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A COMPARATIVE ANALYSIS OF PRE-SERVICE AND IN-SERVICE CHEMISTRY TEACHERS' SCIENCE PROCESS SKILLS IN TARABA STATE, NIGERIA

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ABSTRACT

The study compared pre-service and in-service chemistry teachers' competencies in science process skills in Taraba State, Nigeria; aimed at strengthening teacher competencies and better science education. The study adopted a descriptive-comparative research design with a survey method. The population of the study comprised 851 pre-service and in-service chemistry teachers in the state from which 358 were pre-service chemistry teachers and 493 were in-service chemistry teachers. Krejcie and Morgan table was used to select a total sample size of 403 with 186 pre-service teachers and 217 in-service teachers. Stratified proportionate and simple random samplings were used as sampling techniques. Science Process Skills Test (SPST) which has 8 levels of skills was used for data collection. It was face and content validated by three experts. The reliability index of 0.75 was obtained through KR-20. Mean and standard deviation were used to answer the research questions while independent t-test was used to test the null hypotheses at 0.05 level of significance. The study found that overall; in-service chemistry teachers have significantly higher science process skills score than pre-service chemistry teachers ($p<0.05$). Also, pre-service and in-service chemistry teachers' science process skills overall scores do not statistically differ based on gender ($p>0.05$). The study concluded that the current teachers of chemistry in Taraba State have higher science process skills than the pre-service teachers of chemistry and recommended that pre-service chemistry teachers' training processes should be practical based to enhance the acquisition of science process skills.

Keywords: Science Process Skills, Chemistry teachers, Competencies, Pre-service, In-service, Gender

Introduction

Science has received global recognition for being an initiator of technological development in nations around the world. This is evident in the adoption of science education where science is taught in a formal education setting in order to enhance scientific process skills of citizens of a nation. Science education in Nigeria as well as other countries proceeds through the teaching and learning of subjects such as biology, chemistry, physics, and mathematics among others. The teaching and learning of chemistry contributes to national development. Learning of chemistry in Nigeria begins at the secondary school level

and the knowledge of chemistry at this stage could make the students be able to provide explanations for simple chemical phenomenon happening in their environment such as change in physical states of objects, colourisation and decolourisation accompanying chemical reactions among others (Jack & Shidawa, 2025). Students could realise these abilities with effective chemistry instructions aided by chemistry teachers; especially if the teacher and teacher's instructions take cognisance of science process skills.

Chemistry being a science subject, the learners, teachers and chemists have certain abilities that help them in the course of scientific investigation. These are science process skills (SPS). Jack (2014) identifies science process skills as crucial for acquiring scientific knowledge and solving societal problems, suggesting their use is an indicator of knowledge transfer and practical living skills. These skills are fundamental mental and physical abilities needed for effective science and technology learning, including problem solving and understanding the world (Jack, 2014, 2018). Mirian (2023) views science process skills as the procedural skills or scientific inquiry abilities expected of science learners. Im et al. (2024) stated that science process skills have been grouped at a hierarchical level: basic and integrated science process skills. Padilla as cited in Akyol and Tas (2024) basic science process skills include observing, measuring, inferring, classifying, communicating, and predicting, and they form the basis for integrated science process skills which are more complex and include controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting, and formulating models. In the instructional process, these skills promote active learning by enabling students to engage deeply with material through inquiry and experimentation. Science process skills help in the cultivation of scientific mind-set which enhances innovation and informed decision-making in both societal and educational contexts. Winarti et al. (2019) posited that science process skills improve the quality of science learning, develop students' thinking abilities and potential and also improve academic abilities. Teachers (of chemistry in this regards) significantly influence students' acquisition of science process skills, as teachers play a crucial role in developing students' science process skills (Tosun, 2019) through the implementation of the chemistry curriculum.

As regards chemistry and students' acquisition of science process skills, previous studies identified student and school variables on students' science process skills acquisition (Jack, 2013); chemistry students' science process skills acquisition and influence of gender and class size (Jack, 2018), and impact of science process approach on students' learning outcomes in physics and chemistry (Jack & Uzomah, 2021; Jack, & Ndong, 2022). However, there exists literature gaps mostly on the

comparative assessment of pre-service and in-service chemistry teachers overall level of science process skills acquisition which is essential for advancing teacher education and professional development. Therefore, it is important to assess chemistry teachers' science process skills.

Two categories of chemistry teachers were of interest in this study: the in-service chemistry teachers and the pre-service chemistry teachers. In-service chemistry teachers are the regular teachers of chemistry who have been employed and are teaching chemistry at the secondary school levels. They are simply regarded as chemistry teachers or teachers of chemistry. They have undergone the pre-requisite institutional training and have been certified and employed to teach the subject at either public or private school. Kruea and Fakcharoenphol maintained that teachers are expected to have a good understanding of science process skills so that these skills can as well be transferred to their students (cited in Oguejiofor & Okigbo, 2023). Handayani et al. (2018) observed that science process skills have positive effect on scientific process skills. This suggests that students' achievement in chemistry depends on their science process skills which in turn depend on the chemistry teachers. In Taraba State, available data from the State's Ministry of Education shows that between 2016 and 2023, less than 50% of the students who sat for chemistry in their external examinations achieve the benchmark credit grade. This underachievement could be due to the problem of low science process skills from the chemistry teachers because low process skills from the teachers translates into low process skills in the students and consequently low achievement in chemistry. Hence there is need for investigation of science process skills of in-service teachers. Studies in the past have provided different findings. Im et al. (2024) showed that chemistry high school teachers have high overall science process skills. Setiawan and Sugiyanto (2020) also reported that science teachers have high level of science process skills. Abanikannda and Kolawole (2017) found that there is high awareness of science process skills teaching approach. However, Hikmah et al. (2018) observed otherwise and reported that teachers' conceptual and operational understanding of science process skills is weak. Low science process skills among chemistry teachers amplify the need for teachers' professional development. Prospective teachers undergoing training in various institutions could be employed upon graduation to mitigate this problem. Nevertheless, there is need to compare the science process skills of chemistry teachers and prospective chemistry teachers as so doing will be an appraisal of both the current status of chemistry teachers and chemistry teaching and prospective chemistry teachers training programme in tertiary institutions of Taraba State.

Prospective teachers of chemistry are also regarded as pre-service chemistry teachers. Pre-service chemistry teachers are students in

tertiary institutions undergoing training on how to reach chemistry. They consist of students of education and chemistry programme also called chemistry education at the university level. Upon completion of training and earning certification, they could be employed to provide manpower in the teaching of chemistry. Lindrawati and Rohandi alluded that pre-service teachers need to possess science process skills so that when they become practicing teachers; they can be able to apply it in the activities of classroom as well as passing it on to the students (as cited in Oguejiofor & Okigbo, 2023). Pre-service chemistry teachers are crucial for shaping the next generation of scientists by developing their foundational knowledge and enthusiasm for chemistry. Through their training, they acquire the science process skills necessary to effectively communicate complex concepts thereby fostering critical thinking and problem-solving in students. It implies from the foregoing that it will be laudable for pre-service chemistry teachers to have high science process skills and even better than in-service teachers of chemistry as that probable observation could mean that the next generation of students' will have improved chemistry process skills and academic achievement. Studies such as Irwanto et al. (2018) found that university chemistry students who are the pre-service chemistry teachers have low science process skills. Similarly, Maison et al. (2019) also reported that basic science process skill of physics education is low. However, Kamarudin et al. (2022) found that pre-service teachers' basic science process skills were satisfactory. The current study differed from the reviewed literatures as direct comparisons were made between pre-service and in-service chemistry teachers in this study; thus, establishing the implications of the resulting findings on chemistry teachers' professional development and pre-service chemistry teachers training programmes.

Asides the category of chemistry teachers (in-service or pre-service), gender could influence the teachers' level of science process skills. Gender gaps in science process skills among in-service chemistry teachers may arise from differences in training opportunities, confidence levels, or societal expectations, with female teachers sometimes reporting lower self-efficacy in skills like experimental design or data analysis. Gender studies on in-service chemistry teachers' science process skills have produced varying results. Im et al. (2024) found that there was no significant difference between genders of science process skills levels of teachers. However, Aydogdu et al. (2014) observed that science process skill scores of elementary school teachers differed significantly by gender. Also, Oguejiofor and Okigbo (2023) found that gender has significant influence in the possession of science process skills among basic science teachers. Among pre-service teachers, contrasting reports have been documented as well. Yamtinah (2017) found that male and female students have similar attitude toward

science process skill indicators. Kamarudin et al. (2022) observed that no significant gender difference exists in pre-service teachers basic science process skills. However, Darmaji (2022) found that female physics education students had better science process skills than male students. Identification and remediating gender related gaps in teachers and pre-service teachers' science process skills is crucial and in line with Sustainable Development Goal 5 (SDG 5) which advocates for gender equality. Taking cognisance of gender, this study compared the science process skills of pre-service and in-service chemistry teachers in Taraba State, Nigeria, examining whether they differ in their competency levels to identify strengths and weaknesses in teacher education and professional development.

The study aimed to compare pre-service and in-service chemistry teachers' science process skills, considering gender in Taraba State considering gender; in order to strengthen teacher competencies and better science education. Specifically, **t**he study compared the science process skills of: i. Pre-service and in-service chemistry teachers; ii. Male and female pre-service chemistry teachers; and Male and female in-service chemistry teachers.

Three research questions and null hypotheses tested at 0.05 level of significance guided the study as follows:

Research Questions

1. What is the mean science process skills score of pre-service and in-service chemistry teachers?

2. What is the mean science process skills score of male and female pre-service chemistry teachers?
3. What is the mean science process skills score of male and female in-service chemistry teachers?

Null Hypotheses

H_{o1}: There is no significant difference in the mean science process skills score of pre-service and in-service chemistry teachers.

H_{o2}: There is no significant difference in the mean science process skills score of male and female pre-service chemistry teachers.

H_{o3}: There is no significant difference in the mean science process skills score of male and female pre-service chemistry teachers

Methodology

A descriptive-comparative research design with a survey method was adopted for the study. The design was appropriate for the current study as the study sought to assess pre-service and in-service chemistry teachers' scientific process skills without inferring a cause-and-effect relationship to the observations. The study was conducted in Taraba State, Nigeria. The population of the study was 851 which comprised all pre-service chemistry teachers in Federal University Wukari and Taraba State University Jalingo (students studying

chemistry education programme in the universities) and all the in-service chemistry teachers across the 12 education zones all the secondary schools in Taraba State, Nigeria in the 2024/2025 academic session. From this number (851), 359 were pre-service chemistry teachers and 493 were in-service chemistry teachers. The sample size of 403 was used in the study. Using Krejcie and Morgan table of population and sample distribution, sample sizes of 186 and 217 were obtained for pre-service and in-service chemistry teachers respectively. Stratified proportionate and simple random sampling techniques were used as sampling techniques. The pre-service teachers were stratified proportionately along institutions while the in-service teachers were stratified proportionately along education zones. This was to achieve equal representation of subjects. Simple random sampling was used to provide equal selection opportunities for members of the population.

A 50-item, multiple choice questions, Science Process Skills Test (SPST) was used for data collection. SPST was adapted from adapted from Maranan (2017) and Jack (2014). It has nine sections: A, B, C, D, E, F, G, H and I. Section A accounted for the socio-demographic information of the subjects while section B consisted of 5 multiple choice items that sought to measure the science process skills of observation, section C contained 5 items which measured communication, section D contained 5 items which measured the skill of classification, section E tested measuring skills and had 12 items; Section F determined recording skills and it consisted of 6 multiple choice items; section G determined skills of interpreting data and consisted of 7 multiple choice items, section H contained 5 items to measure inferring and the last section, I, consisted of 5 items which measured prediction. The instrument was face and content validated by three experts: two from the Department of Science Education and one from Measurement and Evaluation unit of the Department of Educational foundations. All of whom were from Faculty of Education, Taraba State University, Jalingo. Kuder Richardson 20 reliability index of 0.75 was obtained for SPST after a pilot test conducted with 35 respondents in Adamawa State. The descriptive statistics of mean and standard deviation were used to answer all the research questions while the inferential statistics of independent t-test were used to test all the null hypotheses formulated at 0.05 level of significance

Results

Research Question 1: What is the mean science process skills score of pre-service and in-service chemistry teachers in Taraba State?

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Table 1: Mean and Standard Deviation of Pre-service and In-service Chemistry Teachers' Science Process Skills

SPS	Teacher	N	Mean	Std dev	Mean diff.
Observation	Pre-service	186	1.88	0.95	0.66
	In-service	217	2.54	1.00	
Communicating	Pre-service	186	1.65	1.07	0.62
	In-service	217	2.27	0.84	
Classifying	Pre-service	186	1.95	0.82	0.45
	In-service	217	2.40	0.78	
Measuring	Pre-service	186	2.91	1.75	2.70
	In-service	217	5.61	2.10	
Recording	Pre-service	186	2.15	1.23	1.05
	In-service	217	3.20	1.06	
Interpreting Data	Pre-service	186	1.97	1.09	0.98
	In-service	217	2.95	1.21	
Inferring	Pre-service	186	1.56	0.86	0.38
	In-service	217	1.94	0.81	
Predicting	Pre-service	186	1.36	0.74	0.47
	In-service	217	1.83	0.66	
Overall SPS	**Pre-service**	**186**	**15.42**	**6.16**	**7.31**
	In-service	**217**	**22.73**	**5.87**	

The result in table 1 shows that in-service chemistry teachers outperformed the pre-service chemistry teachers in each of the science process skill considered in the study. The biggest difference was found in 'measuring skill' where a mean difference of 2.70 was obtained while the least difference was found in 'inferring' with mean difference of 0.38. Overall, both pre-service and in-service chemistry teachers' scores for science process skills were below average (<25.00). However, in-service teachers scored better on the test with overall mean of 22.73 compared to pre-service teachers' mean of 15.42 representing a mean difference of 7.31 in favour of in-service chemistry teachers.

Research Question 2: What is the mean science process skills score of male and female pre-service chemistry teachers in Taraba State?

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Table 2: Mean and Standard Deviation of Pre-service Chemistry Teachers' Science Process Skills based on Gender

SPS	Gender	N	Mean	Std dev	Mean diff.
Observation	Male	68	1.69	0.82	0.29
	Female	118	1.98	1.01	
Communicating	Male	68	1.44	1.10	0.32
	Female	118	1.76	1.04	
Classifying	Male	68	1.76	0.81	0.29
	Female	118	2.05	0.81	
Measuring	Male	68	2.91	1.73	0.00
	Female	118	2.91	1.76	
Recording	Male	68	2.12	1.06	0.05
	Female	118	2.17	1.32	
Interpreting Data	Male	68	2.00	1.17	0.05
	Female	118	1.95	1.04	
Inferring	Male	68	1.50	0.94	0.10
	Female	118	1.60	0.81	
Predicting	Male	68	1.31	0.58	0.08
	Female	118	1.39	0.82	
Overall SPS	**Male**	**68**	**14.74**	**6.08**	**1.07**
	Female	**118**	**15.81**	**6.20**	

The result in Table 2 shows that female pre-service teachers scored better than their male counterparts in 6 of the 8 science process skills. The female pre-service teachers showed higher mean in observation, communicating, classifying, recording, inferring, predicting. The male pre-service teachers outperformed the female pre-service teachers in data interpretation while both genders had the same mean score for measuring. Overall, female pre-service chemistry teachers showed higher science process skills than their male counterparts with a mean difference of 1.07 in favour of female pre-service chemistry teachers.

Research Question 3: What is the mean science process skills score of male and female in-service chemistry teachers in Taraba State?

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Table 3: Mean and Standard Deviation of In-service Chemistry Teachers' Science Process Skills based on Gender

SPS	Gender	N	Mean	Std dev	Mean diff.
Observation	Female	85	2.47	1.13	0.11
	Male	132	2.58	0.92	
Communicating	Female	85	2.32	1.01	0.09
	Male	132	2.23	0.71	
Classifying	Female	85	2.44	0.84	0.07
	Male	132	2.37	0.74	
Measuring	Female	85	5.59	2.29	0.03
	Male	132	5.62	1.99	
Recording	Female	85	3.27	1.18	0.11
	Male	132	3.16	0.98	
Interpreting Data	Female	85	3.01	1.31	0.10
	Male	132	2.91	1.14	
Inferring	Female	85	1.88	0.88	0.09
	Male	132	1.97	0.76	
Predicting	Female	85	1.81	0.68	0.03
	Male	132	1.84	0.64	
Overall SPS	**Female**	**85**	**22.79**	**7.07**	**0.10**
	Male	**132**	**22.69**	**4.98**	

The result in Table 6 shows that female in-service teachers scored better than their male counterparts in 4 of the 8 science process skills while the male in-service chemistry teachers also scored higher than their female counterparts in 4 of the 8 science process skills. The female in-service teachers showed higher mean in communicating, classifying, recording, and interpreting data. On the other hand, the male in-service teachers showed higher mean in observation, measuring, inferring and predicting. Overall, the female in-service chemistry teachers showed higher science process skills than their female counterparts with a mean difference of 0.10 in favour of male in-service chemistry teachers

Null Hypothesis 1: There is no significant difference in the mean science process skills score of pre-service and in-service chemistry teachers in Taraba State.

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Table 4: Independent t-test Result of Pre-service and In-service Chemistry Teachers' Science Process Skills

SPS	Teacher	N	Mean	Std dev	t	df	sig.
Observation	Pre-service	186	1.88	0.95	-6.76	401	0.000
	In-service	217	2.54	1.00			
Communicating	Pre-service	186	1.65	1.07	-6.54	401	0.000
	In-service	217	2.27	0.84			
Classifying	Pre-service	186	1.95	0.82	-5.64	401	0.000
	In-service	217	2.40	0.78			
Measuring	Pre-service	186	2.91	1.75	-13.87	401	0.000
	In-service	217	5.61	2.10			
Recording	Pre-service	186	2.15	1.23	-9.22	401	0.000
	In-service	217	3.20	1.06			
Interpreting Data	Pre-service	186	1.97	1.09	-8.51	401	0.000
	In-service	217	2.95	1.21			
Inferring	Pre-service	186	1.56	0.86	-4.47	401	0.000
	In-service	217	1.94	0.81			
Predicting	Pre-service	186	1.36	0.74	-6.76	401	0.000
	In-service	217	1.83	0.66			
Overall SPS	**Pre-service**	**186**	**15.42**	**6.16**	**-12.18**	**401**	**0.000**
	In-service	**217**	**22.73**	**5.87**			

Table 4 shows that there is a significant difference in the mean score of pre-service and in-service chemistry teachers in each of the 8 science process skills as p-values of 0.000 were observed in all 8 cases. Since the p-values are less than 0.05, there is a significant difference in each science process skillset. Overall, there is also a significant difference between the mean science process skills of pre-service and in-service chemistry teachers as overall p-value is 0.000 which is less than 0.05. The difference is statistically significant in favour of in-service chemistry teachers who recorded significantly higher mean score in the science process skills test. This means that null hypothesis 1 is rejected.

Null Hypothesis 2: There is no significant difference in the mean science process skills score of male and female pre-service chemistry teachers in Taraba State.

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Table 5: Independent t-test Result of Pre-service Teachers' Science Process Skills based on Gender

SPS	Gender	N	Mean	Std dev	t	Df	sig.
Observation	Male	68	1.69	0.82	-2.03	184	0.054
	Female	118	1.98	1.01			
Communicating	Male	68	1.44	1.10	-1.99	184	0.057
	Female	118	1.76	1.04			
Classifying	Male	68	1.76	0.81	-2.31	184	0.052
	Female	118	2.05	0.81			
Measuring	Male	68	2.91	1.73	0.02	184	0.985
	Female	118	2.91	1.76			
Recording	Male	68	2.12	1.06	-0.28	184	0.783
	Female	118	2.17	1.32			
Interpreting Data	Male	68	2.00	1.17	0.31	184	0.759
	Female	118	1.95	1.04			
Inferring	Male	68	1.50	0.94	-0.78	184	0.437
	Female	118	1.60	0.81			
Predicting	Male	68	1.31	0.58	-0.72	184	0.473
	Female	118	1.39	0.82			
Overall SPS	**Male**	**68**	**14.74**	**6.08**	**-1.15**	**184**	**0.252**
	Female	**118**	**15.81**	**6.20**			

Table 5 showed that the significance value (p-value) in each of the science process skill between male and female pre-service teachers is above the benchmark 0.05. This means that the there is no significant difference in each science process skillset of pre-service chemistry teachers based on gender. Overall, there is also no significant difference between the mean science process skills of male and female pre-service chemistry teachers as overall p-value is 0.252 which is above 0.05. The difference is not statistically significant. This means that null hypothesis 2 is accepted meaning both male and female pre-service chemistry teachers have identical science process skills with no gender superiority.

Null Hypothesis 6: There is no significant difference in the mean science process skills score of male and female in-service chemistry teachers in Taraba State**.**

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Table 6: Independent t-test Result of In-service Teachers' Science Process Skills based on Gender

SPS	Gender	N	Mean	Std dev	t	Df	sig.
Observation	Female	85	2.47	1.13	-0.806	215	0.421
	Male	132	2.58	0.92			
Communicating	Female	85	2.32	1.01	0.708	215	0.480
	Male	132	2.23	0.71			
Classifying	Female	85	2.44	0.84	0.593	215	0.554
	Male	132	2.37	0.74			
Measuring	Female	85	5.59	2.29	-0.112	215	0.911
	Male	132	5.62	1.99			
Recording	Female	85	3.27	1.18	0.755	215	0.451
	Male	132	3.16	0.98			
Interpreting Data	Female	85	3.01	1.31	0.609	215	0.543
	Male	132	2.91	1.14			
Inferring	Female	85	1.88	0.88	-0.776	215	0.438
	Male	132	1.97	0.76			
Predicting	Female	85	1.81	0.68	-0.319	215	0.750
	Male	132	1.84	0.64			
Overall SPS	**Female**	**85**	**22.79**	**7.07**	**0.121**	**215**	**0.904**
	Male	**132**	**22.69**	**4.98**			

Table 6 shows that the significance value (p-value) in each of the science process skill between male and female in-service chemistry teachers is above the benchmark 0.05 ($p>0.05$). This means that the there is no significant difference in each science process skillset of in-service chemistry teachers based on gender. Overall, there is also no significant difference between the mean science process skills of male and female in-service chemistry teachers as overall p-value is 0.904 which is above 0.05. The difference is not statistically significant. This means that null hypothesis 6 is accepted meaning both male and female in-service chemistry teachers have identical science process skills with no significant gender superiority.

Discussion of Findings

The finding of the study revealed that in-service chemistry teachers have higher science process skills than pre-service chemistry teachers. The difference was statistically significant in favour of in-service chemistry teachers. In-service chemistry teachers in Taraba State scored higher in the science process skills test than pre-service teachers primarily due to their practical teaching experience, which allows them to refine skills like observation, hypothesizing, and experimentation through real-world classroom application. Unlike pre-service teachers who are still in training and often limited to theoretical or controlled laboratory settings, in-service teachers have had repeated opportunities to engage with diverse

student groups and complex teaching scenarios, enhancing their ability to apply scientific processes effectively. Additionally, the necessity to address real classroom challenges, such as large class sizes or limited resources, compels in-service teachers to adapt and innovate, strengthening their science process skills over time. This agrees with Abanikannda and Kolawole (2017) who found that there is high awareness of science process skills teaching approach. It agrees with Setiawan and Sugiyanto (2020) who also reported that science teachers have high level of science process skills. The finding generally aligns with studies who found lower science process skills results for pre-service teachers. Irwanto et al. (2018) found that university chemistry students have low science process skills. Maison et al. (2019) also reported that basic science process skill of physics education is low. Pre-service chemistry teachers are yet to be saddled with the responsibilities of having to address real classroom challenges such limited resources which could compel them to adapt and innovate and strengthen their science process skills. This explains why their science process skills score is significantly lower than that of in-service chemistry teachers. The finding disagrees with Kamarudin et al. (2022) who found that pre-service teachers' basic science process skills was satisfactory. Pre-service chemistry teachers rely on practical activities provided during their training programmes in order to improve their science process skills. Increasing the frequency of their practical courses will result into improved science process skills. The finding is not consistent with Hikmah et al. (2018) who found teachers' conceptual and operational understanding of science process skills to be weak. This implies that teacher experience alone is not the ultimate predictor or determinant of science process skills but ingenuity, resourcefulness and creativity on the part of the chemistry teacher and also professional development opportunities help boost teachers' science process skills.

The finding showed that male and female pre-service teachers of chemistry have no significant difference in their science process skills score. This finding agrees with Yamtinah (2017) who found that male and female students result similar attitude toward science process skill indicators. Similarly, it is consistent with Kamarudin et al. (2022) finding that no significant gender difference exists in pre-service teachers basic science process skills. However, it is not consistent with Darmaji (2022) who found that female physics education students had better SPS than male students. The present study's finding on the no significant gender disparity in science process skills among pre-service teachers in Taraba State can be attributed to several factors. Firstly, the standardized curriculum of teacher training institutions across Nigeria, including Taraba State, aims to equip all aspiring teachers with essential pedagogical and scientific skills, regardless of gender. This structured training ensures a common baseline for developing science

process skills like observation, experimentation, and data analysis. Secondly, the admission criteria for pre-service teacher programs may already select individuals who demonstrate a certain level of aptitude in science, irrespective of their gender, thus leading to a more homogeneous group in terms of foundational abilities. Finally, increasing awareness and efforts to promote gender equity in science education within Nigeria might be fostering learning environments where both male and female students are equally encouraged and provided with opportunities to develop their practical science skills.

Finding of the study revealed that female in-service chemistry teachers have higher science process skills score than their male counterparts. The t-test analysis showed that there is no significant difference in science process skills score of in-service chemistry teachers based on gender. This is consistent with Im et al. (2024) who found that there was no significant difference between gender and science process skills levels of teachers. However, it disagrees with Aydogdu et al. (2014) who observed that science process skill scores of elementary school teachers differed significantly by gender. Oguejiofor and Okigbo (2023) also found that gender has significant influence in the possession of science process skills among basic science teachers. The present study's finding that there is no significant gender difference in science process skills among secondary school in-service chemistry teachers in Taraba State can be attributed to several convergent factors. Firstly, the professional training for all chemistry teachers in Nigeria, regardless of gender, follows a standardized curriculum designed to impart essential science process skills, ensuring a common baseline of competency. Secondly, the daily demands of teaching chemistry which inherently involve designing experiments, analysing data, and demonstrating scientific inquiry provide consistent and equal opportunities for both male and female teachers to practice and refine these skills over time. There is also the emphasis on quality science education and the promotion of gender equity in education within Nigeria likely contribute to an environment where both male and female teachers are equally supported and expected to develop strong science process skills.

Therefore, this study contributes to the existing body of knowledge by focusing on specific socio-cultural and educational context of Taraba State, on key areas of scientific process skills acquisition by pre-service and in-service teachers with a particular focus on gender, which is often under-studied.

Conclusion

The study concludes that the in-service teachers of chemistry in Taraba State have higher overall levels of science process skills than pre-service chemistry teachers. This implies that a deeper understanding and cultivation of these skills are needed by these prospective teachers in their training

programs. The study also concludes that male and female pre-service teachers show no gender difference in science process skills. This implies that both male and female teachers of chemistry and pre-service teachers of chemistry have identical science process skills levels. Hence, the study challenge and dismantle stereotypical beliefs about male and female abilities in science, fostering more equitable opportunities in education.

Recommendations

The study recommends that:

1. Pre-service chemistry teachers should be provided with rigorous practical activities and experiences in their training programme in order to enhance their science process skills.
2. Schools should be fully equipped with materials and regents for in-service teachers to conduct practical activities to enhance their science process skills.
3. Equal training and professional development opportunities should be provided for male and female teachers of chemistry in order to sustain the observed gender balance.

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