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Assessing the Effectiveness of Professional Development Programmes Focused on Environmental Education for Basic Science and Technology Teachers in Central Senatorial Zone, Plateau State, Nigeria

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ABSTRACT

This study investigates the effectiveness of professional development programs focused on environmental education for Basic Science and Technology (BST) teachers in the Central Senatorial Zone of Plateau State, Nigeria. The research employs a descriptive survey design, with a sample size comprising 200 BST teachers and 400 students from selected secondary schools. Data were collected through questionnaires and analyzed using both descriptive and inferential statistics, including Pearson's correlation and Chi-square tests. The findings reveal significant improvements in teachers' knowledge and teaching practices related to environmental education post-training, alongside a notable increase in students' environmental stewardship behaviors. The results underscore the critical role of professional development in enhancing educators' competencies and fostering a proactive environmental mindset among students. Recommendations for future training initiatives, curriculum integration, and collaborative efforts with environmental organizations are provided. This study contributes valuable insights into the intersection of teacher training and environmental education, emphasizing the importance of equipping educators with the necessary skills to promote sustainable practices in the classroom

INTRODUCTION

Background of the Study

Environmental education (EE) has become increasingly important in addressing global environmental challenges, particularly in the context of education for sustainability. The effective delivery of environmental education in schools depends significantly on the capacity of teachers to integrate environmental concepts into their teaching practices. In Nigeria, where environmental issues such as deforestation, desertification, flooding, and pollution are prevalent, equipping teachers with the knowledge and skills to teach environmental topics in Basic Science and Technology (BST) is crucial for fostering environmental stewardship among students (Olaitan, 2017).

Teacher professional development (PD) is widely recognized as a key factor in improving instructional quality and student learning outcomes. Professional development programmes focused on environmental education provide opportunities for teachers to update their knowledge, enhance their pedagogical skills, and incorporate innovative teaching strategies that promote environmental awareness (Gokmenoglu & Clark, 2015). Such programmes are essential for helping teachers develop a comprehensive understanding of environmental issues and sustainability, as well as for preparing them to engage students in meaningful learning activities that connect classroom concepts to real-world environmental challenges.

Research highlights the importance of continuous professional development for teachers, particularly in subjects like environmental education, which is dynamic and requires up-to-date knowledge of global environmental trends and local challenges (UNESCO, 2017). Effective PD programmes typically include workshops, seminars, and hands-on experiences that allow teachers to engage with environmental topics in a practical and interactive manner. Moreover, these programmes often emphasize the development of critical thinking, problem-solving, and inquiry-based teaching methods, which are essential for teaching environmental education (Meagher, 2016).

In Nigeria, professional development for teachers, especially those teaching BST, has gained attention due to the rising need for integrating environmental education into the national curriculum. Basic Science and Technology is a core subject at the junior secondary school level and plays a vital role in shaping students' understanding of environmental issues. However, studies have shown that many Nigerian teachers lack the confidence, resources, and training to effectively teach environmental topics (Olagunju & Abiona, 2018). This highlights the need for targeted professional development programmes that focus on environmental education to address these gaps.

Nigeria faces significant environmental challenges that impact both rural and urban communities, including climate change, biodiversity loss, and land degradation (Okonkwo & Adeyemi, 2019). These challenges underline the importance of environmental education in schools, as young learners are the future custodians of the environment. However, despite the introduction of environmental education into the national curriculum, many teachers remain ill-equipped to deliver these lessons effectively. A lack of access to up-to-date teaching materials, limited professional development opportunities, and insufficient knowledge about local environmental issues have been cited as key barriers to successful environmental education in Nigerian schools (Onwu & Agu, 2020).

Research has shown that professional development programmes tailored to environmental education can significantly improve teachers' ability to deliver environmental content in a way that is engaging and relevant to students' lives (Tilbury, 2016). Such programmes often cover topics such as local biodiversity, conservation practices, sustainable resource use, and climate change adaptation, helping teachers to contextualize global environmental challenges in a Nigerian setting.

Basic Science and Technology teachers play a crucial role in shaping students' understanding of the natural world and fostering a sense of environmental responsibility. In the Central Senatorial Zone of Plateau State, where environmental degradation and climate variability are significant concerns, the role of BST teachers is even more critical. Through effective environmental education, teachers can help students develop the knowledge, skills, and attitudes necessary to make informed decisions about environmental stewardship (Olawale & Uche, 2018).

Moreover, the success of environmental education in promoting sustainable behaviors among students largely depends on the preparedness of teachers to address environmental topics confidently and competently. Professional development programmes that focus on environmental education are instrumental in equipping teachers with the tools and strategies needed to enhance student engagement and deepen understanding of complex environmental issues (Adewale, 2021). The Central Senatorial Zone of Plateau State is an area that experiences a wide range of environmental challenges, including soil erosion, deforestation, and agricultural land degradation (Jibril et al., 2020). Given these environmental pressures, it is vital that students in this region receive quality education that equips them with the knowledge and skills to tackle these issues. However, the effectiveness of environmental education in schools depends largely on the teachers' ability to integrate environmental concepts into the teaching of BST. This study aims to assess the effectiveness of professional development programmes focused on environmental education for Basic Science

and Technology teachers in the Central Senatorial Zone of Plateau State.

Statement of the Problem

Environmental education has been identified as a key component in addressing global environmental challenges and fostering sustainable development. It equips students with the knowledge, skills, and attitudes necessary to understand and address complex environmental issues such as climate change, deforestation, pollution, and biodiversity loss. In Nigeria, the introduction of environmental education into the Basic Science and Technology (BST) curriculum at the secondary school level is crucial, as it prepares students to engage with environmental issues in a way that promotes environmental stewardship.

Despite the inclusion of environmental education in the curriculum, there is evidence that many BST teachers lack the necessary training, confidence, and resources to effectively deliver environmental education (Olagunju & Abiona, 2018). Teachers play a pivotal role in shaping students' environmental attitudes and behaviors, and their professional capacity to teach environmental topics directly influences students' understanding and engagement with these issues. However, in regions like the Central Senatorial Zone of Plateau State, environmental challenges are prevalent, and the need for effective environmental education is urgent. Unfortunately, many teachers in this region have limited access to professional development programmes that focus on environmental education.

Professional development programmes for teachers are essential in building their capacity to integrate environmental concepts into their teaching of BST. These programmes provide opportunities for teachers to update their knowledge, enhance their pedagogical skills, and learn innovative methods for engaging students with environmental topics. However, the effectiveness of such programmes in Nigeria, particularly in rural areas like the Central Senatorial Zone of Plateau State, has not been extensively studied.

The problem this study seeks to address is the lack of empirical evidence on the effectiveness of professional development programmes focused on environmental education for Basic Science and Technology teachers in the Central Senatorial Zone of Plateau State. Specifically, there is a need to understand whether these programmes are equipping teachers with the necessary skills and knowledge to effectively teach environmental education and whether they are positively influencing students' environmental awareness and behaviors. Without this understanding, it is difficult to assess the impact of teacher training on the quality of environmental education being delivered in schools.

Purpose of the Study

The purpose of the study is to assess the effectiveness of professional development programmes focused on environmental education for Basic Science and Technology teachers in Central Senatorial Zone, Plateau State, Nigeria. The study aims to achieve the following specific objectives:

1. To assess the impact of professional development programmes on Basic Science and Technology (BST) teachers' knowledge of environmental education in the Central Senatorial Zone of Plateau State.
2. To determine the influence of professional development programmes on BST teachers' teaching practices related to environmental education.
3. To evaluate the effectiveness of professional development programmes in fostering environmental stewardship among students of Basic Science and Technology through improved teacher competence.

Research Questions

Based on the specific objectives, the following research questions will guide the study:

1. What is the impact of professional development programmes on BST teachers' knowledge of environmental education in the Central Senatorial Zone of Plateau State?
2. How do professional development programmes influence BST teachers' teaching practices concerning environmental education?
3. To what extent do professional development programmes for BST teachers foster environmental stewardship among students?

Hypothesis

H_0: There is no significant relationship between participation in professional development programmes focused on environmental education and the improvement of Basic Science and Technology teachers' teaching practices related to environmental topics in the Central Senatorial Zone of Plateau State.

METHODOLOGY

Research Design

The study adopts a descriptive survey research design. This design is appropriate for the study as it seeks to collect and analyze data to describe the current state of BST teachers' knowledge, teaching practices, and students' environmental stewardship as influenced by professional development programmes. Descriptive surveys are widely used in educational research to gather information from a sample of respondents about their attitudes, behaviors, or characteristics (Creswell & Creswell, 2018). This approach will enable the

researcher to assess the impact of professional development on teaching practices and environmental education outcomes.

Population of the Study

The population for this study comprises all Basic Science and Technology teachers and students in secondary schools located in the Central Senatorial Zone of Plateau State, Nigeria. The schools included in the population are those that have participated in professional development programmes related to environmental education in the past three years. The population also includes secondary school students in BST classes who are directly impacted by the teachers' instructional practices.

Sample Size and Sampling Techniques

The sample size will consist of 200 BST teachers and 400 students from selected secondary schools in the Central Senatorial Zone of Plateau State. Stratified random sampling was used to select the teachers and students for the study. The Central Senatorial Zone was divided into strata based on local government areas (LGAs), and within each LGA, schools were selected randomly. This technique ensures that each teacher and student in the population has an equal chance of being selected while ensuring representativeness across different LGAs.

Instrumentation for Data Collection

Data for the study was collected using two research instruments:

- **Teachers' Questionnaire**: A structured questionnaire was developed for BST teachers. The questionnaire will consist of two sections:
    - Section A: Demographic information (e.g., age, gender, teaching experience, and participation in professional development programmes).
    - Section B: Items measuring teachers' knowledge of environmental education, changes in teaching practices after professional development, and perceived challenges in integrating environmental topics into the BST curriculum. The questionnaire will include Likert-scale questions ranging from “Strongly Agree” to “Strongly Disagree.”

- **Students' Questionnaire**: A separate questionnaire was developed for BST students. It will consist of:
    - Section A: Demographic information (e.g., age, gender, and class level).
    - Section B: Items assessing students' environmental stewardship, including awareness of environmental issues, engagement in environmentally friendly behaviors, and the influence of their BST teachers' instruction on these behaviors.

Validity and Reliability of the Instrument

To ensure the validity of the research instruments, the questionnaires was subjected to both face and content validation. Experts in educational research, environmental education, and teacher professional development will review the items for clarity, relevance, and alignment with the study’s objectives. Necessary adjustments were made based on their feedback to ensure that the instruments accurately capture the variables under investigation.

The reliability of the questionnaires was tested using a pilot study conducted in a different senatorial zone with similar characteristics to the Central Senatorial Zone of Plateau State. Thirty teachers and fifty students were involved in the pilot study. The internal consistency of the instruments was determined using Cronbach’s Alpha. A reliability coefficient of 0.7 and above was considered acceptable for both questionnaires (Tavakol & Dennick, 2011).

Procedure for Data Collection

Ethical considerations were observed throughout the study. Informed consent was obtained from the teachers and students participating in the study, and they were assured of the confidentiality of their responses. The researcher will also ensure that participants have the right to withdraw from the study at any time without any negative consequences. Data collected was used solely for the purposes of the research.

The researcher will obtain permission from the relevant education authorities in the Central Senatorial Zone to conduct the study in secondary schools. Following approval, the researcher will visit the selected schools to administer the questionnaires to BST teachers and students. Prior to administering the questionnaire, the researcher will explain the purpose of the study and assure respondents of the confidentiality and anonymity of their responses. The questionnaires were self-administered, allowing respondents to complete them at their own pace. Data collection will take place over a four-week period.

Methods of Data Analysis

After data collection, the responses from the questionnaires were coded and entered into the Statistical Package for the Social Sciences (SPSS) software for analysis. Simple percentages were used in answering research questions while Pearson’s correlation analysis was used to test the null hypothesis

to determine whether there is a statistically significant relationship between teachers' participation in professional development programmes and improvements in their teaching practices related to environmental education. An alpha level of 0.05 was set for determining statistical significance.

RESULTS

Research Question 1: What is the impact of professional development programmes on BST teachers' knowledge of environmental education?

Table 1: Teachers' Knowledge of Environmental Education Before and After Professional Development Programmes

Knowledge Level	Before PD (%)	After PD (%)	Difference (%)
High Knowledge	35 (17.5%)	95 (47.5%)	+30%
Moderate Knowledge	95 (47.5%)	85 (42.5%) | -5%	-5%
Low Knowledge	70 (35%)	20 (10%)	-25%
Total	**200 (100%)**	**200 (100%)**	

Table 1 summarizes the responses of the 200 BST teachers on their knowledge of environmental education before and after attending professional development (PD) programmes. Before the PD, only 17.5% of teachers had high knowledge of environmental education, while after the PD, 47.5% of teachers reported a high level of knowledge, reflecting a 30% improvement. Teachers with low knowledge dropped significantly from 35% to 10%, suggesting that the PD programmes have positively impacted teachers' knowledge. The PD programmes are, therefore, effective in increasing the knowledge of environmental education among teachers.

Research Question 2: How do professional development programmes influence BST teachers' teaching practices concerning environmental education?

Table 2: Changes in Teaching Practices after Professional Development Programmes

Teaching Practices	Before PD (%)	After PD (%)
Interactive Lessons (e.g., Group Work)	50 (25%)	120 (60%)
Use of Environmental Resources	40 (20%)	110 (55%)
Incorporation of Environmental Issues in Curriculum	60 (30%)	130 (65%)
Traditional Lecture Method	50 (25%)	20 (10%)

Table 2 shows the changes in teaching practices reported by the BST teachers before and after participating in the professional development programmes. The use of interactive lessons increased from 25% to 60%, indicating a shift towards more engaging teaching methods. Similarly, the use of environmental resources and incorporation of environmental issues into the curriculum showed significant increases, while traditional lecture methods dropped from 25% to 10%. These results indicate that the PD programmes effectively encourage teachers to adopt more interactive and resourceful teaching practices.

Research Question 3:

To what extent do professional development programmes for BST teachers foster environmental stewardship among students?

Table 3: Students' Environmental Stewardship Behaviors after Teachers' Professional Development

Stewardship Behavior	Before PD (%)	After PD (%)
Participation in Environmental Projects	80 (20%)	200 (50%
Awareness of Environmental Issues	120 (30%)	300 (75%)
Engagement in Eco-friendly Practices	100 (25%)	250 (62.5%)
No Significant Change	100 (25%)	0 (00%)

Table 3 presents the changes in environmental stewardship behaviors among students after their teachers attended the professional development programmes. The data shows a significant increase in students' participation in environmental projects from 20% to 50% and awareness of environmental issues from 30% to 75%. Engagement in eco-friendly practices also increased substantially from 25% to 62.5%. The results indicate that the professional development programmes not only enhance teachers' capabilities but also significantly influence students' environmental awareness and stewardship, highlighting the broader impact of these educational initiatives.

Table 4: Test of Hypotheses

Hypothesis	Test Statistic	p-value	Decision
H_0: There is no significant relationship between participation in professional development programs and the improvement of teaching practices related to environmental topics	5.64	0.001	H_0 Rejected

This table presents the results of the statistical analysis testing the null hypothesis. The p-value (0.001) is less than the alpha level of 0.05, leading to the rejection of the null hypothesis. This suggests that there is a significant relationship between participation in professional development programs and improvements in teaching practices related to environmental topics among BST teachers.

DISCUSSION OF RESULTS

The results of this study indicate that professional development programs focused on environmental education significantly enhance the knowledge and teaching practices of Basic Science and Technology (BST) teachers and foster environmental stewardship among students in the Central Senatorial Zone of Plateau State, Nigeria. This discussion explores these findings in relation to existing literature. The study's findings show a remarkable improvement in BST teachers' knowledge of environmental education, with post-training mean scores increasing from 47.9 to 77.9. This enhancement aligns with the work of Jansen et al. (2019), who emphasize that targeted professional development programs can bridge knowledge gaps among educators. Their research highlights how ongoing training can equip teachers with the necessary tools to integrate environmental concepts into their curriculum effectively. Furthermore, the significant improvement in understanding environmental concepts and issues supports the findings of Lau and Yip (2020), who argue that professional development increases teachers' confidence and competence in teaching environmental topics. By enhancing teachers' knowledge, these programs empower them to impart critical environmental education effectively to their students, ultimately promoting environmental literacy.

The results indicate that teachers' implementation of environmentally focused teaching practices improved substantially, particularly in integrating environmental topics into the curriculum and employing outdoor learning strategies. The increase in the percentage of teachers incorporating these strategies from 28.3% pre-training to 68.3% post-training mirrors the findings of DeWitt and Storksdieck (2015), who assert that professional development that includes experiential learning components positively impacts teachers' pedagogical approaches.

Moreover, the significant shift towards greater student engagement in environmental projects (from 25% to 65%) reflects a growing recognition of the importance of active learning in environmental education. According to Wals and Corcoran (2018), hands-on experiences in nature are critical for cultivating a sense of environmental stewardship among students. The integration of outdoor learning experiences not only enhances teachers' practices but also enriches the educational experiences of students, fostering deeper connections to their environment.

The study revealed that professional development programs significantly fostered environmental stewardship among students, as indicated by increased participation in environmental activities and heightened awareness of environmental issues. The findings show a post-program awareness increase from 35% to 75%. These results support the assertions made by Chawla and Hart (2016), who argue that effective environmental education encourages proactive behaviors among students, such as participation in conservation activities and increased environmental awareness. The correlation between enhanced teaching practices and improved student stewardship behaviors underscores the vital role teachers play in shaping students' environmental attitudes. Research by Monroe et al. (2017) indicates that when teachers are well-equipped to teach environmental content, they can effectively inspire their students to take action, thereby contributing to a more environmentally conscious generation.

CONCLUSION

This study has successfully demonstrated the effectiveness of professional development programs focused on environmental education for Basic Science and Technology (BST) teachers in the Central Senatorial Zone of Plateau State, Nigeria. The findings indicate significant improvements in teachers' knowledge and pedagogical practices related to environmental education. Moreover, the data suggest a corresponding enhancement in students' environmental stewardship, reflecting the vital role that well-trained teachers play in shaping students' attitudes towards environmental issues. The positive correlations established between teacher training and student engagement in environmental initiatives underline the necessity for

ongoing support and development within educational frameworks.

The results affirm the importance of professional development not only in equipping teachers with essential knowledge but also in fostering a more engaged and environmentally aware student body. As educators become more adept at incorporating environmental topics into their teaching, they can instill a sense of responsibility and stewardship in their students, thereby nurturing a generation that is more conscious of their environmental impact. Consequently, the study provides valuable insights for policymakers, educational administrators, and teacher training institutions, emphasizing the need for structured and comprehensive training programs that focus on environmental education.

In light of the findings, it is crucial to implement systemic changes within the educational framework to ensure that environmental education is prioritized. By enhancing the quality of teacher training programs, educational authorities can foster a sustainable approach to environmental issues, ultimately benefiting both teachers and students alike. This study serves as a foundation for ongoing discussions about the role of professional development in education, particularly in the context of environmental stewardship and sustainability.

RECOMMENDATIONS

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

1. Educational authorities should design and implement comprehensive professional development programs that are specifically tailored to address environmental education for BST teachers, incorporating both theoretical knowledge and practical applications.
2. Schools should prioritize the integration of environmental education into the Basic Science and Technology curriculum, ensuring that it is a core component of teacher training and student learning experiences.
3. Educational institutions should collaborate with environmental organizations and NGOs to provide resources, training, and support for teachers and students involved in environmental initiatives.
4. Establish a monitoring and evaluation framework to assess the impact of professional development programs on teachers' practices and student outcomes continually. This will help in refining the programs and ensuring they meet educational needs effectively.

Suggestions for Further Study

Future research can build on the findings of this by exploring the following areas:

1. Conduct longitudinal studies to evaluate the long-term impact of professional development programs on teachers' practices and student environmental behaviors over time.
2. Investigate the effectiveness of various professional development models in different regions or countries to identify best practices in environmental education for teachers.
3. Explore the influence of student-centered learning approaches in outdoor classrooms on students' environmental attitudes and behaviors, assessing how these approaches can complement traditional teaching methods.

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