

Enhancing The Teaching And Learning of Basic Science and Technology at the JSS Level Through the Use of Teacher Professional Development Programme

Sunmaila Oyetunji Raimi

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Abstract: This study examined the role of Teacher Professional Development Programmes (TPDP) in enhancing the teaching and learning of Basic Science and Technology at the Junior Secondary School level in Oyo State, Nigeria. A total of 80 teachers from four local government areas (Oyo East, Oyo West, Atiba, and Afijio) participated in the study. Data were collected using a structured questionnaire validated by specialists, with reliability confirmed via Cronbach's alpha ($\alpha = 0.87$). The demographic analysis revealed that 60% of participants were female, 85% held a Bachelor's degree or higher, and 62.5% had more than five years of teaching experience. Descriptive analysis showed that seminars were the most attended form of TPDP ($M = 44.88$, $SD = 5.30$), followed by conferences ($M = 35.00$, $SD = 7.56$), workshops ($M = 21.25$, $SD = 5.59$), and exhibitions ($M = 13.00$, $SD = 3.38$). ANOVA results indicated a significant difference in the impact of TPDP types on teaching effectiveness ($F = 54.63$, $p < 0.05$), and participation varied significantly among teachers ($F = 56.63$, $p < 0.05$). Findings further revealed that teacher gender, qualification, and years of experience did not significantly affect instructional performance. The study highlights that structured, regular, and needs-based TPDP significantly improve teachers' pedagogical competence, instructional innovation, and ability to utilize available resources. Recommendations include continuous in-service training, integration of ICT tools, and practice-oriented workshops to sustain teaching effectiveness in Basic Science and Technology.

Keywords: Basic science & Technology, Teaching and Learning Activities, Teacher Professional Development Programmes

Sunmaila Oyetunji Raimi,

Department of Integrated Science,
Faculty of Science Education,
Emmanuel Alayande University of
Education, P. M. B. 1010, Oyo. Oyo State,
Nigeria

Email: raimiso@eauedoyo.edu.ng

Orcid id: 0009-0003-1109-5236

1.0 Introduction

Teaching and learning activities at all levels of education must be dynamic, adaptive, and context-sensitive, as learners differ across individuals, educational stages, and geographical locations. These variations in learners' characteristics and learning environments necessitate continuous improvement in teaching approaches and instructional delivery. Consequently, regular refresher courses, retraining programmes, and systematic updates of teaching-learning activities have become a global imperative in contemporary education systems (Bellibas & Gumus, 2016; Federal Ministry of Education [FME], 2013).

Science and Technology Education, which serves as a major driver of national scientific and technological advancement, requires that curriculum implementers be adequately guided and equipped with modern, innovative, and learner-centred instructional strategies to ensure effective content delivery. Studies have consistently identified several challenges confronting the effective implementation of Basic Science and Technology in Nigerian schools, including teacher quality, ineffective instructional strategies, inadequacy or non-availability of instructional materials, and teachers' attitudes towards the profession (Ezeobi, 2017; Sambo & Adejohm

2011). These challenges undermine the attainment of the objectives of Basic Science and Technology as articulated in the National Policy on Education (FME, 2013).

Addressing these challenges requires deliberate attention to teachers' professional preparation and the nature of continuous training and reorientation they receive upon entry into, and while progressing within, the teaching profession. A range of instructional strategies such as practical skills acquisition, laboratory-based techniques (Raimi, 2017), guided discovery, problem-solving approaches), and online teaching modalities (Raimi et al., 2024) have been recommended and embedded within the Junior Secondary School Basic Science and Technology curriculum. However, evidence suggests that the classroom implementation of these strategies remains largely ineffective in responding to contemporary educational demands (Ezeobi, 2017).

Njoku (2004) and Ezeobi (2017) observed that many teachers lack adequate familiarity with innovative instructional strategies, including guided discovery, concept mapping, cooperative learning, collaborative learning, and problem-solving approaches. These strategies are central to constructivist learning theory, which emphasizes learners' active participation in knowledge construction, ownership of ideas, and meaningful application of learning within real-life contexts. The limited adoption of such strategies highlights the urgent need to support teachers in internalizing and effectively applying learner-centred pedagogies in classroom practice.

This goal can be achieved through well-structured, functional, and sustained teacher professional development programmes that span pre-service teacher education, in-service training, and continuous retraining and reorientation. Professional development activities must therefore be deliberately designed to address teachers' evolving needs while promoting continuous instructional improvement and professional growth (Bellibas & Gumus, 2016; Errogiu & Kaya, 2021). Ezeobi (2017) emphasized that for the Basic Science and Technology programme to be effective and beneficial, there must be deliberate and systematic reforms in teaching strategies at the pre-service, in-service, and retraining stages of science

teacher education. Transforming prospective and practicing Basic Science and Technology teachers into competent professionals through targeted professional development programmes enhances both content mastery and pedagogical effectiveness. Such improvements are essential not only for newly recruited teachers but also for experienced teachers who require periodic retraining to align their instructional practices with emerging pedagogical innovations and technological advancements.

Empirical evidence indicates that the effective adoption of teacher professional development programmes can significantly enhance the teaching and learning of Basic Science and Technology, leading to improved learning outcomes. This is particularly evident when teachers are exposed to contemporary instructional approaches such as digital literacy, constructivist teaching models, problem-solving strategies, self-regulated learning, and other learner-centred methodologies. These approaches foster critical thinking, creativity, collaboration, and communication skills among learners, thereby strengthening the integrated and applied nature of the subject (Adesina et al., 2023; Niu & Cheng, 2022; Zhan et al., 2023).

Furthermore, teacher training and empowerment programmes enhance teachers' capacity to improvise instructional materials and effectively utilize locally available resources for teaching Basic Science and Technology concepts. While inadequate facilities are often cited as a major constraint to effective science teaching, less attention is paid to teachers' competence in utilizing available resources optimally. Akinrotahun (2001) identified poor facilities as a major setback to effective science teaching but acknowledged that teachers' ability to improvise and creatively use available instructional tools is equally critical.

For effective curriculum implementation, both material availability and teacher competence are indispensable. This reality underscores the importance of continuous training, retraining, and reorientation of teachers through professional activities such as seminars, workshops, conferences, and exhibitions, which provide platforms for updating pedagogical knowledge and technological skills (Bellibas & Gumus, 2016). The



increasing integration of information and communication technology (ICT) into education further reinforces the need for sustained professional development programmes for teachers of Basic Science and Technology (Adesina et al., 2023; Raimi et al., 2024).

Systematic retraining and reorientation of Basic Science and Technology teachers are therefore essential for achieving the objectives of contemporary scientific and technological advancement. This need is particularly critical because many teachers are trained as specialists in single science disciplines such as physics, chemistry, biology, agricultural science, or geography and may continue to rely on outdated instructional methods acquired during their initial training (Njoku, 2004). Teacher professional development programmes thus provide a platform for harmonizing instructional practices and placing teachers on a balanced, current, and curriculum-responsive instructional footing.

Despite the widely acknowledged importance of teacher professional development in enhancing instructional effectiveness, there remains limited empirical evidence on the extent to which Basic Science and Technology teachers at the Junior Secondary School level in Oyo State are exposed to structured professional development programmes and how such exposure influences their teaching effectiveness. Moreover, existing studies have inadequately examined the frequency, nature, and sponsorship of these programmes in relation to teachers' instructional practices (Errogiu & Kaya, 2021). This gap necessitates a systematic investigation into the role of teacher professional development programmes in improving the teaching and learning of Basic Science and Technology.

Accordingly, the purpose of this study is to examine the role of teacher professional development programmes in enhancing the teaching and learning of Basic Science and Technology at the Junior Secondary School level. The findings are expected to contribute meaningfully to educational practice and policy by providing empirical evidence on the effectiveness of professional development programmes. Specifically, the study will inform teachers on areas requiring continuous professional growth, guide school administrators and

policymakers on teacher training, sponsorship, and resource allocation, and assist curriculum planners in identifying gaps between prescribed instructional strategies and classroom practice. Ultimately, the study seeks to support efforts aimed at improving students' learning outcomes and scientific literacy at the basic education level.

1.1 Objective of the Study

The main objective of this study is to examine the role of teacher professional development programmes in enhancing the teaching and learning of Basic Science and Technology at the basic education level. Specifically, the study seeks to assess the relative impact of various professional development activities—such as conferences, seminars, workshops, exhibitions, and refresher courses—on teachers' instructional practices at the Junior Secondary School level. In addition, the study aims to determine the frequency with which Basic Science and Technology teachers participate in these professional development programmes and to examine whether such participation is supported through employer or agency sponsorship or undertaken on a self-sponsored basis. The findings are expected to provide useful insights and recommendations for stakeholders in the education sector.

1.2 Statement of the Problem

Teaching and learning activities constitute a dynamic process that requires continuous updating of instructional methods and pedagogical approaches to effectively convey concepts to learners. Consequently, teachers of Basic Science and Technology at the Junior Secondary School level require regular professional development activities, including refresher courses and participation in programmes such as seminars, workshops, conferences, and exhibitions, to enhance their content knowledge and instructional delivery.

Despite the recognized importance of teacher professional development, there is concern that many Basic Science and Technology teachers have limited opportunities to participate in such programmes. Where opportunities exist, issues related to the frequency of participation, availability of sponsorship, and the extent to which professional development translates into improved



teaching effectiveness remain unclear. Therefore, this study examines the extent to which Basic Science and Technology teachers have access to professional development programmes, the nature of sponsorship supporting their participation, and how these factors influence their teaching and learning activities. Ultimately, the study seeks to critically assess the impact of teacher professional development programmes on the teaching effectiveness of Basic Science and Technology teachers at the basic education level.

1.3 Research Questions

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

1. What influence do teachers' gender, qualifications, and years of teaching experience have on the teaching of Basic Science and Technology at the Junior Secondary School level?
2. To what extent do teacher professional development programmes influence the teaching of Basic Science and Technology at the Junior Secondary School level?
3. How does regular attendance at teacher professional development programmes affect the teaching and learning of Basic Science and Technology at the Junior Secondary School level?
4. Is there a significant difference in instructional effectiveness between teachers who have attended professional development programmes (such as conferences, seminars, and workshops) and those who have not?

2.0 Methodology

The design for this study is descriptive in nature. The information gathered from the subjects was used to draw the inference for the study. The population for the study comprise Teachers teaching Basic Science and Technology at the junior secondary school level. A total of eighty (80) teachers participated in the study. The study area where the sample for the investigation was drawn is Oyo East, Oyo West, Atiba and Afijio Federal Constituency. The selection of the sample was purposively drawn to determine the influence

and extent to which the intention and purpose of the study was based. The major instrument employed for the study is a structured questionnaire items drawn by the investigator with two sections, the first aspect elicit information on the respondents/subjects bio-data while the second part examines the level of attendance, relevance as well as the regularity of how the participants or subjects are opportune to participate on any form of teacher professional development Programme which is the basis of this investigation.

The instrument used for this research is a self-constructed questionnaire items drawn by the investigator and validated by the professionals in the field of science education through constructive criticisms to enable it serve the intended purpose. The observations and suggestions made by the professionals were incorporated into the structure before its administration to the subjects/audience. Its reliability was ascertained through the use of Cronbachs alpha method and the coefficient of reliability obtained was 0.87 which is adjudged to be good enough and considered suitable for the study at hand. The statistical tool used for the analysis of the data collected on this study include simple frequency count, percentages, mean score and analysis of variance to determine the effectiveness of TPDP on teaching and learning activities of concepts in Basic Science and Technology in our junior Secondary schools.

3.0 Results and Discussion

3.1 Results

This section presents the results of the study in line with the research variables investigated. The results are organized to reflect the demographic characteristics of the respondents (gender, professional qualification, and years of teaching experience) as well as the effects of Staff Training and Development Programmes (STDP) on teachers' teaching activities. Each table is introduced, presented, and clearly interpreted to enhance clarity and coherence.



2.1 Distribution of Participants by Gender

Table 1 presents the distribution of the eighty (80) Basic Science and Technology teachers according to gender across the eight selected schools used for the study.

The table shows that female teachers constituted the majority of the respondents, accounting for 48 (60%) of the total sample,

while male teachers accounted for 32 (40%). The equal representation of teachers from each school (10 respondents per school) ensured balance and minimized sampling bias. The result suggests that Basic Science and Technology teaching at the Junior Secondary School level in the study area is female-dominated.

Table 1: Distribution of Participants by Gender

Schools	Male n (%)	Female n (%)	Total n (%)
I	3 (3.75)	7 (8.75)	10 (12.50)
II	6 (7.50)	4 (5.00)	10 (12.50)
III	3 (3.75)	7 (8.75)	10 (12.50)
IV	2 (2.50)	8 (10.00)	10 (12.50)
V	3 (3.75)	7 (8.75)	10 (12.50)
VI	4 (5.00)	6 (7.50)	10 (12.50)
VII	7 (8.75)	3 (3.75)	10 (12.50)
VIII	4 (5.00)	6 (7.50)	10 (12.50)
Total	32 (40.00)	48 (60.00)	80 (100.00)

2.2 Distribution of Participants by Professional Qualification

Table 2 presents the professional qualifications of the respondents across the selected schools. The results indicate that the majority of the teachers, 68 (85%), possessed Bachelor's

degrees in science or science education, while 9 (11.25%) held the minimum teaching qualification of Nigeria Certificate in Education (NCE). Only a small proportion possessed postgraduate qualifications.

Table 2: Distribution of Participants by Professional Qualification

Qualification	I	II	III	IV	V	VI	VII	VIII	Total n (%)
NCE	2	2	–	3	–	1	1	–	9 (11.25)
HND	–	–	–	–	–	–	–	1	1 (1.25)
B.Sc./B.Sc. Ed	8	8	10	7	10	8	9	8	68 (85.00)
M.Sc./M.Sc. Ed	–	–	–	–	–	1	–	1	2 (2.50)
Total	10	10	10	10	10	10	10	10	80 (100.00)

Overall, 79 teachers (98.75%) met or exceeded the minimum qualification required by the National Policy on Education for teaching at the Basic Education level, suggesting that Basic Science and Technology in the study area

is largely handled by suitably qualified teachers.

2.3 Distribution of Participants by Years of Teaching Experience



Table 3 presents the distribution of respondents according to their years of teaching experience. The results show that 50 teachers (62.5%) had more than five years of teaching experience, while 30 teachers (37.5%) had between one and five years of experience. This suggests that a substantial proportion of the respondents were relatively experienced, which is expected to positively influence instructional delivery and classroom management in Basic Science and Technology.

2.4 Effects of Staff Training and Development Programmes on Teachers' Activities

Table 4a presents the descriptive statistics showing the relative effects of different types

of Staff Training and Development Programmes (STDP) attended by teachers.

3.2 Discussion of Findings

The findings of this study reveal that gender does not constitute a barrier to the teaching of Basic Science and Technology, as female teachers formed the majority of the workforce without any indication of diminished effectiveness. This aligns with previous studies that report no significant gender-based differences in teaching effectiveness at the basic education level. The results indicate that seminars recorded the highest mean score, followed by conferences, workshops, and exhibitions.

Table 3: Distribution of Participants by Years of Teaching Experience

Years of Experience	I	II	III	IV	V	VI	VII	VIII	Total	%
1–5 years	–	6	2	1	5	7	4	5	30	37.50
6–10 years	3	1	2	1	–	1	1	–	9	11.25
11–15 years	2	1	1	2	5	–	3	2	16	20.00
16–20 years	3	–	1	3	–	1	1	–	9	11.25
20 years & above	2	2	4	3	–	1	1	3	16	20.00
Total	10	10	10	10	10	10	10	10	80	100.00

Table 4a: Relative Effects of Different Types of STDP on Teachers' Activities

Type of STDP	N	Mean	Standard Deviation	Standard Error
Seminar	8	44.88	5.30	1.88
Conference	8	35.00	7.56	2.67
Workshop	8	21.25	5.59	1.82
Exhibition	8	13.00	3.38	1.20
Total	32	28.53	13.50	2.39

This suggests that seminars are the most commonly attended and possibly the most impactful form of professional development among the teachers. To further establish whether significant differences exist in the impact of the various STDP types, an Analysis of Variance (ANOVA) was conducted, as presented in Table 4b. The F-value of 54.634 at the 0.05 level of significance indicates a

statistically significant difference in the effects of the various STDP types on teachers' teaching activities.

2.5 ANOVA on Staff Participation in Teacher Professional Development Programmes. Table 5 presents the ANOVA results on staff participation in professional development programmes.



Table 4b: ANOVA of the Impact of STDP on Teachers' Teaching Activities

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4825.594	3	1608.531		
Within Groups	824.375	28	29.442	54.634	0.000
Total	5649.969	31			

The significant F-value (56.634, $p < 0.05$) indicates that teachers' participation in STDPs varies significantly, reflecting differences in access, opportunity, and type of professional development attended.

The high proportion of teachers with qualifications above the minimum NCE requirement suggests a strong human resource base for Basic Science and Technology

teaching in the study area. This finding supports earlier studies which emphasize that teacher qualification is a critical factor in effective curriculum implementation. However, despite adequate qualifications, challenges related to content depth, instructional strategies, and contextualization of science concepts may persist.

Table 5: ANOVA Result on Staff Participation in Teacher Professional Development Programmes

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4825.594	3	1608.531		
Within Groups	824.375	28	29.442	56.634	0.000
Total	5649.969	31			

In terms of teaching experience, the dominance of teachers with more than five years of experience implies instructional stability and professional maturity. Experienced teachers are more likely to adapt content, manage classrooms effectively, and respond to learners' needs. Nevertheless, experience alone may not guarantee instructional quality without continuous professional development.

The results further show that seminars and conferences are the most influential forms of STDP, possibly because they are more frequently organized and accessible. The significant ANOVA results confirm that STDPs have a substantial impact on teaching activities, supporting the view that continuous professional development enhances pedagogical competence and instructional innovation. This finding is consistent with earlier reports that emphasize the role of high-quality professional development in improving

teacher performance and student learning outcomes.

From a technical and policy perspective, the findings underscore the need for structured, needs-based, and practice-oriented STDPs that emphasize hands-on workshops, use of instructional materials, integration of digital tools, and contextual teaching approaches. Regular evaluation of STDP content and alignment with curriculum demands is essential to maximize their impact. Strengthening collaboration among teachers, education planners, and training providers will further enhance the effectiveness of professional development initiatives and ultimately improve the teaching and learning of Basic Science and Technology.

4.0 Conclusion

This study has empirically established the central role of Teacher Professional Development Programmes (TPDP) in



enhancing the teaching and learning of Basic Science and Technology at the Junior Secondary School level in Oyo State, Nigeria. The findings demonstrate that participation in structured professional development activities significantly improves teachers' instructional effectiveness, pedagogical competence, and capacity for instructional innovation, irrespective of teachers' gender, academic qualification, or years of teaching experience.

The results further reveal that while seminars and conferences are the most frequently attended and impactful forms of professional development, all categories of TPDP examined contribute meaningfully to improving classroom practices. The significant differences observed in the effectiveness of various professional development programmes underscore the importance of not only providing opportunities for teacher training but also ensuring that such programmes are well-designed, relevant, and aligned with curriculum objectives and classroom realities. The observed variation in teachers' participation also highlights disparities in access and opportunities, which require deliberate policy attention.

Overall, the study confirms that teacher experience and formal qualifications alone are insufficient to guarantee effective teaching without continuous professional growth. Regular, needs-based, and practice-oriented professional development programmes remain essential for equipping Basic Science and Technology teachers with contemporary instructional strategies, effective use of instructional resources, and the integration of ICT in teaching. Sustained investment in teacher professional development is therefore critical to improving instructional quality and achieving the goals of Basic Science and Technology education at the basic education level. By strengthening and institutionalizing continuous professional development, stakeholders can enhance teachers'

effectiveness and ultimately improve students' learning outcomes and scientific literacy.

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