Assessing the Role of STEM Curriculum in Promoting Skill Acquisition among Senior Secondary School Students in Bichi Local Government Area of Kano State

By

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Abstract

In the face of rapid global technological advancement, Science, Technology, Engineering, and Mathematics (STEM) education has emerged as a strategic tool for equipping youths with employable and entrepreneurial skills. This study was conducted to assess the role of STEM curriculum in promoting skill acquisition among senior secondary school students. The study had three main objectives: (1) to examine the implementation of the STEM curriculum in Bichi LGA, (2) to assess its contribution to students' acquisition of practical, technical, and entrepreneurial skills, and (3) to identify the challenges hindering its effective implementation. Corresponding research questions were formulated to guide the study. A descriptive survey research design was adopted. The study population comprised 3,860 students and 60 STEM subject teachers across 18 public and 3 private secondary schools. A sample size of 353 respondents which includes 338 students and 15 teachers was selected using multi-stage sampling technique. Data were collected using structured questionnaires developed by the researchers. Content validity was ensured through expert review, while the reliability of the instrument was confirmed using the Cronbach Alpha method, with a pilot test yielding a coefficient of 0.70. The data was analyzed using descriptive statistics mean and standard deviations, via SPSS version 23. The findings showed that while STEM subject are taught, the integration of practical learning and real-life applications is limited. Students acknowledged improvement in creativity and critical thinking but felt unprepared for employment. Teachers reported similar challenges, emphasizing poor infrastructure, lack of training, and inadequate teaching resources. The study concludes that effective STEM implementation in Bichi LGA is constrained by structural and pedagogical gaps. It recommends investment in infrastructure, teacher training, practical learning methods, and partnerships with industries and NGOs to improve student outcomes and ensure the curriculum fulfills its transformative potential.

Keywords: *STEM Curriculum, Skill Acquisition, Secondary Education*

Introduction

Education remains a critical driver of national development and economic competitiveness in the 21st century. The rise of the Fourth Industrial Revolution has made Science, Technology, Engineering, and Mathematics (STEM) central to global education reform. Countries such as the United States, China, South Korea, and Finland have significantly restructured their education systems to produce STEM-proficient graduates capable of thriving in knowledge-driven economies (Adebayo and Olatunji, 2023). In Africa, and particularly Nigeria, there has been increased advocacy for STEM education to empower youth with digital literacy, problem-solving abilities, and entrepreneurial skills (Ugwoke, Onah and Okeke, 2020).

The Nigerian National Policy on Education highlights the importance of equipping learners with life-relevant skills, and STEM education is recognized as a strategic instrument to achieve this goal (Federal Ministry of Education, 2020). To this end, STEM subjects are integrated into the secondary school curriculum to promote analytical thinking, innovation, and employability. However, various studies (Ishola and Ajayi, 2022; Ogundele and Adesanya, 2019) reveal that STEM implementation in Nigerian secondary schools is hindered by lack of infrastructure, poorly trained teachers, and limited use of project-based learning.

Furthermore, there is a growing concern about the disconnect between classroom instruction and real-life applications of knowledge. In many senior secondary schools, STEM subjects are taught theoretically, with little or no emphasis on practical learning and experimentation. As a result, students graduate without acquiring the essential life and technical skills required for gainful employment or entrepreneurship (UNESCO, 2017). This situation perpetuates youth unemployment and underutilization of human capital, especially in northern Nigeria.

In many rural and semi-urban communities like Bichi Local Government Area in Kano State, these challenges are even more pronounced. Despite the inclusion of STEM subjects in

school curricula, the absence of practical learning environments such as science labs, ICT hubs, and workshops limits the potential for real-world application. As a result, students often graduate without acquiring employable or entrepreneurial skills, contributing to the persistent issue of youth unemployment (Akinfeleye and Adeyemo, 2020). This study therefore soughs to investigate the role of STEM curriculum in enhancing skill acquisition among senior secondary students in Bichi LGA, providing evidence-based recommendations to bridge the gap between policy intent and classroom realities.

Aim and Objectives of the Study

Aim of the Study

The aim of this study was assess the role of STEM curriculum in promoting skills acquisition among senior secondary school students in Bichi Local Government Area of Kano State.

Objectives of the Study

The specific objectives were to:

i. Examine the implementation of the STEM curriculum in senior secondary schools in Bichi LGA.
ii. Assess the extent to which the STEM curriculum contributes to students' acquisition of practical, technical, and entrepreneurial skills.
iii. Examine the challenges hindering effective implementation of the STEM curriculum in Bichi LGA.

1.4 Research Questions

To achieve the objectives of this study, the following research questions were posed:

i. What is the extent of implantation of STEM curriculum in senior secondary schools in Bichi LGA?

ii. What extent does the STEM curriculum facilitates students' acquisition of practical and employable skills?

iii. What are the challenges that hinder the effective implementation of STEM education in Bichi LGA?

METHODOLOGY

Research Design

The study adopted a descriptive survey research design. This design is appropriate because it enables the researchers to collect data from a sample of respondents to describe the status of the implementation of the STEM curriculum and its effect on students' skill acquisition. According to Al-khresheh, (2024) a survey design allows researchers to gain insights into practices, opinions, and experiences through structured instruments.

Population of the Study

The target population for this study comprised all senior secondary school students (SS2) and STEM subject teachers (particularly Mathematics and Biology teachers) in public and private secondary schools in Bichi Local Government Area of Kano State. There are 21 senior secondary schools in the area, with student population of 3,860 and STEM teaching staff strength of 60.

Sample and Sampling Technique

A total sample of 353 respondents was selected for the study. This includes: two hundred and ninety three (338) SS2 students and sixty (15) teachers (Mathematics and Biology teachers)

Sampling Technique

The study adopted a multi-stage sampling technique: Purposive Sampling for selecting five (5) senior secondary schools (four public and one private) out of 21 secondary schools in Bichi LGA, proportionate sampling was used in selecting number of student from the sample schools. Simple random sampling was used in selecting the respondents from the sample schools. Purposive Sampling: Within each selected school, STEM subject teachers (Mathematics and Biology) were purposively selected based on their specialization and relevance to the study objectives.

Instrumentation

The primary instrument for data collection was structured questionnaire, developed by the researcher. Two sets of questionnaires was prepared: one for students and the other for teachers. Section A: Demographic information (age, gender, school type, level, etc.), Section B: Items related to components of the STEM curriculum; Section C: Questions on skills acquisition (technical, cognitive, practical skills). While Section D: Items addressing challenges in implementing STEM. The items will be rated using a 4-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree.

Validity of the Instrument

To ensure validity of the instrument, the questionnaire was reviewed by two experts in science education and one from test and measurement department of Federal College of Education (Technical), Bichi. Their suggestions and corrections were incorporated before final administration.

Reliability of the Instrument

The reliability of the instrument was determined using the Cronbach Alpha method. A pilot study was conducted with 20 students and 5 teachers in a neighboring LGA not included in

the main study. A reliability coefficient of 0.70 was considered acceptable (Govindasamy, Cumming, & Abdullahi 2024).

Procedure for Data Collection

Permission was obtained from the school authorities and Bichi Education Zonal Directorate. The researchers visit each selected school and personally administered the questionnaires. Participants were assured of the confidentiality of their responses, and their participation was entirely voluntary.

Method of Data Analysis

Data collected was analyzed using descriptive statistics. Mean and standard deviation to interpret Likert scale responses. All analyses were done using Statistical Package for the Social Sciences (SPSS) version 23.

Analysis of Research Questions

Research Question 1: *What are the major components of the STEM curriculum implemented in senior secondary schools in Bichi LGA?*

Table 1: Students' Perceptions on STEM Curriculum Components (n = 338)

Item	Mean	SD	Decision
The school offers STEM subjects (Math, Science, Tech)	3.45	0.68	Agree
Curriculum integrates theory and practice	2.91	0.74	Agree
Adequate time is allocated for STEM subjects	2.22	0.88	Disagree
Real-life examples used in STEM teaching	2.84	0.81	Agree
STEM projects/experiments are encouraged	2.41	0.92	Disagree

The mean score for the statement 'The school offers STEM subjects (Math, Science, Tech)' is 3.45 (SD = 0.68), indicating a strong agreement among students that STEM subjects are included in the school curriculum. Similarly, students agreed that the curriculum integrates theory and practice with a mean of 2.91 (SD = 0.74). However, they disagreed that adequate time is allocated for STEM subjects (mean = 2.22, SD = 0.88) and that STEM projects or experiments are encouraged (mean = 2.41, SD = 0.92). These findings suggest a theory-heavy approach with limited practical exposure.

Research Question 2: *What extent does STEM curriculum facilitate students' acquisition of practical and employable skills?*

Table 2: Students' Responses on Skill Acquisition (n = 338)

Item	Mean	SD	Decision
STEM curriculum helps me develop practical skills	2.89	0.75	Agree
I can apply STEM knowledge to real-life problems	2.94	0.79	Agree
STEM improves my critical thinking	3.06	0.64	Agree
It promotes creativity and innovation	3.18	0.6	Agree
I feel more prepared for employment due to STEM	2.35	0.85	Disagree

Students agreed that the STEM curriculum promotes creativity and innovation, with a high mean of 3.18 (SD = 0.60). Other positively rated items include critical thinking (mean = 3.06, SD = 0.64), application to real-life problems (mean = 2.94, SD = 0.79), and development of practical skills (mean = 2.89, SD = 0.75). However, the item 'I feel more prepared for employment due to STEM' received a lower mean of 2.35 (SD = 0.85), indicating that students still feel underprepared for the workforce.

Table 3: Teachers' Perceptions of Students' Skill Acquisition (n = 15)

Item	Mean	SD	Decision

Students acquire practical skills through STEM	2.96	0.7	Agree
Students show improved creativity/innovation	3.12	0.66	Agree
STEM knowledge is applied in real-life by students	2.37	0.8	Disagree
STEM promotes collaboration among students	3.06	0.61	Agree
Technical/vocational skills have improved over time	2.91	0.74	Agree

Teachers generally agreed that STEM fosters creativity and collaboration among students, as indicated by mean scores of 3.12 (SD = 0.66) and 3.06 (SD = 0.61), respectively. They also acknowledged improvement in technical and vocational skills (mean = 2.91, SD = 0.74). However, they disagreed on whether students apply STEM knowledge in real-life settings (mean = 2.37, SD = 0.80), revealing a gap between knowledge and application.

Research Question 3: *What are the challenges that hinder the effective implementation of STEM education in Bichi LGA?*

Table 4: Challenges Faced by Students (n = 338)

Item	**Mean**	**SD**	**Decision**
Lack of lab/workshop facilities	3.34	0.53	Agree
Teachers lack training in practical teaching	3.08	0.64	Agree
Inadequate teaching materials/equipment	3.17	0.59	Agree
Classes are mostly theoretical	3.21	0.58	Agree
Time constraints affect STEM learning	3.01	0.73	Agree

Students strongly agreed that lack of lab/workshop facilities (mean = 3.34, SD = 0.53) and classes being mostly theoretical (mean = 3.21, SD = 0.58) are major challenges. They also agreed that teachers lack practical teaching training (mean = 3.08, SD = 0.64), and that inadequate materials (mean = 3.17, SD = 0.59) and time constraints (mean = 3.01, SD = 0.73) hinder effective STEM learning.

Table 5: Challenges Reported by Teachers (n = 15)

Item	Mean	SD	Decision
Lack of lab facilities affects teaching	3.35	0.5	Agree
Lack of training in modern STEM methods	3.15	0.61	Agree
STEM teaching materials are outdated or unavailable	3.19	0.58	Agree
Students lack motivation in STEM	2.81	0.83	Agree
Overcrowded classrooms limit STEM engagement	3.12	0.7	Agree

Teachers strongly agreed that the lack of lab facilities significantly affects STEM teaching (mean = 3.35, SD = 0.50). They also identified the lack of modern STEM training (mean = 3.15, SD = 0.61), outdated materials (mean = 3.19, SD = 0.58), student motivation issues (mean = 2.81, SD = 0.83), and overcrowded classrooms (mean = 3.12, SD = 0.70) as key barriers.

Discussion of Findings

The study found that while STEM subjects are present in schools, the integration of practical activities remains insufficient. Students reported a lack of project-based learning and real-world applications, and teachers confirmed that limited resources and time constraints hinder the implementation of hands-on STEM education. This aligns with Akinfeleye and Adeyemo (2020), who observed that STEM delivery in Nigerian secondary schools is often hindered by outdated curricula and insufficient infrastructure. Similarly, Oyeniran et al. (2021) emphasized the need for improved STEM delivery mechanisms that merge theoretical teaching with practice, particularly in underserved communities. These scholars argue that real-life relevance and active learning are crucial to developing critical thinking and problem-solving skills among learners.

Both students and teachers agreed that the STEM curriculum fosters creativity, critical thinking, and collaboration. However, concerns were raised about its effectiveness in preparing students for real-world employment and entrepreneurial opportunities. Many students reported being unable to apply classroom knowledge to practical situations. These findings echoed Ishola and Ajayi (2022), who found that while Nigerian students gain cognitive skills through STEM subjects, the lack of experiential learning limits their readiness for the workforce. In the same vein, Ugwoke, Onah & Okeke (2020) highlighted that integrating skills-based learning, including coding, robotics, and entrepreneurship, into the curriculum is essential for improving the employability of graduates.

Respondents identified key challenges including lack of laboratory facilities, insufficient teaching materials, limited teacher training, and large class sizes. These constraints were commonly reported by both students and teachers, who indicated that STEM teaching is predominantly theoretical. These findings agreed with Ogundele and Adesanya (2019), who found out that infrastructure deficiencies and poorly trained educators remain the major obstacles to STEM reform in Nigerian secondary schools. Furthermore, Adebayo and Olatunji (2023) stressed that without modern instructional tools and continuous teacher development programs, achieving STEM objectives in rural or semi-urban areas remains elusive.

Conclusion

This study concludes that although STEM education is being implemented in senior secondary schools in Bichi LGA, its effectiveness in promoting skill acquisition is limited by several structural and pedagogical challenges. Students are exposed to theoretical aspects of STEM, but rarely to hands-on, practical learning opportunities that build employable and

entrepreneurial skills. The curriculum holds potential for skill development, but only if supported by adequate infrastructure, modern instructional resources, and trained educators.

Without addressing these systemic issues, the goal of using STEM education as a tool for youth empowerment, employability, and innovation in Nigeria may remain unfulfilled particularly in rural and semi-urban areas like Bichi.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Government and school authorities should prioritize the provision of science laboratories, technical workshops, and ICT facilities to support hands-on STEM learning.

2. Regular and targeted professional development workshops should be organized to train teachers on innovative and practical STEM teaching methods, including project-based and problem-solving approaches.

3. The existing STEM curriculum should be enriched with more real-life applications, local industry partnerships, and entrepreneurship components to prepare students for job creation and self-reliance.

4. Public schools should receive increased funding and grants dedicated to improving STEM infrastructure and learning materials.

5. Schools should collaborate with NGOs, industries, and universities to provide mentorship, internships, exhibitions, and STEM competitions that motivate and engage students.

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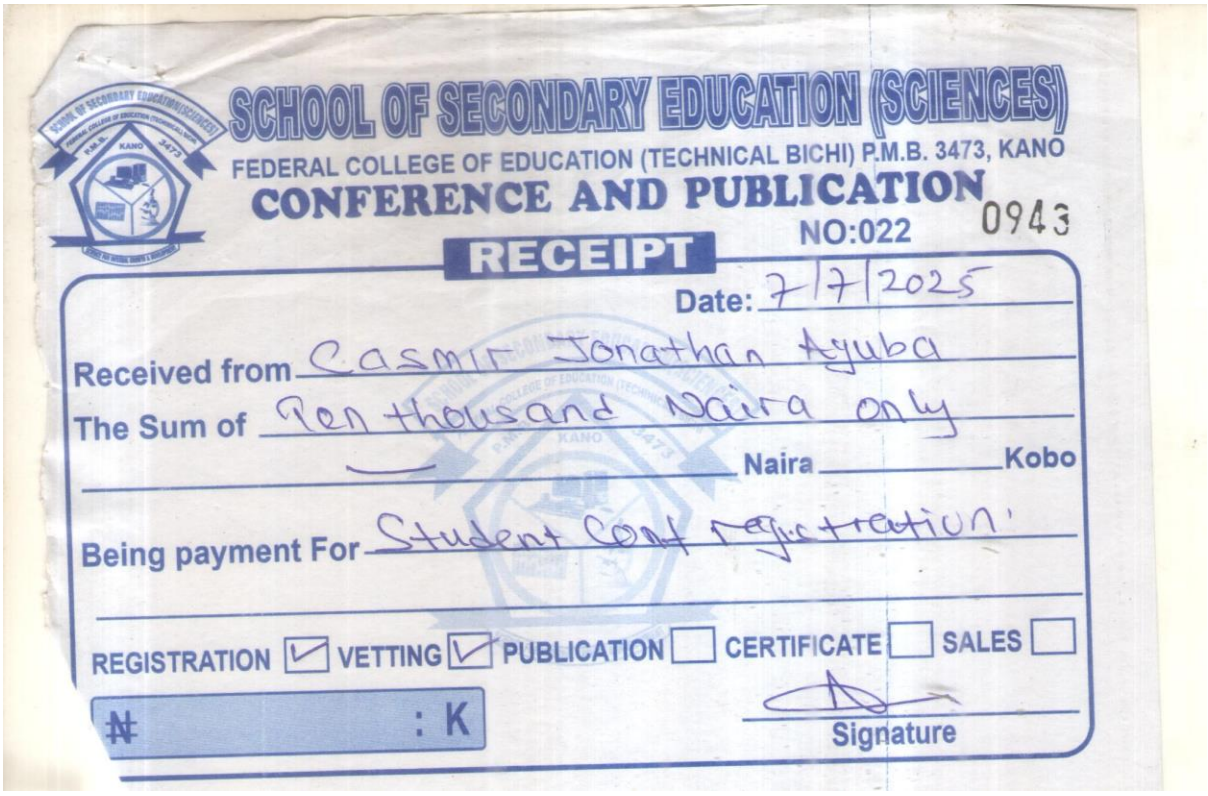

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