

## Basic science teachers' possession of science process skills: a perspective from Nigeria as a function of gender, experience and qualifications

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### Abstract

This research explored the possession of Science Process Skills (SPS) by basic science teachers as a perspective from Nigeria as a function of gender, teaching experience and teaching qualification. Three research questions guided the study and three hypotheses were tested at 0.05 alpha level. Descriptive survey research design was used in the study. The population comprised 178 Basic Science Teachers in all the 266 public secondary schools in the six education zones of Anambra state. No sampling was done because it is small and manageable. The instrument used for data collection was Science Process Skill Test (SPST). The reliability of SPST was established using Kuder richardson formular 21 ( $KR_{21}$ ), which yielded coefficient of internal consistency of .89. Research questions were answered using mean and standard deviation while t-test and ANOVA was used to test the null hypotheses. The findings of the study showed that gender has significant influence in the possession of Science process skills. Surprisingly, it was found that the perception and social convention that males are stronger than females in science appears not to be the case among basic science teachers. It also showed that there was no significant difference in the possession of Science Process Skills based on teaching experience and teaching qualification. Therefore, it was concluded basic science teachers can possess SPS irrespective of their teaching experience and qualification and it is a matter of individual differences. It was recommended that the government, managers and administrators of education in Nigeria should create a forum that will bring these teachers together and provide them the opportunity to improve (periodic training) on Science Process skills. Employment of basic science teacher should be gender friendly.

*Keywords: Gender, Science Process Skills, Basic Science Teachers, Teaching Experience, Teaching Qualification.*

### Introduction

Science education is very necessary for useful and functional living in any society. According to Baram-Tsabari (2022), science education prepares learners for civic participation in a quantified digital and science infused world. It is the tool for driving scientific and technological development of any nation, including Nigeria. The advancement of technology has expanded the objectives of basic science teaching not only to develop the students' understanding of the basic science concepts, but also to teach them how to use the knowledge to solve real-life problems. Thus, students are required to collect relevant information to be analyzed and interpreted in order to find the intended solutions by means of implementing sound scientific processes. It is expected that teachers as well as students' master various skills and by doing so assist to provide positive contributions to the global society.

There are a number of skills applied in basic science learning, one of which is science process skills. Science process skills can be defined as an approach used as a reference for teachers to design and implement science learning processes. It is a way for students to investigate and understand the surrounding environment and build scientific concepts correctly (Sri, 2021). Learning with the Science process skills emphasizes the existence of treatment in teaching and learning activities that emphasize using thinking skills and creative abilities efficiently and effectively to achieve learning goals. Thus, the acquisition of science process skills is the basic requirement of research that is needed in learning certain concepts in basic science. In Nigeria, the federal government introduced basic education which gave room

for the teaching of science. Thus, effective teaching and learning of Basic Science requires an understanding of science process skills to guarantee meaningful learning. One of the characteristics that scientists employ during scientific investigation according to Lindrawati and Rohandi (2015) is science process skills. They are skills used by scientists to carry out daily activities including studying and seeking solution to problems by following scientific processes. According to Agustina and Saputra (2016) science process skills consist of basic science process skills and integrated process skills. In addition, Science process skills as stipulated in Science A Process Approach (SAPA) is divided into two groups namely; basic skills (observation, classification, measuring, communicating, predicting and inferring) and integrated skills (formulating hypothesis, interpreting data, formulating models, experimenting, operationally defining, and identifying and controlling variables).

Olowu (2023) states that Basic science processes are critical for science learning and promote affective reactions to science concept formulation at the primary and junior secondary school levels. Thus, Basic Science process skills compiled According to Yang and Liu (2016), the following science process skills were identified; *Observation*: This involves using the senses to gather information about an object or event, *inferring*: Making an educated guess about an object or event based on previously gathered data or information, *measuring*: Using standard and non-standard measures or estimates to describe the dimensions of an object or event, *Communication*: Using words or graphic symbols to describe an action, object or event, *Classifying*: Grouping or ordering objects or events into categories or criteria, *Predicting*: Stating the outcome of a future event based on a pattern of evidence, *Controlling Variable & Identifying variables* that can affect an experimental outcome, keeping most constant while manipulating only the independent variable, *Defining Operationally*: Stating how to measure a variable in an experiment, *Formulating hypothesis*: Stating the expected outcome of an experiment, *Interpreting Data*: Organizing data and drawing conclusion from it, *Asking Questions*: Raising an appropriate question, *Formulating Models*: Creating a mental or a physical model of a process or event. Science process skills (SPS) as explained by Idiege, Nja, Cecilia and Ugwu (2017) encourages students to develop the knowledge they have received and help them work like scientists. According to Jack (2013), the basic and integrated process skills are very relevant and in accordance with science subjects in secondary schools. Rauf, Rasul, Mansor, Othman and Lyndon (2013) also added that students who do not master basic science process skills will not master the integrated science process skills. This is because, integrated science process skills can only be obtained after basic science process skills are mastered by students through the efforts of their teachers.

Successful learning process is a factor of both the quality and way a teacher teaches. It is therefore important that teachers equip themselves with necessary skills to necessitate effective teaching and learning. According to Kruea and Fakcharoenphol (2015), teachers are expected to have a good understanding of Science Process skills so that these skills can as well be transferred to their students. Lindrawati and Rohandi (2015) opined that pre-service physics teachers should possess science process skills so that when they become practicing teachers, they can have an adequate understanding of science process skills and be able to apply it in the activities of classroom as well as passing it on to the students. If the physics teacher does not have the science process skills, the authors confirmed that the teacher will not be able to develop the students' science process skills which will in turn make learning passive thereby restricting students from constructing their own knowledge independently. Contributing, Mutisya and Rotich (2013) posited that, a teacher must possess science process skills.

Teaching and learning are lifelong processes, therefore the purpose of teaching at any level according to Pacia (2014) is to bring about a fundamental change in learners and such change may be in the form of acquiring intellectual skills, solving problems and instilling desirable attitude and values. Therefore, only teachers who adopt different approaches can help students acquire knowledge, skills and experience. Teaching science encompasses both content and process, therefore, giving more credit and attention to one over the other is rather an incomplete knowledge. According to Aydemir (2014), contents consists of subject matter and science concepts while the process consists of essential skills that students need to gain. It is important that teachers' professional development should include science content knowledge, science process skills. Teachers play an important role in learning, including the acquisition of science process skills as well as classroom managerial skills. Cowan, Goldhaber, Hayes, and Theobald (2016) revealed that the most important factor affecting students' learning is the teacher. Students however, cannot acquire these skills without the guidance of their teacher. Therefore, equipping school students

with the science process skills requires teachers to be familiar with the skill and also possess the skills in managing the classroom.

Many factors but not limited to poor laboratory, school location, administrative problem have been shown to hinder teachers' possession of certain skills thereby disrupting teaching and learning which can ultimately affect students' achievement. Gender, teaching experience and qualification may also be a contributing factors to the level of science process skills possessed by basic science teachers.

The issue of gender in teaching and learning in science has precipitated many research regarding the direction of performance either male or female. Gender, can be referred to as both social and ethnic roles of women and men in order to understand how the differences in power between them operate. It is a broader concept that has both social bearing and important characteristics in addition to mere masculinity and femininity. Gender is considered socially -society meaning assigned to male or female. Every society emphasizes particular roles assigned to each sex. Therefore, the gender roles of teachers may also influence their way of education including their roles in the society. The impact of gender is obvious, especially in developing countries. In the developing world's context, such as Nigeria, gender concerns are very relevant and extremely significant. SPS is a crucial area not only in education but also in science classroom. Several studies have been carried out to examine the link between SPS and gender. Studies like Nejati, Hassanni and Sahrahpour (2014) supposed that there is a link between teachers' gender and their classroom management methods. Abanikanda and kolawole 2017, found no significant difference between gender and teachers' awareness of SPS. This variety of results may be due to cultural considerations and different environments. Therefore, gender roles vary from society to society and societal responses also vary as per cultures. Irrespective of the influence of gender as factor that may influence teachers' possession of SPS. Anastasia (2015) observed that teachers with long teaching experience use better classroom management approaches, managing classroom problems and keeping students on tasks. Experience in any profession is considered as an asset, it could be referred to as the number of years spent in a particular thing. The basis for the classification of teachers as experienced and less experience may differ according to different settings. Usually, teachers below 5 years in service are considered in experienced while those with more than 5 years teaching experience are considered experienced. Kosgei, Mise, Odera and Ayugi (2013) opined that experienced teachers have a richer background of experience to draw from and can contribute insight and ideas to the course of teaching and learning. They are open to corrections and are less dictatorial in the classroom. Furthermore, experienced teachers are able to device means to teach students with different abilities, background and previous knowledge. The authors believe that one of the catalyst for experience is in-service training and there is also the need for teachers to be open and receptive to change. They emphasized the need for teachers to be given to both conceptual and operational understanding of SPS during pre-service and in service teacher education to enable science teachers to use the skills. Findings from Shahali, Halim, Treagust, Won and Chandrasegaran (2017) showed that teachers' understanding of SPS does not differ by their teaching experience, but differed by their teaching qualifications.

Teachers' qualification is the number of academic and professional degrees that enable a person to become a registered teacher in primary, secondary or tertiary schools. Such qualifications for primary and secondary schools include but are not limited to Nigerian Certificate in Education (NCE), Bachelor of Education (B.Ed.) and Postgraduate Diploma in Education (PGDE). The role of the quality of teacher is important and cannot be overemphasized in an educational system. This is because, it is the teacher that will elicit the necessary changes and ensure that the expected outcome of a programme is achieved. One cannot not give what he doesn't have, therefore during teaching and learning, the teacher's aim of imparting knowledge and ensuring continuity is paramount. Adeniyi, Ogundele and Odetola (2014) were of the view that teachers' qualification in terms of prescribed certificate is paramount for teaching to be rewarding and effective in Nigeria. According to the authors, there is need for training prospective teachers as well as training in-service teachers who are already on the job. From the above, one may wonder if Basic Science teachers in Anambra state have the experience and are qualified for effective use of the science process skills.

### Statement of the problem

Public schools in Nigeria are riddled with various problems such as overcrowding and indiscipline among students in the classrooms which can cause teachers to be ineffective, contributing to students' low

academic achievement. This low achievement of students could also be attributed to lack of science process skills by teachers which may in turn affect its impartation on students. This can lead to poor achievement since the teacher can't give what he/she don't have. little or no study has assessed science process skills possessed by Basic Science teachers for teaching in Anambra state as it affects students' achievement in Basic science. Against these backdrops, it becomes questionable on the capability of teachers acquiring and using science process skills for teaching effectiveness in the classroom.

### Purpose of the Study

The purpose of the study was to assess the science process skills and classroom managerial skills possessed by Basic science teachers in Anambra State, Nigeria.

Specifically, the study sought to assess the:

1. Science Process Skills (SPSs) possessed by male and female Basic Science teachers in Upper Basic schools in Anambra State.
2. Science Process Skills (SPSs) possessed by Basic Science teachers in Upper Basic schools in Anambra State based on their teaching experience (experienced and less experienced).
3. Science Process Skills (SPSs) possessed by Basic Science teachers in Upper Basic schools in Anambra State based on their teaching qualifications (OND, HND, NCE, B.Ed./ B.S.Ed. /PGDE, M.Ed./M.ScEd. and PhD).

### Research Questions

1. What are the Science Process Skills (SPSs) possessed by male and female Basic Science teachers in Upper Basic schools in Anambra State?
2. What are the Science Process Skills (SPSs) possessed by Basic Science teachers in Upper Basic schools in Anambra state based on their teaching experience (experienced and less experienced)?
3. What are the Science Process Skills (SPSs) possessed by Basic Science teachers in Upper Basic schools in Anambra state based on their teaching qualifications (OND, HND, NCE, B.Ed./ B.S.Ed. /PGDE, M.Ed./M.ScEd. and PhD)?

### Hypotheses

1. There is no significant difference between the possession of Science Process Skills by male and female Basic Science teachers in Upper Basic schools in Anambra State.
2. There is no significant difference between the possession of Science Process Skills by experienced and less experienced Basic Science teachers in Upper Basic schools in Anambra State.
3. There is no significant difference between the possession of Science Process Skills by Basic Science teachers in Upper Basic schools in Anambra state based on their teaching qualification (OND, HND, NCE, B.Ed./ B.S.Ed. /PGDE, M.Ed./M.ScEd. and PhD).

### Methods

The study adopted the descriptive survey research design. Three research questions guided the study and three hypotheses were tested at .05 alpha level. The population comprised 178 Basic science teachers in Anambra state. There was no sampling because the sample size was small and manageable. The instruments for data collection was Science Process Skill test (SPST). The reliability of SPST established using Kuder-Richardson Formula 21 (KR-21) was .89. Data were obtained by administering the instruments to the Basic science teachers with the help of six Biology teachers from the six Education zones as research assistants. The data collected were analyzed using mean, standard deviation, test and analysis of variance.

### Results

**Research Question 1:** What are the science process skills possessed by male and female basic science teachers in upper basic school in Anambra State?

**Table 1: Mean ratings of Science Process Skills of Basic Science Teachers in Upper Basic School based on Gender**

S/N	Skills	sex			
		Male n=14	Female n=164	Male n=14	Female n=164
		Mean	S.D	Mean	S.D
1	Observation	2.50	0.65	2.57	0.79
2	Classification	1.50	0.65	2.36	0.77
3	Communication	1.36	1.15	2.67	1.13
4	Measuring	2.14	0.86	2.79	0.78
5	Inferring	2.57	0.64	2.05	0.68
6	Predicting	2.14	0.36	2.46	0.61
7	Formulating Hypothesis	2.21	1.42	3.05	1.39
8	Experimenting	1.86	0.86	2.79	0.79
9	Interpreting Data	1.86	1.03	2.32	0.95
10	Formulating Model	1.14	0.36	1.53	0.52
11	Identifying Variable	3.00	1.04	3.84	1.39
12	Controlling Variable	1.93	1.44	1.29	1.03
13	Graphing	1.64	0.84	2.02	0.75
	<b>Total</b>	1.98	0.87	2.44	0.91

Table 1 shows the aggregated mean, standard deviation and percentage score of 1.98, 0.87 and 4.22 for male and 2.44, 0.91 and 60.32 for female. These mean score indicate that the possession of SPS by female is higher than that of male. The item by item analysis of the science process skills shows that the mean ratings for male teachers ranged from 1.14 to 3.00 while that of their female counterpart ranged from 1.29 to 3.05.

**Research Question 2:** What are the science process skills possessed by basic science teachers in Anambra State based on their teaching experience?

**Table 2: Mean ratings of Science Process Skills of Basic Science Teachers based on Teaching Experience.**

S/N	Skills	0-5yrs n=88		6yrs& above n=90	
		Mean	S.D	Mean	S.D
1	Observation	2.59	0.88	2.45	0.77
2	Classification	2.26	0.84	2.32	0.76
3	Communication	2.57	1.25	2.57	1.12
4	Measuring	2.81	0.87	2.69	0.74
5	Inferring	2.14	0.65	2.04	0.73
6	Predicting	2.38	0.63	2.49	0.57
7	Formulating Hypothesis	2.92	1.46	3.04	1.36
8	Experimenting	2.64	0.87	2.79	0.79
9	Interpreting Data	2.31	0.93	2.26	0.99
10	Formulating Model	1.59	0.54	1.41	0.49
11	Identifying Variable	3.81	1.32	3.74	1.45
12	Controlling Variable	1.60	1.17	1.10	0.91
13	Graphing	1.82	0.78	2.16	0.70
	<b>Total</b>	2.42	0.94	2.39	0.89

The Analysis in the table above shows the overall mean, standard deviation and percentage score of 2.42, 0.94 and 31.95 for those with 0-5 years of experience and 2.39, 0.89 and 32.39 for those with experience of 6 years and above. The mean scores indicate that teachers with experience between 0-5 years performed slightly above those with experience of 6 years and above. The item by item analysis shows that the mean ratings for teachers with 0-5 years of teaching experience range from 1.59 to 3.81 while those with experience of 6 years and above ranged from 1.10 to 3.74.

**Research Question 3:** What are the science process skills possessed by basic science teachers in Anambra State based on their teaching qualification?

**Table 3: Mean ratings of Science Process Skills of Basic Science Teachers based on Teaching Qualification.**

Mean and Standard deviation													
S/ N	Skills	OND n=10		HND n=2		NCE n=26		BED n=81		PGD E n=55		MED n=4	
		Mea n	S.D	Mea n	S.D	Mea n	S.D	Mea n	S.D	Mea n	S.D	Mea n	S.D
1	Observation	2.60	1.07	3.00	0.00	2.50	0.76	2.47	0.85	2.60	0.81	2.50	0.58
2	Classification	2.50	0.85	2.50	0.71	2.31	0.74	2.27	0.85	2.24	0.77	2.75	0.50
3	Communication	3.40	0.97	3.00	0.00	2.58	1.03	2.51	1.29	2.45	1.11	3.25	0.96
4	Measuring	2.70	0.82	3.00	0.00	2.62	0.85	2.69	0.82	2.87	0.82	3.00	0.00
5	Inferring	1.90	0.88	2.00	0.00	1.96	0.82	2.11	0.67	2.18	0.64	1.75	0.50
6	Predicting	2.10	0.57	3.00	0.00	2.42	0.58	2.43	0.61	2.51	0.57	2.00	0.82
7	Formulating Hypothesis	1.80	1.55	4.50	0.71	3.08	1.49	2.74	1.35	3.45	1.26	3.00	1.63
8	Experimenting	2.50	0.85	3.50	0.71	2.58	0.76	2.53	0.81	3.04	0.82	3.00	0.82
9	Interpreting Data	2.60	0.97	2.50	0.71	2.50	0.91	2.17	1.05	2.29	0.86	2.00	1.15
10	Formulating Model	1.70	0.48	2.00	0.00	1.58	0.50	1.42	0.54	1.51	0.50	1.75	0.50
11	Identifying Variable	3.10	0.99	5.00	1.41	3.27	1.08	3.72	1.36	4.13	1.52	4.50	1.29
12	Controlling Variable	1.40	0.84	1.00	1.41	1.23	1.07	1.37	1.09	1.38	1.13	1.25	0.96
13	Graphing	1.80	0.42	2.00	0.00	1.88	0.71	1.93	0.86	2.15	0.68	2.25	0.50
<b>Total</b>		2.34	0.87	2.85	0.44	2.35	0.87	2.34	0.93	2.52	0.88	2.54	0.79

The Analysis above shows the overall mean scores of 2.34, 2.85, 2.35, 2.34, 2.52. and 2.54 for teachers with OND, HND, NCE, Bed, PGDE and Med respectively. The mean scores were all above the cut-off point of 2.50 except for teachers with OND, indicating that teachers with HND, NCE, BED, PGDE and MED qualifications possess science process skills. The item analysis of science process skills shows that the respondents mean ratings ranged from 1.40 to 3.40 for those with OND, 1.00 to 5.00 for those with HND, 1.23 to 3.27 for those with NCE, 1.93 to 3.72 for those with BED, 1.38 to 4.13 for those with PGDE and 1.25 to 4.50 for those with MED.

**Hypothesis 1:** There is no significant difference between the possession of Science Process Skills by male and female Basic Science teachers in Upper Basic schools in Anambra State.

**Table 4: t-test comparison of Male and Female Basic Science Teachers Science Process Skills.**

Source of variation	N	$\bar{x}$	SD	df	t	P value
Male	14	25.86	5.92	176	-3.672	0.000
Female	164	31.71	5.71			

The result in table 4 shows that the mean score (sum) for male (M= 25.86, SD= 5.92) was significantly less than that of the female (M= 31.71, SD= 5.51);  $t_{176} -3.672$ ,  $p=0.000$ , indicating that there is a significant difference in the possession of science process skills between male and female basic science teachers in upper basic schools in Anambra State. The null hypothesis of no significant difference between the two groups was therefore rejected.

**Hypothesis 2:** There is no significant difference between the possession of Science Process Skills by experienced and less experienced Basic Science teachers in Upper Basic schools in Anambra State.

**Table 5: t-test comparison of Basic Science Teachers Science Process Skills by Teaching Experience.**

Source of variation	N	$\bar{x}$	SD	df	t	P value
0-5yrs	86	31.34	6.55	176	0.196	0.845
6yr and above	92	31.16	5.30			

Table 5 shows that the mean score (sum) for teachers with 0-5 years of experience (M= 31.34, SD= 6.55) was at par with that of teachers with experience of 6 years and above (M= 31.16, SD= 5.30);  $t_{176} 0.196$ ,  $p=0.845$ , indicating that there was a significant difference in the possession of science process skills by basic science teachers in upper basic schools in Anambra State based on their teaching experience. Therefore, we fail to reject the null hypothesis of no significant difference between the two groups.

**Hypothesis 3:** There is no significant difference between the possession of Science Process Skills by Basic Science teachers in Upper Basic schools in Anambra state based on their teaching qualification (OND, HND, NCE, B.Ed./ B.S.Ed. /PGDE, M.Ed./M.ScEd. and PhD).

**Table 6: Analysis of Variance of Basic Science Teachers Science Process Skills their Teaching Qualification**

	Sum of squares	df	Mean square	F	sig
Between Groups	299.724	5	59.45	1.747	1.26
Within Groups	5903.399	172	34.322		
Total	6203.124	177			

As shown in table 6, the F-ratio (df:5/172) is 1.747 and the p-value (1.26) is greater than the stipulated 0.05 level of significance. Therefore, it was decided that there is no significant difference in the possession of SPS among basic science teachers in upper basic schools based on their teaching qualification. It implies that irrespective of their teaching qualification, they have equal chance in possessing SPS. The null hypothesis was therefore not rejected.

## Discussions-Conclusion

The findings of this study shows that the possession of science process skills by male and female is low, but that there was a significant difference with the level of possession of SPS in favour of females. This could be because the situation of the country has not helped basic teachers to put in their very best in acquiring these skill with the males saddled with various responsibility as an average Anambra man, hence it may pose distraction. The finding of this study was in line with Okafor (2018), who reported that the influence of gender on integrated science process skills was observed in favor of females. This was also in line with the finding of Al-rabanni (2014), who reported that both male and female social studies teachers have high level of science process skills, with females having more than the males. Also, Aydogdu *et. al* 2014, found that SPS levels of classroom teachers differ by gender in favour of females. The finding of the study was in contrast with the study by Aydogdu (2015) who investigated the science process skills of teachers' in terms of some variable, and found that female teachers' had higher basic process skills and integrated process skills and overall science process skills, however, the difference were not statistically significant in any group. This finding was also in contrast with the findings of Abanikannda and kolawole (2017), who found no significant difference between gender and teachers' awareness of SPS.

The findings of this study showed that there is there is no significant difference in the possession of SPS based on teaching experience and teaching qualification. A plausible reason could be that they show equal level of professionalism and it may depend on the personality of the individual in SPS, this was in line with studies by Mumba, Miles and Chabalengula (2019), who examined the extent to which in-service elementary teachers are familiar with science process skills and their interest in learning more about science process skills and reported that teaching experience did not make a difference in their ability to articulate basic and integrated science process skills. The finding of the study was in contrast to the findings of Aydođdu, Erkol and Erten (2014), who investigated the science process skills of elementary school teachers and found that that there was a significant difference between basic process skills scores of teachers in terms of 1-5 years' seniority and 16-20 years in favour of those with 1-5 years' seniority. The finding was also in line with the finding of Inko-tariah (2019) reported that science teachers' attitude of science process skills does not differ significantly based on educational qualification.

Based on the findings above, it was concluded that there was no significant difference in the possession of Science Process skills among basic science based on teaching experience and teaching qualification. The findings also revealed that gender has significant difference in the possession of Science process skills. This study therefore concludes that possession of SPS is not dependent on teaching experience and teaching qualification but depends on gender.

## Recommendation

1. Stake holders of education in Nigeria should give free scholarship to young men who are interested in the teaching profession to study science education, particularly basic science in higher institution after which they will be gainfully employed to various secondary schools to teach the subject. Employment of basic science teachers should be gender friendly.
2. Irrespective of teaching experience and teaching qualification, the stake holders of education should ensure periodic training of basic science teachers in order to effectively control other factors that can impede their possession of these skills.
3. Since the basic science teachers have poor level of science process skills, the government and stake holders of education should create a forum that will bring these teachers together and provide them the opportunity to improve on this skill since one cannot do away with science as it is an important part of humans and the society at large.

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