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REMODELLING EDUCATION FOR STUDENTS IN NIGERIA BY PROVIDING RELEVANT SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS LEARNING (STEM).

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ABSTRACT

Over the past thirty years, it is evident that there has been little change in the methodology of teaching Science, Technology, Engineering, And Mathematics (STEM) in Nigeria. Consequently, Nigerian students have lagged, encountering difficulties in science and math proficiency. Despite national reform initiatives aimed at enhancing the situation, the absence of uniformity and a unified effort has resulted in negligible alterations in instructional methods. This research examined data from student and teacher programs conducted by State Universal Basic Education Board (SUBEB). The focus was on two programs implemented over a two-year period: STEM Bootcamps for children and Teacher training initiatives. The results indicated that these programs successfully enhanced learning and forged a robust link to the real world. Even though it was their initial encounter with STEM pedagogy, both educators and students recognized its worth and found it advantageous in grasping the concepts addressed during the programs. These favorable outcomes sparked conversations about expanding the pilot programs and considering the ramifications for policy and future research.

Keywords: *Cross River State, Curriculum, Education, Teaching, Skills Development, STEM.*

INTRODUCTION

The state of Cross River through SUBEB in partnership with social organizations working to improve education outcomes seeks to remodel the learning culture of Nigerian students by helping teachers in the state through some successful teaching modifications. Often, the changes made are not as substantial as they should be, failing to address the core issue: the true essence of teaching and learning STEM. Studies indicate that in the next 15 to 30 years, Africa will face a significant number of youths without employment if the necessary STEM skills are not taught today, considering the rapid evolution and heavy focus of the job market on STEM. STEM education is characterized by an interdisciplinary approach that integrates the four disciplines of science, technology, engineering, and mathematics into a cohesive learning paradigm based on real-world applications. It emphasizes the use of technology in the classroom, preparing students to use and understand the latest tools and resources that are essential in the modern world. It is vital for economic growth and stability, as it equips students with the skills necessary for high-demand careers in the 21st century. As the world becomes more technologically advanced, nations with a strong STEM-educated workforce are more competitive on the global stage because STEM education is crucial for solving global challenges such as climate change, health issues, and sustainable energy and provides the knowledge base for innovation in these areas. By promoting STEM education among all students, including girls and underrepresented groups, we can work towards greater empowerment and equity in society. STEM careers often offer higher wages and more opportunities, which can lead to improved social and economic outcomes. This is why this program, launched in 2017, has the mission of changing the narrative in Cross River State, Nigeria, and Africa as a whole by equipping students with highly competitive STEM skills required to be relevant for the job market of the 4th industrial revolution.

STATE OF AFFAIRS FOR BASIC EDUCATION IN NIGERIA

The data on Nigerian education reiterates the need for effective policies to enhance access and learning, especially for girls. Nigeria has a significant out-of-school population, with 10.5 million children not enrolled. Girls' enrollment is lower, accounting for only 47% at the primary school level and further declining to 44% at the junior secondary school level. The rate of survival to the last grade of primary school is 69.8% for girls and 77.4% for boys, and only 53% of students progress to secondary school. Disparities in school access are notable across regions, with gender disparities more pronounced in northern states compared to the progress made in southern Nigeria. In the south, a very small percentage of boys and girls from rural and urban areas are out of school. However, the focus on improving education goes beyond access, as many Nigerian students struggle with basic skills. A significant percentage of students cannot read a complete sentence even after completing grade 4 or do basic addition by the end of primary school. The situation is particularly challenging in the Northern region, where learning outcomes are poor, and a large number of students remain illiterate even after completing grade 6. For instance, in Sokoto State, 80% of Grade 3 pupils struggle to read a single word (Duyilemi and Olusa 2008).

Acknowledging the pressing concerns and disparities in educational provision in Nigeria, this paper centers on remodeling science education and learning for both girls and boys already enrolled at the primary level in Cross River State. With over 20 million children in this category, the paper emphasizes the importance of not squandering their potential to contribute significantly to Nigerian society through adequate encouragement and training in science education. Various obstacles within the Nigerian education sector hinder the promotion of pro-STEM interests among its students (Salim 1998). STEM interest among students lacks adequate support and

encouragement from educational institutions to catalyze and nurture it (Ugboduma 2009). Presently, students are discouraged from pursuing academic careers in STEM due to negative influences on their psychological inclinations (Ezeweani and Atomatofa 2012).

THE SUBEB TEACHER TRAINING AND AFTER-SCHOOL INITIATIVE

The typical approach to teaching STEM in Nigeria follows a set pattern where the teacher demonstrates problem-solving steps, the class solves similar problems together, and then students practice exercises independently. During the SUBEB summer boot camps in 2018 and 2019, they decided to change this approach for 6-8-year-olds. Instead of merely providing formulas, they engaged them in project-based learning activities centered around understanding area concepts and their relation to shapes like squares, rectangles, and triangles. Through real-world projects, such as calculating the carpet required for fictional projects and furniture spaces, students grasped the concepts of area, perimeter, and volume in a more meaningful way.

The pedagogical method called “Project-based learning’ is a method using elements like authentic assessment, decision-making, complex tasks, and real-world problem-solving, as well as collective and individual learning objectives. It requires teachers to facilitate and guide student-directed learning. However, many STEM educators do not possess the training or experience to establish project-based learning. Studies indicate that some teachers, especially those with extensive experience, may lack the management skills needed for challenging projects, which could lead to negative attitudes toward project-based learning among novice teachers. It has been proven that teaching experientially and through student-directed hands-on projects leads to better performance during achievement assessments. That's why we emphasize project-based learning as the fundamental principle of STEM Education.

NEED ASSESSMENT FOR BOOT CAMPS

According to SUBEB, their approach always begins by identifying opportunities within challenges and focusing on a specific topic or theme. The aim was to help students connect these challenges to their daily lives, fostering an authentic interest in problem-solving. During boot camps, they have seen success in engaging students by sharing inspiring stories from visual books such as "The Most Magnificent Thing" and "Rosie Revere Engineer". Additionally, for specific challenges, they use internet articles and YouTube videos to provide context.

During the assessment, their main objectives are:

- Emphasizing effort instead of relying on innate talent as a major factor to excel in STEM subjects. They consistently acknowledge and reward students for their effort and problem-solving skills.
- Nurturing self-efficacy and self-confidence, especially among female students, whose confidence levels are lower when it comes to engineering activities.
- Establishing continuous real-world connections to highlight the importance of STEM skills and concepts in everyday life.
- Developing cognitive skills by focusing on the process, not just the final product. We encourage students to sample different approaches to accomplish tasks and articulate their thought processes.

OBJECTIVES OF THE STUDY

1. To evaluate the methodology of teaching STEM (Science, Technology, Engineering, and Mathematics) in Cross River State, Nigeria.

2. To assess the impact of STEM Bootcamps for children and teacher training initiatives on learning outcomes and the ability of educators and students to connect STEM concepts to real-world applications.

3. To address the stagnation in STEM education methodologies in Nigeria and to ensure that students are equipped with the necessary skills to be competitive in the future job market, particularly in the context of the 4th industrial revolution.

4. To provide recommendations for policy and future research based on the findings of the study, to scale up successful pilot programs and enhance the overall STEM education framework in Nigeria.

MATERIALS AND METHOD

Population and Sample

This study utilized data from two teacher training programs conducted by SUBEB along with two STEM boot camps in Cross River State, Nigeria. The population of the study includes teachers represented by a mix of public schools and private schools (72 percent from our schools' network and low-cost partnership) and children aged 6-16 years old The sample consists of approximately 83 children and nearly 120 teachers who were engaged directly through the SUBEB STEM Teacher training and Afterschool initiatives over 2 years.

Sampling Techniques

The study employed a non-experimental sampling technique.

Instruments Used to Collect Data

The study used cross-sectional surveys as the primary instrument for data collection. Data was collected anonymously through quantitative surveys, which included pre and post-assessments to measure changes in the target populations. The surveys were designed with carefully crafted questions, informed by insights from informal interviews and previous focus group surveys.

Validation

To ensure unbiased responses, the surveys were crafted based on insights from informal interviews and previous focus group surveys.

Method of Data Analysis

Quantitative data was obtained from the pre and post-training surveys, with results presented in tables showing the percentage of respondents agreeing with various statements. Qualitative data was obtained through participant feedback during the workshops, with responses to specific questions about the workshop's effectiveness and impact on teaching practices.

The analysis of quantitative data was done using descriptive statistics by calculating the percentage of responses in different categories (Strongly Agree, Agree, Uncertain, Disagree, strongly Disagree). Qualitative data analysis

was thematic, with participant responses indicating satisfaction with the workshop, intentions to apply learned methodologies, and plans to share knowledge with peers.

RESULTS AND DISCUSSION

Over 2 years, The SUBEB STEM Teacher training and Afterschool initiatives engaged approximately 83 children directly and nearly 120 teachers in Cross River state, Nigeria. These are results from questionnaires handed to participants before and after the training.

Table 1: Pre-training survey questionnaire - 3 questions were most significant from the questionnaire-:

S/N	ITEMS	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	I'm seeking a more effective method to teach STEM.	62%	27%			
2	I'm unclear about what STEM entails.	28%		5%		52%
3	I require assistance with teaching STEM.	73%	23%	4%		

Table 2: Post-training evaluation form - 3 questions were most significant from the questionnaire

S/N	ITEMS	Strongly Agree	Agree	Uncertain
1	The presenters possessed a thorough understanding of the subjects discussed.	91%	6%	
2	The workshop material was both practical and pertinent.	92%	4%	
3	In general, I was content with the workshop.	70%	19%	5%

During the workshop, we also inquired about participants' feedback through specific questions, such as:

- Do you think that the workshop lived up to your anticipations?
- A participant responded: Yes, it will aid me in forging stronger connections and captivating my students in the classroom.
- Another respondent expressed: I am satisfied with the workshop.
- How will the insights gained from this workshop impact your teaching or approach?
- One participant stated: It will elevate my teaching by integrating additional STEM-related exercises.
- Another participant remarked: I intend to involve my students in more project-based learning.
- What are your plans to share the knowledge acquired in this workshop among your fellow educators at your institution?

A participant responded: I will pass on the information to my colleagues to ensure that other students can reap the benefits of the knowledge received here.

DISCUSSION

Analysis of Qualitative and Quantitative Data

Quantitative data from the pre-training and post-training surveys revealed significant shifts in teacher perspectives and preparedness to teach STEM. Before the training, a substantial number of teachers (62%) were actively seeking more effective methods to teach STEM, and a majority (73%) indicated a need for assistance in teaching STEM subjects. This suggests a recognition among educators of the inadequacies in current STEM teaching methodologies. There was also a notable lack of clarity about what STEM entails, as 28% of respondents strongly disagreed and 52% of respondents disagreed with having a clear understanding of STEM.

Post-training evaluations showed a marked improvement in teacher and student satisfaction and confidence. The data indicated that 91% of participants strongly agreed that the presenters had a thorough understanding of the subjects discussed, and 92% found the workshop material both practical and pertinent. Furthermore, 70% of participants were generally content with the workshop, indicating a positive reception to the training provided.

Qualitative feedback from participants during the workshop underscored the quantitative findings. Teachers and students said that the workshop lived up to their expectations and would help forge stronger connections between students and teachers. Teachers also indicated that the insights gained would elevate their teaching by integrating more STEM-related exercises and project-based learning. Teachers also planned to share the knowledge acquired with their colleagues, suggesting a potential multiplier effect on the broader teaching community.

1. To evaluate the methodology of teaching STEM in Cross River State, Nigeria: The results demonstrate that the teacher training initiatives were effective in addressing the need for more effective STEM teaching methodologies. The positive feedback from teachers regarding the practicality and pertinence of the workshop material suggests that the training provided them with new strategies and tools to enhance their teaching methods.

2. To assess the impact of STEM Bootcamps for children and teacher training initiatives on learning outcomes and the ability to connect STEM concepts to real-world applications: The qualitative feedback from teachers indicates that the training and bootcamps were successful in helping educators connect STEM concepts to real-world applications. The use of project-based learning activities, which focus on real-world problem-solving, likely

contributed to this success, as evidenced by the teachers' intentions to incorporate more of these exercises into their teaching.

3. To address the stagnation in STEM education methodologies in Nigeria and ensure students are equipped with the necessary skills for the future job market: The study's findings suggest that the initiatives have begun to address the stagnation in STEM education by introducing innovative teaching methods such as project-based learning. This aligns to equip students with the skills required for the 4th industrial revolution, as the training emphasized real-world applications and problem-solving.

4. To provide recommendations for policy and future research based on the findings of the study: The positive outcomes of the pilot programs provide a strong basis for recommending the expansion of these initiatives. The study suggests establishing STEM centers, enhancing teacher training, and integrating project-based learning throughout the curriculum. These recommendations are aimed at scaling up the successful programs and improving the overall STEM education framework in Nigeria.

RECOMMENDATIONS

SUBEB should collaborate with more partners to conduct a minimum of 5 training programs across various locations in Cross River State, training at least 1,500 teachers. To further the advancement of STEM education, I further propose actively implementing the following:

- Establishing STEM Centers that serve as hubs for teachers, students, and parents to learn while fostering STEM growth and awareness.
- Training STEM teachers to enhance their effectiveness in delivering STEM content.
- Providing training in STEM pedagogy to non-STEM teachers, enabling them to integrate project-based learning throughout the schools' curriculum.
- Securing sponsorships for educators in STEM to participate in training workshops and enhance their expertise.
- Encouraging organizational involvement in backing Public-Private initiatives that propel STEM education in Nigeria.

CONCLUSION

To drive meaningful change, we must prioritize professional development effectively. A major obstacle to faster progress is insufficient STEM training and comprehension for administrators. Educators depend on administrators, especially principals, to establish a cohesive vision for curriculum implementation and instructional strategies for schools. To excel in STEM instructional techniques, teachers require administrators who share a common vocabulary, vision, and understanding of STEM pedagogy. Additionally, fostering student interest and success in STEM is a critical objective. Extensive research has revealed the significant social and economic benefits experienced by countries with higher educational levels among girls. Women who possess backgrounds in STEM play a vital role in the betterment of their communities and families. Their scientific knowledge nurtures critical thinking, leading them to reject superstitions and approach issues through reason and logic, which, in turn, positively impacts the health and education of their children.

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