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Effects of School-Based Professional Development Training on Instructional Practices Among Secondary School Chemistry Teachers in Zaria, Kaduna, Nigeria

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ABSTRACT

This study examined the effect of School-Based Professional Development Training (SBPDT) on Instructional Practices among Secondary School Chemistry Teachers in Zaria, Kaduna State, Nigeria. Quasi-Experimental design was employed for the study involving teachers. 22 teachers (12 experimental and 10 control) The instrument used for data collection was Classroom Lesson Observation Checklist (CLOC). The instrument was validated; pilot tested and the reliability coefficients were established to be 0.76. Two research questions were answered using mean, standard deviation, mean ranks and standard error while corresponding null hypotheses were tested using Kruskal Walli's H test and Mann-Whitney at p≤ 0.05 level of significance. Data collected were analyzed with the Statistical Package for the Social Science (SPSS), IBM version 21. The results obtained revealed that; a significant mean difference difference exist on Teachers Instructional Practices between those exposed to SBPDT and not exposed to SBPDT at Senior Secondary Schools in Zaria ($x^2_{(.15.795),}$ $p < .001$). No significant mean difference difference exist on Teachers Instructional Practices among male and female Chemistry Teachers after exposed to exposed to SBPDT ($Z_{(-740),}$ $p < .0.459$). The study concluded that School-Based Professional Development Training, using the Lesson Study Model, improved Chemistry teachers' Instructional Practices in Chemistry. However, it is gender friendly. Based on the findings, recommendations were made among others which include Teachers Service Boards should use School-Based Professional Development Training using Lesson Study Model in order to improve teachers' instructional Practices at Senior Secondary School levels in Nigeria. There is also the need to include School-Based Professional Development Training using Lesson Study Model in seminars and workshops for improved academic performance of the students.

Keywords: School-Based, Teachers, Instructional-Practices.

Introduction

Science is a search for evidence in order to answer questions or solve problems. As solutions to problems can be more than one, this challenges scientists to solve problems by observing and collecting data and constructing inferences from collected data (Hassan, 2021). Science, according to Isa and Usman (2021), involves exploring and investigating the world around, both natural with the aim of learning more about it and understanding it better. Science is both body of knowledge and a process; it contains knowledge of (facts, theories, laws, models and concepts) and a process (method) which develops this knowledge (Isa, 2018). Through the processes of science, students/learners acquire knowledge and develop a rich understanding of concepts, principles, models, theories and skills. In the age of science and technology when scientific knowledge has grown exponentially, technological innovations have progressed at a rapid pace, and the effects of science and technology are clearly witnessed in all aspects of life. Science and technology has branches and play a key progressive role in the future of societies (Hassan, 2021). One of which is Chemistry.

Chemistry education is the vehicle through which chemical knowledge and skill reach the people who are in need of capacities and potentials for development. In addition, chemical education addresses the social objective of substance development as education is now of the primary means for empowerment, participation, cultural preservation, social mobility and equity (Muhammad & Isa, 2018). According to Isa and Usman (2021) Chemistry education is central in the drive of global sustainable economic development. It plays major roles in provision of food (fertilizers and insecticides), clothing (textile fibers), housing (cement, concrete, steel, bricks), Medicine (drugs), Transportation (fuel, alloy materials). Presently, man is experiencing an era in scientific and technological development that affects his life in one way or the other (Isa, (2018). Virtually everything we use daily involves chemistry. With this indispensable knowledge richly acquired, man can shape and reshape his world for his benefit and boost students' performance in other sciences.

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Academic performance is an important educational variable that expresses the success or failure of a teaching and learning process. The success of a course in any subject is a measure of its academic performance. Despite the key role of chemistry education as the central science that forms the basic foundations to many disciplines and in improving the quality of life, the performance of Nigeria secondary school students in the subject has been fluctuating and for many years remained a matter of serious concern (Isa & Muhammad 2021). The persistent decline and fluctuation of students' performance in Chemistry is due to multifaceted factors; according to Isa and Usman (2021) and WAEC Chief examiner's report (2021) some of these factors that negatively affect students' performance in secondary schools include lack of students' interest, poor study habit and teacher-related factors, like teachers' poor preparation, lack of pedagogical content knowledge (poor teaching methods) and because of technological advancement where new equipment, skills, pedagogies have emanated after graduation from universities. This calls for a need for the in-service Chemistry teachers to update their knowledge through Continuous Professional Development training so as to enable them meet up with the educational challenges of 21st century and in turn boost Teachers' quality of delivery in classrooms.

The rate of academic development and the increasing demand with regards to knowledge-based economy and technology advancement, modern innovative learner's centered strategies, large class sizes and lack of adequate science facilities to enhance meaningful learning require a constantly and regularly update of teaching workforce (Yusuf, 2022). Also, effective and efficient curriculum planning and implementation requires professionally trained teachers needed to constitute the vital force for effective implementation of the curriculum at every stage of the educational programme. Thus, teachers that are professionally trained and have acquired required skills are expected to be exposed to in-service recurrent training due to changes in job content skills demand for the learner in a dynamic environment. To meet these requirements, teacher development must become a life-long process. Therefore, in-service training for teachers is an important factor in educational development for effective quality of teachers/teachers' instructional practices using SBPDT.

School-Based Training is an in-house training run by the school for itself (Isa, 2024). It is training for the teachers by the teachers in their own schools for Continuous Professional Development (CPD). It is one of the easiest modality of disseminating information or skills

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acquired in a workshop, seminar and so. School-Based Training (SBT) according to Muhammad (2017), is a model of teachers' professional development through which all teachers would be reached and a common ground would be built for teaching and learning irrespective of teacher and teaching style. SBT is coordinated and run by teachers themselves and it takes the forms of collaborative

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Lesson Study is one of the models that improve professionalism of an education practitioner (teacher) through collaborative and simultaneous learning study based on the principles of collegiality and mutual learning to build a learning community (Muhammad,2019). Lesson study according to Weston, (2017) involves a comprehensive process of planning, observation, analysis and identifying the best approaches in a classroom. Lewis (2002), opined that, the idea included in Lesson Study is actually succinct and simple, which is when a teacher wants to improve their learning quality, one of the proper ways is to collaborate with other teachers to design, monitor, and do a reflection on the conducted learning strategy. The principle of lesson study starts by composing learning instruments, performing learning process, and reflection and evaluation conducted collaboratively. Therefore, not only does lesson study approach encourage the teachers in preparing the learning well, it also gives valuable input from other colleagues to do better improvement for the next learning process (Masduki, 2016). In view of this this study was carried out to examined the effects of SBPDT on teachers' instructional practices among secondary school chemistry teachers in Kaduna State Nigeria.

Gender issue is also at the forefront of science education reform, as educators are trying to achieve equity in lesson delivery between the sexes (Muhammad, 2017). Researchers are trying to determine if teachers' professional development based on gender influence quality of delivery

of chemistry concepts. The trend towards the acquisition of professional development may actually have a deleterious effect on gender equity which creates a gap in lesson delivery between male and female teachers (Danjuma and Shuaibu in Muhammad 2017). Other researchers have shown little or no gender difference in the lesson delivery and inclination to participate in professional development (Muhammad, 2019). These contradictory findings have caused for inclusion of gender as one of the moderating variable in this study. Since in professional development model teachers with different backgrounds and experiences, come together as a team, to develop innovative ideas, build and refine ideas about "best practice" through careful, collaborative study of actual instruction. As teachers work together, they build a habit of learning from each other as such the disparity in terms of lesson delivery would reduce among male and female teachers. Hence the study investigates whether School-Based Professional Development Training using Lesson Study model is gender friendly among Chemistry teachers at senior secondary schools in Zaria.

Statement of the Problem

The role of chemistry in driving national and technological progress is undeniable. However, the process of teaching and learning the subject faces numerous challenges, including students' underperformance and fluctuating or declining achievement levels. These inconsistencies in performance have been linked to several factors, such as a lack of interest among students, poor study habits, and teacher-related issues. Specifically, inadequate preparation by teachers, ineffective instructional methods due to limited pedagogical content knowledge, and insufficient in-service training for chemistry teachers hinder the effective implementation of the curriculum (SMASE, 2013; Muhammad, 2017; Isa & Usman, 2021).

Extensive research has explored the impact of teaching strategies on students' academic achievement in science education. Studies by Muhammad ands Isa (2018), Muhammad (2019), and Isa (2022) indicate that the adoption of innovative instructional methods can enhance students' performance in chemistry. Despite these findings, there remains a gap between research and classroom practice. Many recommendations from scientific studies remain confined to academic repositories, with little application in actual teaching. Consequently, many secondary school teachers are unaware of these advancements, leading to gaps in their pedagogical content knowledge. The lack of adequate in-service training further exacerbates this issue, negatively affecting students' learning outcomes and confidence in chemistry at the senior secondary school level

The influence of teachers' gender may be linked to variations in teaching approaches. Research suggests that female teachers tend to be more supportive and expressive (Nasser & Sahar, 2012), as well as nurturing in their interactions with students (Islahi & Nasereen, 2013). They are often described as being more open and informal, dedicating a significant amount of time to encouraging student participation (Thomas & Nelson, 2013). Additionally, they frequently

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promote peer collaboration, adopt flexible teaching methods, pose more referential questions, offer more compliments, and use a less directive approach. Their classroom management style balances authority with relationship-building, ensuring a positive rapport with students. In contrast, male teachers are generally perceived as more authoritative and structured in their instructional methods. They tend to exert greater control over the classroom, emphasize group work and structured activities, and rely more on display questions, which result in shorter yet more frequent teacher-student exchanges (Nasser & Sahar, 2012). Their teaching style is often described as task-oriented and authoritarian, sometimes prioritizing authority over student engagement. However, some studies have found minimal or no significant gender differences in lesson delivery or willingness to engage in professional development. Given these perspectives, this study examines the impact of a school-based professional development model on instructional practices among male and female Chemistry teachers in senior secondary school in Zaria Education Zone, Kaduna State, Nigeria.

Objectives of the Study

The objectives of this study were to:

1. find out the effect SBPDT on Chemistry Teachers Instructional Practices at senior secondary schools in Zaria education zone.
2. Determine the effect of SBPDT on male and female Chemistry teachers in Zaria education zone.

Research Questions

The study addressed the following research questions.

1. what is the mean difference on Teachers Instructional Practices between those exposed to SBPDT and not exposed to SBPDT at Senior Secondary Schools in Zaria in Zaria Education zone?
2. what is the mean difference on Teachers Instructional Practices among male and female Chemistry Teachers after exposed to exposed to SBPDT?

Null Hypotheses

The following null hypotheses were tested at $\acute{\alpha} = .05$ level of significance.

Ho_1: There is no significant mean difference on Teachers Instructional Practices between those exposed to SBPDT and not exposed to SBPDT at Senior Secondary Schools in Zaria in Zaria Education zone.

Ho_2: There is no significant mean difference on Teachers Instructional Practices among male and female Chemistry Teachers after exposed to exposed to SBPDT

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Methodology

Research Design

This study employed a quasi-experimental research design with a pre-test and post-test structure. Participants were divided into two groups: an experimental group and a control group. Teachers in the experimental group underwent School-Based Professional Development (SBPD) training using the lesson study model for eight weeks. Within this collaborative forum, teachers worked together to establish student learning objectives, design activity-based lessons using the ASEI-PDSI approach, and implement these lessons in the classroom. One teacher delivered the lesson to students in the experimental group while colleagues and researchers observed. Following each session, the team analyzed the lesson, reflected on collected evidence, revised the lesson plan for improvements, and then re-taught the modified lesson. This iterative cycle continued throughout the eight-week period. In contrast, teachers in the control group did not receive SBPD training through the lesson study model. Instead, they taught the same concepts to their students using conventional instructional methods for the same duration.

Population/Sample Sampling Technique

The study targeted all secondary school chemistry teachers in co-educational institutions within the Zaria Education Zone, Kaduna State, Nigeria, with a total population of 49 teachers. From this population, a sample of 22 chemistry teachers was selected using a simple random sampling technique. The sample consisted of 12 teachers assigned to the experimental group and 10 to the control group, drawn from two schools within the zone, as outlined in Table 1.

Table 1 Sample for the Study

S/No.	Name of School	Male	Female	Total	Group
1	School A	7	5	12	Experimental
2	School B	6	4	10	Control
	Total	13	9	22	

Instrumentation

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A validated instrument, titled **"Classroom Observation Checklist (COCL),"** was utilized for data collection in this study. The reliability of the COCL was determined using Cronbach's Alpha, yielding a reliability coefficient of 0.76.

Results and Findings

The null hypotheses were analyzed using Kruskal-Wallis One-Way Analysis of Variance and Mann-Whitney U, test at a significance level of $\mathbf{P \leq 0.05}$. The data analysis was conducted using **Statistical Package for the Social Sciences (SPSS), version 20**.

Ho$_{1}$: There is no significant mean difference on Teachers Instructional Practices between those exposed to SBPDT and not exposed to SBPDT at Senior Secondary Schools in Zaria in Zaria Education zone.

The data was analyzed using Kruscal-walli's One-Way Analysis of Variance statistical tools. The results of this hypothesis is shown in Table 2.

Table 2: Kruscal-walli's One-Way Analysis of Variance on Teachers Instructional Practices among Teachers exposed to the School-Based Professional Development using Lesson Study Model.

Variable	Group	n	Mean Rank	df	Chi-square	Sig.	Remark
Pretest	Experimental	12	12.29	1	0.409	.522	*NS
	Control	10	10.55				
Posttest	Experimental	12	16.50	1	15.795	.001	*S
	Control	10	5.50				
	Total	22					

***S= Not significant at α ≤0.05.**

The result in table 2, showed that the ratters or observers do not differ significantly in their rating of the effectiveness of teachers in their usage of Classroom Instructional Practices before exposure to School-Based Professional Development Training with observed p-value of 0.522 which is greater than α ≥0.05 level of significance. However, a significant mean rand difference was observed after exposed to SBPDT with a observed p-value of 0.001 which is less than α ≥0.05 level of significance. This therefore means, that there is significant mean difference

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between Chemistry Teachers Instructional Practices after exposed to School Based Professional Development Training. Hence, the null hypothesis which states that 'There is no significant mean difference between Chemistry Teachers Instructional Practices after exposure to School Based Professional Development Training at Senior Secondary Schools in Zaria Education zone is hereby rejected.

Ho_2: There is no significant mean difference on Teachers Instructional Practices among male and female Chemistry Teachers after exposed to exposed to SBPDT

The hypothesis was tested with the Mann -Whitney test as presented in Table 3.

Table 3: Mann-Whitney U test on Instructional Practice among Male and Female Chemistry Teachers exposed to the School-Based Professional Development using Lesson Study model.

Sex	N	Mean Rank	Sum of Ranks	Z_{-value}	*df*	p_{-value}	Decision
Male	7	7.40	50.00				
				-.740	10	.459	*NS
Female	5	5.60	28.00				
Total	12						

***NS= Not significant at α ≤0.05.**

The result presented in Table 3 revealed that the rating of Instructional Practices among Male and Female Chemistry teachers after exposed to School-Based Professional Development training shows that the observed p-value is 0.459 which is greater than the α ≤0.05 level of significance. This means there no significant mean difference in the rating of observed

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classrooms Instructional Practice between male and female Chemistry teachers after exposed to School-Based Professional Development training. Therefore, the null hypothesis that states "there no significant mean difference on Teachers Instructional Practices among male and female Chemistry teachers after exposed to School-Based Professional Development training at Senior Secondary Schools level is hereby retained.

Discussion of Results

Result in table 2 shows that there was significant difference in the ratings of observed classroom instructional practices among Chemistry teachers exposed to School-Based Professional Development Training. The result revealed that the use of School-Based Professional Development training using Lesson Study model significantly enhance the Instructional Practices of Chemistry teachers at Senior Secondary level. The superiority of School-Based Professional Development training using lesson study model stems from the fact that it was a task structured, teachers in the experimental group were trained using four pedagogical component of ASEI-PDSI approach which guided them to develop and practice their lessons and observations made improved their approaches to teaching and in turn boost their Instructional Practices. The finding agreed with earlier findings of Muhammad (2017) who reported there was significant difference in the ratings of observed classroom lesson delivery skills among teachers exposed to School-Based Professional Development using Lesson Study model. The finding disagrees with that of Muhammad, (2019) who reported that there was no significant difference in the mean ratings of observed classroom lesson delivery skills among Basic Science Teachers after exposed to School-Based Professional Development using Lesson Study model. Even though both studies adopted the use of lesson study model, the Muhammad study was conducted among Basic Science Teachers in Bauchi State, while the present study is conducted in Kaduna State among Chemistry teachers. Perhaps the present study involved teachers who are graduates of BSc. Hons. Chemistry and were just employed to teach chemistry in secondary schools that results to the difference in the level of instructional practices or perharps the use of primary school teachers in Muhammad study had the treatment not seriously felt among them like the present study. Hence, the disparity in the two studies.

Result in table 3 revealed that there was no significant mean difference in the rating of observed classroom lesson delivery skills on gender among Chemistry teachers after exposure to School-

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Based Professional Development training at Senior Secondary Schools level. This study is in line with the revealed findings of Danjuma and Shuaibu (2015) and Muhammad (2017) that exposure of male and female science teachers to professional development training such as School-Based Professional Development Training using Lesson study model is gender friendly. No study availble to the researchers diagreed with the earliaer findings. Hence, SBPDT is gender friendly.

Recommendations

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

1. Chemistry teachers should be exposed to School-Based Professional Development using Lesson Study model in order to help them boost their Instructional Practices/ clasroom delivery skills in senior secondary schools.
2. The Kaduna State Teachers Service Board (TSB) should recommend the use of School-Based Professional Development using Lesson Study model as a means of improving teachers' instructional practices/ Classroom Delivery Skills in Sciences at both Junior and Senior Secondary School level through organizing Seminars and workshops with strict supervision and inspection.
3. Federal and State Government should strongly encourage the implementation of School-Based Professional Development using Lesson Study model in schools all over Nigeria as a way of instilling collaborative working environment, better cooperation and improve Teachers' Instructional Practices/ Classroom Delivery skills among science teachers.

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