

**CHALLENGES AND PROSPECTS OF
IMPLEMENTING INNOVATIVE PEDAGOGIES AND
PRACTICAL WORK IN STEM EDUCATION: A CASE
STUDY OF SECONDARY SCHOOL TEACHERS IN
CROSS RIVER STATE, NIGERIA**

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Abstract

The study determined teachers' perceived challenges of utilizing innovative pedagogies and practical work skills in secondary schools STEM classrooms in Cross River state. It found teachers perceived solutions to the challenges of utilizing innovative pedagogies and practical work skills in secondary schools STEM classrooms in cross River State and determined the prospects of utilizing innovative pedagogies and practical work skills in STEM classrooms in cross River State. These were with a view to providing empirical information on perceived challenges of utilizing innovative pedagogies and practical work skills in secondary school STEM classrooms in Cross-Rivers state. The study adopted a descriptive survey research design

.The population for the study was 1509 STEM teachers in all the 32 government science secondary schools in the Cross-River state. Simple random sampling technique was used to select 250 STEM teachers for the study. The research instrument was a researcher made 4- points Likert scale type of Questionnaire titled: "Questionnaires for Challenges and Prospects of Implementing Innovative Pedagogies and Practical Work in STEM Education"(CPIIPPWSE) which was validated by experts, test retest method was used to determine the reliability of the instrument to be 0.81. The instrument was administered in 2025/2026 academic session through research assistants, and data collected was analysed using descriptive statistics of mean and standard deviation with a criterion mean score of 2.50. The findings of the study revealed factors like lack of electricity supply to rural schools, inadequate

infrastructures particularly in rural schools, large class size, motivation and related factors are barriers to innovative STEM pedagogy and practical work skills particularly in rural schools in the state as perceived challenges. Seven recommendations were made, among which is: Government commitment, community support, and partnerships with private companies are needed to establish annual STEM teacher professional development programmes to give all STEM teachers the needed skills for effective implementation of STEM education goals in the state, irrespective of school location.

Keywords: STEM, Innovative Pedagogy, Practical Work skills, Challenges, Prospects and Solution

Introduction

The main objective of science education is to equip students with the knowledge, skills, and competencies required to function effectively in an increasingly complex and technology-driven world. By developing a deep understanding of scientific principles, technological innovations, engineering design processes, and mathematical reasoning, learners are better prepared to navigate the challenges and opportunities of the modern workforce and contribute meaningfully to innovation and societal development. Science, Technology, Engineering, and Mathematics (STEM) education provides a pathway for achieving these goals by offering engaging and hands-on learning experiences that bridge the gap between theoretical knowledge and real-life applications. Through project-based learning, experiential activities, and collaborative problem-solving tasks, students are able to apply their knowledge in authentic contexts and appreciate the interconnectedness of STEM disciplines (Tanner, 2013). STEM education also promotes the development of critical thinking, creativity, communication, and collaboration skills that are essential for success in the 21st-century workforce

(David et al., 2018; Al. Hamad et. al., 2024). By encouraging inquiry-based learning and fostering a growth mind-set, students are motivated to actively participate in the learning process, develop problem-solving abilities, and work collaboratively. According to Nkok and Nkok (2024), science education policies increasingly criticize the traditional emphasis on rote learning and memorization of facts, which often limits students' conceptual understanding and ability to apply knowledge in different contexts. Consequently, the use of active teaching and learning strategies such as group projects, problem-based learning, and experimental activities has been recommended to enhance student engagement and deeper understanding of scientific concepts. Savec (2019) noted that hands-on and interactive learning experiences enable students to explore scientific ideas more deeply, test different approaches, and acquire practical skills that are applicable in real-life situations. The transition from rote learning to active and inquiry-based learning therefore forms the foundation of STEM education (NPE, 2014; Shironica, 2023).

Despite these benefits, the effective utilization of innovative pedagogies and practical work skills by STEM teachers in Nigerian secondary schools faces several challenges. One major challenge is the shortage of qualified science teachers (Nkok, & Chukelu 2025, Nkok &Nkok 2025; Ajemba et al. 2021) described science teachers as professionals trained to teach science-related subjects such as Biology, Chemistry, Physics, and Mathematics. However, many Nigerian secondary schools suffer from an inadequate supply of these teachers, which limits the effective implementation of STEM education. In addition, many teachers lack professional training in the use of modern technological tools such as coding, robotics, and computer-assisted instruction, while the few skilled teachers are often overloaded and poorly motivated. This situation highlights the importance of teacher

professional development and the integration of pedagogical content knowledge (PCK) into teacher education programmes (Lee et al., 2023).

Another major challenge is the limited integration of information and communication technology (ICT) in science classrooms. Teachers' ICT competence involves not only operating digital tools but also understanding when and how to apply them effectively in teaching and learning (UNESCO, 2018). However, studies have shown that many teachers in Cross River state have limited experience in using ICT for instructional purposes (Oduma & Ile, 2014; Umate et al., 2018; Beri & Sharma, 2019). This problem is more severe in rural areas where many schools lack science laboratories, computers, internet access, and basic instructional materials. As a result, teachers are often expected to teach practical STEM concepts using only textbooks without adequate exposure to the required tools.

Infrastructure and funding constraints also hinder the effective implementation of STEM education in the state (Damaševičius, et. al., 2018). Many schools experience poor electricity supply, inadequate laboratory facilities, and limited access to instructional resources. Without adequate infrastructure, teachers find it difficult to conduct experiments or integrate modern technologies into classroom instruction. In addition, STEM learning tools such as robotics kits, computers, and laboratory equipment are expensive and beyond the reach of many schools (Popoola, 2020; UNDESA 2014). Poor funding of the education sector further worsens the situation, as the state government allocations to education often fall below recommended levels, resulting in poor infrastructure, limited instructional resources, and low teacher motivation (Echono, 2023). Other challenges affecting the effective utilization of innovative pedagogies in STEM classrooms in the state include large student–teacher ratios,

gender inequality in STEM participation, limited access to modern research resources, and corruption within the education sector. Large class sizes make it difficult for teachers to implement interactive and student-centered teaching strategies (Nkok & Nkok, 2024). Cultural beliefs, gender stereotypes, and lack of role models also discourage many female students from pursuing STEM-related fields (Nwoke, 2017). Furthermore, corruption and mismanagement of educational resources have contributed to poor infrastructure, inadequate staffing, and declining educational standards (Madaki, 2019; Ogunode & Johnson, 2021).

In cross River State, the major challenges are infrastructural and manpower disparity between the urban and the rural schools. Recent research finding has revealed that teachers in the urban schools have more access to capacity building trainings, and exposure to novel technologies, hence, utilize innovative teaching strategies more than teachers in the rural schools (Nkok & Nkok, 2024). This place students in the rural schools at disadvantage over their mates in the urban schools. Despite these challenges, the effective utilization of innovative pedagogies and practical work skills in STEM education holds significant prospects for Cross River state and Nigeria at large. Research has shown that innovative STEM teaching approaches can improve students' interest, academic achievement, and retention in science subjects (Umar, 2019). It can also promote problem-solving skills, technological competence, and collaboration among learners, thereby preparing them for careers in engineering, medicine, computing, and other science-related fields (Sidi et al., 2024).

From the literature available to the researcher, numerous challenges of the implementation of innovative teaching in STEM have been identified, it has also been established that successful implementation of STEM education can contribute to the development of a knowledge-based society and

strengthen technological and economic growth of Cross Rivers State and Nigeria at large, but no specific studies were carried out in rural /urban infrastructural availability, man power capacity development and the peculiar challenges affecting the utilization of innovative pedagogies and practical work skills in Cross River state, which might be responsible for the persistent poor performance of science students in senior secondary schools certificate examination (SSCE) in the rural schools of the state (Field work, 2026). This creates a gap in knowledge, to fill the gap, this study investigates the Challenges and Prospects of Implementing Innovative Pedagogies and Practical Work in STEM Education: Evidence from Secondary School Teachers in Cross River State, Nigeria. The study anchors on Experiential Learning Theory which was Proposed by David Kolb (1984), and argues that learners develop knowledge and skills through experience, reflection, conceptualisation and active experimentation rather than listening to theoretical explanations. The theory can be represented as: Concrete Experience → Reflective Observation → Abstract Conceptualisation → Active Experimentation. This theory supports innovative teachings and practical work- skills as students are allowed to perform an experiment → reflect on what happened → connect the experience with scientific principles → apply what they learnt to a new practical problem. This is the central focus of innovative teaching strategy and the practical work skills. Practical work skills are acquired by doing, which can make learning more impactful than rote learning and memorization.

Purpose of the Study

The general objective of this study is to identify teachers perceived Challenges and prospect of effective utilization of innovative pedagogies and practical work skills in Cross River state. Specifically, the objectives of the study are to:

- i. determine teachers perceived challenges of utilizing innovative pedagogies and practical work skills in

- secondary schools STEM classrooms in Cross River state
- ii. find teachers perceived solutions to the challenges of utilizing innovative pedagogies and practical work skills in secondary schools STEM classrooms in cross River State
 - iii. determine the prospects of utilizing innovative pedagogies and practical work skills in STEM classrooms in cross River State

Research Questions

What are the challenges of utilizing innovative pedagogies and practical work skills in secondary schools STEM classrooms in Nigeria?

1. What are teachers perceived challenges of utilizing innovative pedagogies and practical work skills in STEM classrooms in cross River State?
2. What are teachers perceived solutions to the challenges of utilizing innovative pedagogies and practical work skills in secondary schools STEM classrooms in cross River State?
3. What are the prospects of utilizing innovative pedagogies and practical work skills in secondary schools' STEM classrooms in cross River State?

Methodology

The study adopted a descriptive survey research design. The study population was 509 STEM teachers in all the 32 government science secondary schools in the State. A proportionate stratified random sampling technique was employed to select 250 participants for the study. The sample were proportionately allocated to the 32 schools based on the number of teachers in each school using Yamane's formula and increased to 250 to allow for possible non-response or incomplete questionnaire. The research instrument was a researcher made 4- points Likert scale of strongly agree 4

points, agree 3points, disagree 2points and strongly disagree 1point, with reverse scoring of strongly disagree 4 points, disagree 3 points, agree 2points and strongly agree 1points for negative items titled: 'Challenges and Prospects of Implementing Innovative Pedagogies and Practical Work in STEM Education'(CPIIPPWSE). The instrument made up of four sections, section one was the bio-data of the respondents,' section two to three contained, 10 items each. The items were questions on perceived challenges, solutions and prospects of innovative teaching strategies and practical work skills by STEM teachers in Cross Rivers state, Nigeria. The instrument was duly validated by 2 experts in science education and 2 experts in educational technology. Test retest method was used to determine the reliability of the instrument to be 0.81 using Pearson product -moment correlation coefficient. The instrument was administered on all the selected 250 participants in the 32 schools in 2025/2026 academic session through research assistants, and data collected was analysed using descriptive statistics of mean and standard deviation. A mean score above 2.50 was considered to be agreement of the respondents while below 2.50 was considered as disagreement (below average) because 4point Likert scale was used in the study.

Results

Research Question 1

What are teachers perceived challenges of utilizing innovative pedagogies and practical work skills in STEM classrooms in cross River State?

Table 1 shows the mean and standard deviation scores of responses on challenges of utilizing innovative pedagogies and practical work skills in secondary schools STEM classrooms in Cross River State Items 1,2,3,4,5,7,8 and 9 with mean scores of 3.33,2.8,3.2,3.2,3.2, 3.2,2.75 and 2.8 which are above the criterion score of 2.50 shows the respondents

agreement to those items while negative items 6 and 10 with mean scores of 1.87 and 1.76 respectively which are below the criterion score of 2.5 indicates that the respondents disagreed to the items

Table 1: Mean Responses on the challenges of Effective Utilization of Innovative Pedagogies and Practical Work Skills

S/N		SA	A	D	SD	Mean	Std	Remark
1	Limited access to modern equipment and technology pose challenge to innovative pedagogies in STEM classrooms	129	88	21	12	3.33	0.82	Agreed
2	Inadequate teacher training on Innovative pedagogies and practical application work skills hinders effective utilization of innovative pedagogies and practical work skills by science teachers	98	81	15	56	2.8	1.16	Agreed
3	Large STEM class size and inadequate infrastructure impedes effective pedagogies in STEM classrooms in Nigeria	120	89	21	20	3.2	0.91	Agreed
4	Rigid curriculum structure and focus on theoretical exams is another challenge to innovative pedagogies in STEM	119	89	25	14	3.2	0.86	Agreed
5	Poor funding of schools can improve the quality of STEM teaching	132	77	19	22	3.2	0.91	Agreed
6	Electricity is not a challenge of innovative pedagogies	118	78	24	30	1.87	0.80	Disagreed

7	Difficulty in assessing practical skills hinders effective pedagogies in STEM education	116	87	31	16	3.2	0.93	Agreed
8	Limited parental involvement is not a challenge of innovative pedagogies in STEM	115	99	23	13		0.79	Agreed
9	Poor teacher motivation affects STEM policy implementation	111	37	52	50	2.8	1.19	Agreed
10	Losing of professionally trained science teachers to other professions does not affect STEM education in Nigeria by Secondary School STEM Teachers in Cross River State.	123	111	9	7	1.76	0.82	Disagreed

Research Question 2

What are teachers perceived solutions to the challenges of utilizing innovative pedagogies and practical work skills in secondary schools STEM classrooms in cross River State?

Table 2 shows the mean and standard deviation scores of responses on challenges of utilizing innovative pedagogies and practical work skills in Cross River State secondary school's STEM classrooms Items 1,2,3,4,5 and 7 with mean scores of 3.2, 3.3, 3.72 3.2, 3.4 and 3.1 which are above the criterion score of 2.50 shows the respondents agreement to those items while negative items 6,8,9 and 10 with mean scores of 1.48,1.3,1.68 and 1.6 which are below the criterion score of 2.5 indicates that the respondents disagreed to the items

S/N		SA	A	D	SD	Mean	Std	Remark
1	Regular training of teachers on innovative pedagogies and practical work skills can help solve the challenges of innovative teaching methods in STEM	119	88	20	23	3.2	0.94	Agreed
2	Integration of project-based learning and practical assessment can reduce the challenges of innovative pedagogies and practical work skills in STEM education	134	81	32	3	3.3	0.75	Agreed
3	Partnership with other schools for collaboration can help reduce the challenges of implementing innovative teaching strategies	120	89	21	20	3.2	0.91	Agreed
4	Increased school funding will help produce the challenges of innovative pedagogy and practical work skill	120	93	17	20	3.2	0.85	Agreed
5	Mentorship of teachers by industry experts and experienced educators for guidance will help equip teachers with practical work skills for innovative teaching of STEM education	129	97	19	5	3.4	0.67	Agreed
6	Improved teacher motivation has no effect on innovative STEM teaching	175	47	11	17	1.48	0.84	Dis agreed
7	Enacting laws that check corruption in education sector can help the growth	100	93	43	14	3.12	0.88	Agreed

	of STEM education in Nigeria								
8	Provision of up to date learning facilities in all schools cannot help implementation of STEM education policies in Nigeria	210	18	10	12	1.30	0.75	Dis agreed	
9	Electricity supply does not have effect on innovative pedagogies	118	11 2	3	17	1.68	0.90	Disagreed	
10	Availability of ICT network does not affect the utilization of innovative pedagogies	102	13 2	7	9	1.6	0.82	Disagreed	

Table Two: Mean Responses on the solution to the challenges of Effective Utilization of Innovative Pedagogies and Practical Work Skills by Secondary Schools STEM Teachers in Cross River State

Research Question 3

What are the prospects of effective utilization of innovative pedagogies and practical work skills in secondary schools STEM classrooms in Cross River State?

Table: 3 shows the mean and standard deviation scores of responses on the Prospects of Effective Utilization of innovative pedagogies and practical work skills by secondary school STEM teachers in Cross River state. Positive items 1-10 with mean scores of 3.1, 3.3, 3.3, 3.4, 3.2, 3.2, 3.3, 3.2, 3.0 and 3.1 which are above the criterion score of 2.50 shows the respondents agreement to those items

Table 3: Mean Responses on the Prospects of Effective Utilization of Innovative Pedagogies and Practical Work Skills by Secondary School STEM Teachers in Cross River State

S/N		SA	A	D	SD	Mean	Std	Remark
1	Innovative pedagogies and practical work skills will enhance critical thinking on learners	121	70	27	32	3.1	1.04	Agreed
2	Innovative pedagogies can bridge the gap between theoretical knowledge and practical application in STEM	132	80	20	18	3.3	0.90	Agreed
3	Students are more likely to pursue STEM carriers if thought with innovative pedagogy and practical work skills	125	100	15	10	3.3	0.77	Agreed
4	STEM education will enhance students' ability to solve societal problems if innovative pedagogies and practical work skills are utilized in STEM classrooms	145	67	25	13	3.4	0.86	Agreed
5	Innovative pedagogies will Increase students' engagement	147	54	21	28	3.2	1.04	Agreed
6	Innovative pedagogies will Increase students' motivation	121	88	27	14	3.2	0.86	Agreed
7	Innovative pedagogies will Increase academic achievement of students	119	99	23	9	3.3	0.78	Agreed
8	Innovative pedagogies will Increase students' retention	123	79	28	20	3.2	0.94	Agreed
9	Practical work skills will ease transfer of knowledge	90	109	25	25	3.0	0.93	Agreed

Discussion of Findings

STEM teachers’ perception of challenges of Effective Utilization of Innovative Pedagogies and Practical Work Skills in Cross River State reveals poor power supply in the rural schools as one of the major challenges affecting effective utilization of innovative pedagogies and practical work skills in STEM classroom in the state. This finding is in agreement with that of Ow hoeke, and Chukwuka, (2023); Aina (2022) which concluded that challenges such as inadequate infrastructure, limited teacher training, and insufficient policy support continue to hinder effective implementation of STEM education, particularly in the Nigerian context. The highlighted challenges may be the reasons that utilization of innovative pedagogies and practical work skills in STEM classrooms in Cross River State is so difficult to achieve.

The findings on STEM teachers perceived solution to the challenges of effective utilization of innovative pedagogies and practical work skills in Cross River revealed that teacher training, collaboration within schools, proper school funding, integration of project based learning, curriculum review and providing of expert’s mentorship to STEM teachers as some of the possible ways of tackling the challenges of effective utilization of innovative pedagogies and practical work skills in STEM education classrooms. This finding is in agreement with that of Okanya, et. al. (2025) which highlighted the critical role of innovative pedagogy and practical skill development in enhancing STEM education outcomes and concluded that learner-centred approaches, hands-on activities, and the integration of real-world problem-solving significantly improve students’ understanding, engagement, and retention of scientific concepts. The study of Ajemba (2024) which

concluded that, addressing the challenges of the barriers of effective utilization of innovative pedagogies and practical work skills in STEM classroom requires coordinated efforts from government, educational institutions, and other stakeholders to invest in teacher capacity building, modern learning resources, and supportive policies also aligns with the findings of this study. The identified solutions to the challenges in this study if achieved will bridge the gap between theoretical knowledge and practical skills in STEM education.

STEM teachers' perception of the prospects of effective utilization of innovative pedagogies and practical work skills in Cross River state shows that it can improve students' engagement and motivation. This finding is in line with that of Babalola and Keku (2024) which established that, strengthening innovative and practical approaches in STEM education is essential for development, as it fosters critical thinking, creativity, and problem-solving skills among learners. If the challenges of STEM education are addressed, STEM education has the potential to enhance critical thinking of students, improve academic achievement and retention and result to transfer of knowledge to solve problems in the society.

Conclusion

The paper examined the various problems militating against the implementation of STEM education in Cross Rivers State, Nigeria, as perceived by STEM teachers. Teachers identified inadequate resources, training, funding, lack of electricity supply to rural schools, inadequate infrastructures particularly in rural schools, large class size, motivation and related factors as barriers to innovative STEM pedagogy and practical work skills particularly in rural schools in the state.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government commitment, community support, and partnerships with private companies are needed to establish annual STEM teacher professional development programmes to give all STEM teachers the needed skills for effective implementation of STEM education goals in the state, irrespective of school location.
2. STEM teachers particularly in rural areas should make conscious efforts to teach in accordance with the prescription of STEM objectives so as to improve students' engagements and inculcate critical thinking and problem-solving skills in them.
3. Government should provide laboratory, digital equipment, constant electricity supply, internet, and other instructional resources in both urban and rural areas in the state.
4. The government should set up laws to checkmate the activities of educational planners and all other educational stakeholders so as to eradicate corruption in the educational sector.
5. The government, parents/guardians, NGO and well-meaning Nigerians should collaborate to Provide the necessary study materials for science students in both urban and rural schools
6. Educational planners and administrators should Check the teacher-student levels by reducing the student population in STEM classrooms irrespective of the schools' location.
7. The government and school owners should improve STEM teacher motivation by providing special incentives to encourage them to put in extra effort and time in the STEM education implementation process.

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