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Science Teachers' Perceptions of the Utilisation of Science Process Skills (SPS) in Senior Secondary Schools in Dutsin-Ma Metropolis, Katsina State, Nigeria

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Abstract
To meet the needs of all learners in science classrooms including special needs education students, science teachers should be able to demonstrate their knowledge of science process skills. It is as a result of this that this paper aimed at investigating the views of science (Physics, Chemistry and Biology) teachers in senior secondary schools in Dutsin-Ma metropolis on the use of science process skills. The study employed a descriptive survey research design. The population comprised of all Physics, Chemistry and Biology teachers in senior secondary schools in Dutsin-Ma metropolis. The sample size consisted of all the Chemistry (n = 17), Physics (n = 12) and Biology (n = 13) teachers in senior secondary schools. A questionnaire titled Science Teachers Views on the Use of Science Process Skills (STVSPS) was used to generate data for the study. The questionnaire was designed to ascertain the teachers' views on the importance of science process skills in teaching their subject areas of specialization, the frequency of use of these skills by teachers as well as problems that teachers face during their practice of the science process skills in the class. It is concluded that science process skills had positive effects on teaching science and in-class activities. They also promote conceptual learning. It is therefore recommended that adequate training should be given to science teachers to foster an in-depth understanding of the science process skills so that there can be effective teaching and learning of the sciences.

Keywords: Science Process Skills, Science Education, Science Teachers, Science Teachers' Views,Senior Secondary Schools

Introduction

One of the most important and pervasive goals of schooling is to teach students to think. All school subjects should therefore contribute in accomplishing this overall goal. Science contributes its unique skills with its emphasis on hypothesizing, manipulating the physical world and reasoning from data. Understanding the nature of science, producing scientific knowledge, suggesting and interpreting problems, solving problems as well as gaining knowledge should be the primary gains of students (Gutlepe, 2016). The main goal of science education is to develop scientific literacy among students that will prepare them to be informed and participative citizens that are able to make judgments and decisions regarding applications of scientific knowledge that may have social, health and environmental impacts. To achieve this goal of science education therefore the principal objectives of the science subjects that is Physics, Chemistry and Biology curricular should be to educate individuals to be able to understand the nature of scientific query, produce scientific knowledge and methods in order to explain a case and be able to apply them to new circumstances Provide justifications for claims through evidence and proof, analyse and evaluate attained/current knowledge through experience, share scientific knowledge and utilize information technology when required (Mone in Gutlepe, 2016).

In today's world attaining knowledge is becoming relatively easy due to technology and the level of technological development of a society is measured by the level of scientific literacy that is obtainable in that society. For educators to teach science process skills effectively, it requires that they have a good understanding of these skills and should be able to identify the different science process skills that constitute procedural understanding as well

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as to plan and provide opportunities for learners to practice these skills individually within learning activities. Science education integrates science and technology in the civic, personal, social, economic and the values and ethical aspects of life. Science education is therefore designed around the three (3) domains of learning science, understanding and applying scientific knowledge, performing scientific process skills developing and demonstrating scientific attitudes and values (Gutlepe, 2016). Teaching science involves the content and process components, underestimating the content over the process or process over the content is not acceptable because all of them are equally important (Gutlepe, 2016). Content consists of subject matter and science concepts while process consists of essential skills that students need to gain (Inan in Gutlepe, 2016). One of the primary skills that curricular aim for students to attain is science process skills because effective teaching and learning of science requires an understanding of the science process skills. These skills have to be included not only in pure science courses but also in all science related courses. Science process skills are skills that focus on the learning process to develop student's skills in understanding the knowledge or concepts, independently discovering and developing necessary facts, concepts and values.

Park in Sihaan et al. (2017) considered science process skills as a kind of learning approach that integrates science process skills into the system of integrated material presentation, the learning approach is not only transferring knowledge but also emphasizing the process of scientific enquiry. The teacher in this type of learning approach acts as a facilitator that guides and manage students learning activities so that they can construct necessary facts, concepts and new values in their lives independently. Skills in the science process skills include: observing, identifying, predicting, hypothesizing, manipulating variables, summarizing, organizing and interpreting data, investigating, classifying, communicating, measuring, experimenting and survey. These skills help in problem solving and discovering new knowledge. Science process skills are considered as skills that focus on the learning process to develop students skills in understanding the knowledge or concepts, independently discovering and developing necessary facts, concepts or values (Sihaan et al., 2017). Science process skills are a set of broadly transferable abilities appropriate to many scientific disciplines and reflective of the behavior of scientists. They are those activities that scientists execute when they study and investigate a problem, an issue or a question (Rambuda & Fraser, 2004). These skills are used to generate content and to form concepts. Much of the pleasure of both teaching and learning science is experiencing science. Harlen in Gutlepe (2016) considered science process skills as one of the major goals to be achieved in science education because they are utilized not only by scientists but also by everyone inorder to become scientifically literate individuals.

Scientific process is a procedure essentially shaped by analytical and critical thinking skills (Mone in Gutlepe, 2016). Science process skills are regarded by Wagner and Gerlovich in Rambuda and Fraser (2004) as the way of thinking, measuring, solving problems and using thoughts. Science process skills were defined by Gutlepe (2016) as tools that students use to investigate the world around them and to construct science concepts. It is therefore very important that teachers have a good understanding of these skills. There is also a need for teachers to employ and develop a curricular that emphasizes process rather than content in problem solving (Shaw in Gutlepe, 2016). Science process skills have been defined by Karsli et al. (2009) as skills used by scientists for composing knowledge, thinking of problems and making conclusions. Science process skills are commonly used as popularized by the curriculum project as Science – A – Process Approach (SAPA). Science process skills are grouped into Basic and Integrated skiills (Gutlepe, 2016). The basic skills provided the foundation for learning the complex. The primary (basic) skills include observation, classification, prediction, measurement, deduction, inferring and communicating. They form the backbone of the more advanced problem solving skills and capacities (Rambuda & Fraser, 2004). Basic science process skills are interdependent, implying that investigators may display and apply more than one of these skills in any single activity while integrated science process skills are more advanced, well rounded and based upon the primary skills example include experimental process skills because variables are specified, hypotheses are shaped, data are attained inorder to prove or rebut them, data are recorded and judgement is reached. These processes pave way for more questions and more experiments to be carried out. Brotherton and Preece in Rambuda and Fraser (2004) argued that scientists are able to use integrated skills effectively once they have mastered the basic skills. The mastery of science process skills is positively correlated with the mastery of 21st century skills.

Statement of The Problem

Science process skills are very fundamental for effective science teaching and learning but researches have continue to show that there is still a serious educational gap in bringing these skills into the classroom for both teachers and students acquisition. This could be attributed to the fact that most of the science teachers are either unaware or not proficient in developing science process skills. The low science teachers understanding of the science process skills has serious implications for science teaching-learning activities. Whether or not students gain in scientific process skills depend on teachers being able to adequately present the teaching environment and practices to enable students apply the necessary skills. Much pleasure is derived in teaching and learning of

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science by experiencing it. Therefore, mastering and utilizing the science process skills will help us develop the kind of science program that mirrors real science.

Aim and Objectives of The Study

The purpose of this study is to survey the science teachers opinions on the use of science process skills in senior secondary schools in Dutsin-Ma metropolis, These specific objectives were raised:

1. To investigate the views of science teachers on the importance of science process skills in teaching their subject areas of specialization
2. To investigate the views of science teachers on their frequency of use of science process skills in teaching their subject areas of specialization
3. To investigate the views of science teachers on the problems they encounter when using science process skills to teach their subject areas of specialization.

Research Questions

1. What are the views of science teachers on the importance of science process skills in teaching their subject areas of specialization?
2. How frequent do science teachers use the science process skills in teaching their subject areas of specialization?
3. What are the views of science teachers on the problems they encounter when using the science process skills to teach their subject areas of specialization?

Methodology

The study adapted a descriptive survey research design comprising all the science (Physics, Chemistry and Biology) teachers in the 7 public secondary schools in Dutsin-Ma Metropolis. All the science teachers were used as sample for the study. A structured questionnaire titled science teachers views on the use of science process skills (STVSPS) was used as the instrument for data collection. The researcher administered the instrument to the respondents by herself. Forty four (44) questionnaires were distributed out of which forty two (42 were completely filled and returned to the researcher. The questionnaire consists of four sections A-D. Section A consists of the demographic information of the respondents, section B contains information on the views of the science teachers about the importance of science process skills in teaching their subject areas of specialization, section C contains information on the frequency of use of the science process skills by the science teachers while section D contains information on the challenges that the science teachers face when using science process skills to teach their subject areas of specialization. Sections B and D were scored on a four Likert scale of Strongly Agreed (SA), Agreed (A), Disagreed (DA) and Strongly Disagreed (SD). Section C has 3 points scale of Always Used (AU), Sometimes Used (SU) and Never Used (NU). SA was scored 4 points, A was scored 3 points, D was scored 2 points and SD was scored 1 point. AU was scored 3 points, SU was scored 2 points and NU was scored 1 point. The respondents were asked to tick (V) on the appropriate items to fill the questionnaire. Data collected was analyzed using frequencies and percentages. The instrument was validated by experts from Science Education Department, Federal University Dutsin-Ma. The reliability coefficient of the instrument yielded a Cronbach alpha of 0.75.

Results

Research Question 1: What are the views of science teachers on the importance of science process skills in teaching their subject areas of specialisation?

Table 1: Rating the views of science teachers on the importance of science process skills in teaching their subject areas of specialization.

S/N	Statement	Strongly Agreed	Agreed	Disagreed	Strongly disagreed
1	They enable permanent learning	22(52.4%)	18(42.8%)	2(4.8%)	00(00%)
2	They facilitate learning	24(57.1%)	17(40.5%)	1 (2.4%)	00(00%)
3	They eliminate rote learning	25(59.5%)	15(35.7%)	00 (00%)	2 (4.8%)
4	They ease learning	30 (71.4%)	12(28.57%)	00 (00%)	00 (00%)
5	They improve positive attitude of students	14 (33.33%)	20 (47.6%)	8 (19.0%)	00(00%)
6	They improve science learning	30 (71.4%)	10(23.8%)	2 (4.8%)	00 (00%)
7	They improve thinking skills	25 (59.5%)	15(35.7%)	00 (00%)	2 (4.8%)
8	They foster different points view to problems	27 (64.3%)	13(30.9%)	2 (4.8%)	00 (00%)
9	They enable students to discover answers to different questions of why and how	30 (71.4%)	12 (28.6%)	00 (00%)	00 (00%)
10	They enable students to have self-confidence and courage	40 (95.2%)	2 (4.8%)	00(00%)	00 (00%)

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11	They aid learning through experience	19 (45.2%)	20 (47.6%)	3 (7.2%)	00(00%)

Source: Field Survey, 2024

Results of findings in Table 1 revealed that respondents on items number 1 – 11 strongly agreed with the opinions that science process skills enabled permanent learning, helped to facilitate learning, help to eliminate rote learning and they eased learning, improved positive attitude of students, improved science learning, improved thinking skills and fostered different points of view to problems. They enabled students to discover answers to different questions of why and how, enabled students to have self-confidence and courage and they aid learning through experience with frequencies and percentage scores of 22(52.4%), 24 (57.1%), 29 (69.5%), 30 (71.4%), 14 (33.33%), 30 (71.4%), 25 (59.5%), 27 (64.3%), 30 (71.4%), 40 (95.2%) and 19 (45.2%) respectively. While respondents with frequencies and percentage scores of 18 (42.8%), 17 (40.5%), 15 (35.7%), 12(28.57%), 12 (28.57%), 20 (47.6%), 10 (23.8%), 15 (35.7%), 13 (30.9%), 12 (28.6%), 2 (4.8%) and 20 (47.6%) agreed respectively on the items. Results on the table also indicated that respondents with frequencies and percentage scores of 2 (4.8%), 1 (2.4%), 8 (19.0%), 2 (4.8%), 2(4.8%) and 3 (7.2%) disagreed respectively with the statements that science process skills enabled permanent learning, help to facilitate learning, improved positive attitudes of students, improved science learning, fostered different points of view to problems and aided learning through experience. Results also showed that respondents with frequencies and percentage scores of 2 (4.8%) and 2 (4.8%) are the only ones that strongly disagreed with the statements that science process skills eliminated rote learning and improved thinking skills respectively. These results therefore indicated that majority of the respondents agreed that science process skills are important in teaching their subject areas of specialization.

Research Question 2: How frequent do science teachers use science process skills in teaching their subject areas of specialization?

Table 2: Rating the science teachers views on their frequency of use of the science process skills

S/N	Items	Responses		
		Always	**Sometimes**	**Never**
(i)	Observing	12(28.6%)	30(71.4%)	00(00%)
(ii)	Measurement	10(23.8%)	32 (76.2%)	00(00%)
(iii)	Classification	20(47.6%)	22(52.4%)	00(00%)
(iv)	Hypothesis	15(35.7%)	27(64.3%)	00(00%)
(v)	Designing experiment	30(71.4%)	12(28.6%)	00(00%)
(vi)	Prediction	07(16.7%)	35(83.3%)	00(00%)
(vii)	Specifying	19(45.2%)	23(54.8%)	00(00%)
(viii)	Graphing	25(59.5%)	17(40.5%)	00(00%)
(ix)	Data organization in graphs and tables	28(66.7%)	14(33.3%)	00(00%)
(x)	Interpretation	20(47.6%)	22(52.4%)	00(00%)
(xi)	Comparism	16(38.1%)	26(61.9%)	00(00%)
(xii)	Graph interpretation	30(71.4%)	12(28.6%)	00(00%)
(xiii)	Inferring	14(33.3%)	28(66.7%)	00(00%)
(xiv)	Changing Variables	17(40.5%)	25(59.5%)	00(00%)
(xv)	Summarization	32(76.2%)	10(23.8%)	00(00%)
(xvi)	Conclusion	22(52.4%)	20(47.6%)	00(00%)

Results of findings in Table 2 - reveal that respondents with frequencies and percentage scores of 12 (28.6%), 10 (23.8%), 20 (47.6%), 15 (35.7%), 30 (71.4%), 7 (16.7%), 19 (45.2%), 25 (59.5%),28 (66.7%),20 (47.6%), 16 (38.1%), 30 (71.4%), 14 (33.3%), 17 (40.5%), 32 (76.2%) and 22 (52.4%) always use the science process skills of observation, measurement, classification, hypothesis, designing experiment, prediction, specifying, graphing, data organization in graphs and tables, interpretation, comparism, graph interpretation, inferring, changing variables, summarization and conclusion respectively in teaching their subject areas of specialization. While respondents with frequencies and percentage scores of 30 (71.4%), 32 (76.2%), 22 (52.4%), 27 (64.3%), 12 (28.6%), 35 (83.3%), 23 (54.8%), 17 (40.5%) 14 (33.3%), 22 (52.4%), 26 (61.9%), 12 (28.6%), 28 (66.7%), 25 (59.5%), 10 (23.8%) and 20 (47.6%) sometimes use the aforementioned science process skills respectively, It can therefore be inferred from the results that majority of science teachers (respondents) sometimes use the science process skills in teaching their subject areas of specialization.

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Research Question 3: What are the views of science teachers on the problem they face when using the science process skills in teaching their subject areas of specialization?

Table 3: Rating the views of science teachers on the problems they face when using the science process skills to teach their subject areas of specialization.

	Statement	Responses Strongly Agreed	Agreed	Disagreed	Strongly disagreed
1	Crowded classrooms	15(35.7%)	27(64.3%)	00(00%)	00(00%)
2	Insufficient time due to heavy schedule	23(54.8%)	19(45.2%)	00(00%)	00(00%)
3	Inadequate focus of text books on skill development	27(64.3%)	15(35.7%)	00(00%)	00(00%)
4	Inadequate students' basic skills knowledge	12(28.6%)	30(71.4%)	00(00%)	00(00%)
5	Insufficient laboratories	24(57.1%)	18(42.9%)	00(00%)	00(00%)
6	Insufficient in class hands-on activities	20(47.6%)	22(52.4%)	00(00%)	00(00%)
7	Negative attitude of students toward science	10(23.8%)	32(76.1%)	00(00%)	00(00%)
8	Central examination-based teaching	25(59.5%)	17(40.5%)	00(00%)	00(00%)
9	Insufficiency of the Science Teachers Pedagogy in SPS	30(71.4%)	12(28.6%)	00(00%)	00(00%)

Results of findings in Table 3– revealed that respondents on items 1 – 9 with frequencies and percentage scores of 15 (35.7%), 23 (54.8%), 27 (64.3%), 12 (28.6%), 24 (57.1%), 20 (47.6%), 10 (23.3%), 25 (59.5%) and 30 (71.4%) strongly agreed that the problems they faced in using the science process skills when teaching their subject areas of specialization included overcrowded classrooms, insufficient time due to heavy schedule, inadequate focus of text books on skill development, inadequate students basic skills knowledge, insufficient laboratories, insufficient hands – on activities, negative attitude of students towards science, central examination based teaching and teachers pedagogical field inadequacy in science process skills respectively. Findings from the table also revealed that respondents with frequencies and percentage scores of 27 (64.3%), 19 (45.2%), 15 (35.7%), 30 (71.4%), 18 (42.9%), 22 (52.4%), 32 (76.1%), 17 (40.5%) and 12 (28.6%) agreed with the items respectively. All the respondents agreed with the items as the problems they faced in using SPS to teach.

Discussion

From the findings of this study it could be observed that all the science teachers were of the view that SPS was important in teaching their subject areas of specialization because they all agreed that SPS facilitated learning, eliminated rote learning, made learning easy, improved positive attitudes of students, improved science learning, improved thinking skills, fostered different points of view to problems, enabled students to discover answers to different questions of why and how, enabled students to have self-confidence and courage and aided learning through experience. The findings of this study were in line with those of Gutlepe (2016) found that SPS had positive effects on science education in terms of learning, attitude, higher thinking, self-efficacy and practice, more than half of all the teachers held the view that SPS backed up permanent learning without rote learning and supported higher thinking skills. Majority of the teachers therefore believed that SPS had significant effect on the teaching and learning of sciences. This study was also in line with the work of Novianty et al. (2018) who found out that SPS were important skills that should be mastered by students so that they can understand science concepts and that SPS was important in improving scientific attitude and also in the production of scientific products. Findings from the study also revealed that the science teachers used SPS in teaching their subject areas of specialization. Majority of the science teachers were of the view that they always used prediction, Summarization, Experimentation and Graph interpretation but sometimes use measurement in teaching their subject areas of specialization, this is in line with Gutlepe (2016) where it was found that highest percentage of utilization of SPS was recorded in experimentation. With regards to the findings in research question 3 all the science teachers agreed that overcrowded classrooms , insufficient time due to heavy schedule, inadequate focus of text books on skill development, inadequate students basic skills knowledge, insufficient laboratories, insufficient in class hands- on activities, negative attitude of students towards science, central examination based teaching and poor teachers pedagogical skills as among the challenges that teachers face in using science process skills to teach their subject areas of specialization. This work was in line with Gutlepe (2016) where the science teachers expressed that lack of time due to intense curricular, national examination focus education system, insufficient students' basic process

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skill, lack of laboratories and materials, pedagogical insufficiency of teachers in SPS as some of the problems hindering the use of SPS by the teachers. This work is also in line with Yildrim et al. (2020) who admitted that the main problems of teaching scientific procsess skills to students were overcrowding of classes, time constraints, content in the curriculum and problems in supplying materials for activities. The findings of this work were in line with the work of Novianty et al. (2018) who found in their work that SPS were important skills that should be mastered by students to enable understand other science concepts because they are important in improving scientific attitude and production of scientific products.

Conclusion

The study indicated that science teachers in public senior secondary schools in Dutsin-Ma metropolis agreed that SPS was an important skill to be mastered by students so as to be able to understand science concepts. SPS is fundamental in teaching and learning activities. Meaningful learning occurs by experiencing it and this occurs by hands-on activities. For meaningful learning to take place students should be engaged in SPS like experimentation, prediction, summarization, classification, measurement and others. Students' acquisition of SPS depends on the teachers who guide them in the teaching and learning process. In fact the students' level of success is considered as a reflection of their teachers' level of possession of these same skills. The problems that hinder the utilization of science process skills like overcrowded classrooms and others should be controlled for proper utilization of science process skills.

Recommendations

- Science teachers should strive to update their knowledge of science teaching and improve their pedagogical skills by furthering their studies, attending seminars/ workshops.
- In-service training should also be organized by the government and other professional bodies.
- More classroom facilities should be provided to reduce the problem of overcrowding
- There should be provision of more equipped laboratories in senior secondary schools
- Curriculum should be fashioned out to with emphasis on practice rather than theory
- Teachers should be supported through various channels (on – line, off – line, and face – face) contact on SPS.

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