial testing was done using 40 SS 2 students in Calabar South Local Government Area of Cross River State who were not part of the sample for the study but have same characteristics as the one used in the study. Cronbach Alpha reliability was used to examine the internal consistency of the instrument which give the reliability indices ranges .83 to .87 which showed that the research instrument was reliable. The

hypotheses formulated to guide the study were appropriately tested using a Pearson Product Moment Correlation Coefficient.

Presentation of results

The result of the analysis is presented in tables 1 and 2. The hypotheses were tested at .05 significant level.

Ho_1: There is no significant relationship between Mathematics Education and secondary school students' ethical values for sustainable national development in Calabar Metropolis in Cross River State, Nigeria.The independent variable in this hypothesis is Mathematics Education while the dependent variable is students' ethical values for sustainable national development . In testing this hypothesis, mean, standard deviation of between Mathematics Education and secondary school students' ethical values for sustainable national development were computed, compared and correlate using Pearson Product Moment Correction.The results are presented on Table 1.

Table 1: Person Product Moment Correlation of the relationship between Mathematics Education and secondary school students' ethical values for sustainable national development (N= 470)

Variables	N	Mean	SD	r-value	p-value
Mathematics Education	470	19.823	2.132	.812	.000
Students' ethical values	470	29.888	4.232		

*Significant at the .05 level, df =468

The result presented on Table 1 shows the high positive significant relationship between Mathematics Education and secondary school students' ethical values for sustainable national development in Calabar Metropolis in Cross River State, Nigeria (r=.812; p=.000). With this result, the null hypothesis was rejected while the alternative was retained at the 0.05 level of significance. The positive r-value indicated that the more they students acquired mathematics education , the more positive ethical values for sustainable national development tend to be. On the other hand, there is no effective Mathematics Education , the more negative ethical values for sustainable national development tend to be

Ho_2: There is no significant relationship between Mathematics Education and secondary school students' management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria.The independent variable in this hypothesis is Mathematics Education while the dependent variable is students' management skills for sustainable national development . In testing this hypothesis, mean, standard deviation of between Mathematics Education and secondary school students' management skills for sustainable national development were computed, compared and correlate using Pearson Product Moment Correction.The results are presented on Table 2.

Table 1: Person Product Moment Correlation of the relationship between Mathematics Education and secondary school students' management skills for sustainable national development (N= 470)

Variables	N	Mean	SD	r-value	p-value
Mathematics Education	470	19.823	2.132	.873	.000
Students' management skills	470	27.432	4.831		

*Significant at the .05 level, df =468

The result presented on Table 1 shows the high positive significant relationship between Mathematics Education and secondary school students' management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria (r=.873; p=.000). With this result, the null hypothesis was rejected while the alternative was retained at the 0.05 level of significance. The positive r-value indicated that the more they students acquired mathematics education , the more management skills for sustainable national development tend to be. On the other hand, there is no effective Mathematics Education , the lesser management skills for sustainable national development tend to be

Discussion of findings

The result of hypothesis one revealed that there is a significant relationship between Mathematics Education and secondary school students' ethical values for sustainable national development in Calabar Metropolis in Cross River State, Nigeria. This is because Mathematics education is not only about numerical skills but also plays a crucial role in fostering ethical values such as honesty, integrity, responsibility, and fairness among students. Embedding ethical considerations within mathematical problem-solving and decision-making processes encourages learners to develop moral consciousness, which is vital for sustainable national development. An ethical approach to mathematics education promotes responsible citizenship equipped to address societal challenges ethically and sustainably (Akarsu & Çetin, 2020). As nations strive for sustainable growth, integrating ethical values into mathematics curricula helps cultivate morally upright individuals capable of making decisions that benefit both society and the environment.

The finding agreed with Khan et al. (2020) who that when students solve real-world problems rooted in social issues, they internalize values such as fairness and social responsibility. Similarly, in Australia, Williams and Miller (2021) found that incorporating ethical dilemmas in mathematics lessons increased students' appreciation for moral reasoning and ethical decision-making. The finding agreed with Lee and Tan (2022) who found that improvements in students' capacity for ethical judgment, particularly relating to sustainability and equitable resource distribution, highlighting the potential of mathematics to serve as a platform for moral development. The finding agreed with Ojo and Olaleye (2021) who found that teachers trained in the ethics-based approach reported higher student engagement in moral reasoning activities, and students exhibited greater concern for societal issues, including sustainability and resource management.

The result of hypothesis second revealed that there is a significant relationship between Mathematics Education and secondary school students' management skills for sustainable national development in Calabar Metropolis in Cross River State, Nigeria. This is because Mathematics education is integral to developing critical management skills such as decision-making, strategic planning, resource management, and problem-solving. These competencies are essential for students to effectively contribute to sustainable national development. According to Mishra, and Raghav (2021), management skills refer to the abilities required to effectively plan, organize, lead, and control resources (people, time, materials), to achieve organizational or societal goals efficiently. The finding aligned with Kirkland, and Bonder (2020) who found that integrating real-world management problems into mathematics curricula improves students' decision-making, strategic thinking, and leadership skills crucial for sustainable development. The finding agreed with Yusuf, and Singh (2021) who *found* that project-based mathematical modeling enhances entrepreneurial and management skills, vital for entrepreneurship-driven sustainable development. The finding agreed with Smith, and Lee,(2019) who *found* integrating management theories into mathematics lessons to better prepare students for leadership roles in sustainable development. Adebayo, and Oladipo (2020) *found* that students with higher proficiency in mathematics demonstrated better project management, resource utilization, and decision-making skills linked to community development.

Conclusion

Mathematics education extends beyond numerical and theoretical skills, playing a vital role in fostering ethical values and management competencies essential for sustainable national development. When mathematics is contextualized within real-world management issues and imbued with ethical considerations, it cultivates critical thinking, decision-making, resource management, and a strong sense of integrity among students. These attributes are indispensable for developing responsible citizens capable of contributing effectively to sustainable development goals. Thus, integrating ethical dimensions and management-oriented approaches into mathematics curricula is crucial for nurturing morally upright and competent future leaders committed to national progress.

Recommendations

The following recommendations are made based on this study

i) Educators should Incorporate real-world management problems and ethical dilemmas into mathematics teaching to promote practical management skills and ethical awareness among students.

ii) School management should provide professional development for educators to effectively integrate ethical values and management concepts within mathematics instruction, emphasizing contextualized learning approaches.

iii) Curriculum planer should engage policymakers, educational institutions, and industry stakeholders in designing and implementing mathematics programs that align with sustainable development and ethical practices.

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