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An Assessment of Senior Secondary School In-Service Science Teachers' Views of the Nature of Science

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ABSTRACT

This study examined the views of nature of science (NOS) of secondary school in-service science teachers in Egor Local Government Area of Edo State, South-South, Nigeria, relative to experience and professional training. Three research questions and two hypotheses guided the study. The study adopted the descriptive survey design. The population for the study comprised 211 secondary school in-service science teachers in Egor Local Government Area of Edo State, South-South, Nigeria. A sample of 100 secondary school in-service science teachers was randomly selected from twenty-one public and private schools. Data were collected through the administration of validated questionnaire adapted from Palmquist and Finley (2007) views of nature of science. Findings from this study revealed that based on the scientific literacy approach of the five levels of Palmquist and Finley (2007) views of the nature of science, secondary school in-service science teachers have both traditional and contemporary views of the nature of science (NOS).Most teachers held traditional view, while a reasonable number have contemporary view. There was no significant difference in the views of nature of science between experienced and in experienced science teachers. There was no significant difference in the views of nature of science between professionally and non-professionally trained science teachers. It was concluded that the teaching of science is limited owing to inadequate science teachers' professional training in the nature of science and its application to science teaching. Based on the finding, it was recommended that the goals of science teaching are to be framed within the elaborate understanding of the nature of science so as to achieve the gains of science education.

Keywords: Nature of Science (NOS), Experienced Science Teacher, Professionally Trained Science Teacher.

Introduction:

Science has come to stay in school curricula in almost every country around the world. In Nigeria, science is a core subject at the basic levels of education. The development of science education in many countries is varied and diverse (Omoifo & Urevbu, 2005., Abimbola, 2015., Upahi, Ramnarain & Ishola, 2020). However, one common goal of science education in the different contexts is to achieve a scientific literate citizenry (McDonald & Abd-El-Khalick, 2017).

In Nigeria, one of the six Nigerian goals of science education is to produce scientists with knowledge and skills of the 21st century for national development (FME, 2018:15). Science education is also to provide a range of competences for sustainable economic self-reliance. Achieving these goals requires qualified and highly scientific literate teachers. McDonalds & Abd-El-Khalick (2017) conceive such teachers as those who understand, scientific facts, concepts, principles, theories and science process skills and are away of the complex relationship between science, technology and society. Such teachers actually must develop an understanding of the **Nature of Science** (NOS). Science therefore needs to recognize the nature of the scientific endeavor and how it relates to science teaching if they are to help their students completely understand the content and underlying philosophy of science (Omoifo & Urevbu, 2005). In view of this, the National Science Teachers Association (NSTA, 2010) proposed that all those who are involved in science teaching should have a common view of the nature of science. In Nigeria, this view is interpreted to have informed a stronger advocacy for teachers to develop an understanding of the scientific enterprise as articulated in the nation's policy document and revised science curriculum (Upahi & Ishola, 2020). Consequently, Jegede (1998) in Abimbola (2015) asserted that the importance of teacher knowledge base for effective science teaching and teacher preparation programmes that will produce sound and effective scientifically literate teachers in Africa in general and Nigeria particular have long been stressed.

There is a lack of consensus as regarding the definition of nature of science (Irzik & Nola, 2014; McDonald & Abd-El-Khalick, 2017). However, Lederman and Lederman (2014) defined it in terms of characteristics of scientific knowledge that derived from the manner in which the knowledge is developed. As a result, scientific knowledge is considered to be empirical, tentative and partially subjective as if depends on a particular scientist's background, aims and experiences. Nature of science represents the unique characteristics of science by describing and explaining what the science is, how it works and how it is different from other disciplines, what scientists have done throughout history, and how science and scientists interact with in the society. Therefore, nature of science typically refers to the epistemology of science, science as a way of knowing, or the values and beliefs inherent to the development of scientific knowledge (Lederman & Lederman, 2014). There are various views of the **nature of science**. One of such views is that proposed by Palmquist and Finley (2007): Traditional (or naïve) and 'contemporary' (or informed) views. A total of twenty three (23) of science realms have been investigated. However, each is known to fall into five (5) broad categories: scientific knowledge, scientific method, scientific theory, scientific law and the role of the scientist (Palmquist and Finley, 2007).

The traditional view of nature of science holds that science bases on truth to be told, tentativeness of scientific knowledge, empirical nature and reliance on prior knowledge. Contemporary view of nature of science has made it known that science is conducted in a social context, providing opportunities for personal bias and public adoption or rejection of

ideas. Thus, science is a human activity, has social machinery and operates as an institution. It then follows that to communicate and teach science as a human and social institution, teachers must have contemporary (or informed) view of nature of science (Sambo, Mahmud & Eggari, 2015).

Scientific knowledge is the value obtained by scientists from scientific investigation and is represented by facts, concepts, theories and laws which similarly represent the product of science (Naseer & Afzal, 2022). Scientific method is the process skills of inquiry that include observing, classifying, experimenting, measuring, inferring, communicating, questioning, hypothesizing, predicting, using numbers, making operational definitions and interpreting data. (Demirel & Cakiroglu, 2022). Scientific theory is a reliable, rigorous and comprehensive form of scientific knowledge which guide the enterprise of finding facts and is neutral concerning alternatives among values. McDonald and And-El-Khalick (2017) defined scientific theory as a complete and exhaustive account of reality. It explains unobservable phenomena. Scientific law is a descriptive generalization of how some aspects of the natural world behaves understated circumstances (Schofield & Takriti, 2023). Hence, scientific law can only describe observable phenomena, but cannot explain the mechanism by which the law comes to be, explanation is the domain of scientific theory. Scientific law describes things that occur in the natural world without any human intervention. Natural law is another name for scientific law. Scientists' role is the way science operates. It requires creativity, imagination, open-mindedness and objectivity (Upahi, Ramnarain & Ishola, 2020).

Current teaching and learning practices follow learner-centered approach that is underpinned by the constructivist's view (NERDC, 2009). This principle advocates the provision of opportunities for students to construct new understandings for themselves at both individuals and social levels (Oyinloye & Ige, 2018). However, the teacher has significant role to play in this endeavor (Ajaja, 2012). The role of the teacher is that of a facilitator (Abimbola, 2015). Therefore, science teachers must possess an adequate understanding of the nature of science to effectively contribute to the students' understanding of this concept (Lederman & Lederman, 2014).

With the use of different methods and instruments, the literature suggests that most science teachers possess an inadequate understanding of the NOS. Their conceptions of the NOS are mixed, unsolified and confused (Ajaja, 2012., Dorsah, 2020., Dorji & Jatsho, 2022). Also, there is no significant different between science teachers' professional training or teaching experience in school and their conceptions of the nature of science (Sambo, Mahmud & Eggari, 2015., Adedoyin & Bello, 2017, Adegboye, Bello & Abimbola, 2017, Dorji & Jatsho, 2022). The studies related to conceotions of the NOS held by science teachers can be categorized in five major groups: Scientific knowledge, scientific method, scientific theory, scientific law and role of scientists.

In various studies, majority of science teachers lack clear understanding of the NOS in terms of scientific knowledge, scientific method and scientists' work (Dorji & Jatsho, 2022, Schofield & Takriti, 2023). In terms of scientific knowledge, most teachers had simple conceptions regarding a hierarchical relationship between hypotheses, theories and laws (Dorji & Jatsho, 2022). The teachers believed that when a hypothesis is proven correct, it becomes a theory. After a theory has been proved true many times by enough evidence, it becomes a law. Accordingly, scientific theories were a lesser type of knowledge than laws. Also, many science teachers confused a scientific theory with scientific fact. They believed that theories were facts before being proven by experiment

(McDonald & Abd-El-Khalick, 2017). The conception that these constructs are different types of ideas was not grasped (McDonald & Abd-El-Khalick, 2017, Upahi, Ramnarain & Ishola, 2020).

The scientific method is commonly perceived by science teachers as a universal step-wise method to be followed in order to reach certain results or unambiguous scientific truth. Rather, most science teachers believe that a good scientist follow the steps depending on the nature of the experiment (McDonald & Abd-El-Khalick, 2017). The conceptions of science teachers on scientists' work are subjectively and objectively, theory-laden and theory-free, resulting in lack of clear understanding (McDonald & Abd-El-Khalick, 2017, Dorji and Jatsho, 2022).

Teachers' conceptions nature of science is influenced by the kinds of textbooks they use for instruction (Ajaja, 2012). Upahi, Ramnarain and Ishola (2020) found that secondary school science teachers respond to textbooks in a way that contribute to transmission mode of science teaching. Adedoyin and Bello (2017) stated that various studies revealed that in any classroom, the science taught and the way it is taught depends primarily on what the teacher believes, knows and does. This implies that science teaching and practices in most schools in the developing countries do not follow the recommended standard use of inquiry-based learning, discovery and science process skills.

Science teachers' conceptions of the nature of science influence their choices of instructional approaches, whether traditional or contemporary (Ajaja, 2012). The traditional approach starts the definition of a topical idea by the teacher and finishes with a problem while the contemporary approach starts from a problem and the learner to the pretermined body of knowledge, which is the constructivist's approach to science teaching. Bello and Abimbola (2017) further explained that in constructivism, learners should create their own knowledge through the interaction of what they already know and the ideas, events and activities with which they come in contact with. In recent time, nature of science emphasizes that knowledge should be constructed and created by the learner rather than knowledge being prepared and distributed to the learner by the teacher who claims to be a reservoir of knowledge.

The study which was motivated by research efforts on teachers' conceptions of nature of science globally and the intention of contributing words re-engineering science education for sustainable self-reliance in Nigeria has the main purpose of examining senior secondary school in-service science teachers' views of the nature of science in Egor Local Government Area of Edo State, South-South, Nigeria. The specific areas of emphasis in this study are: Finding out the significant difference in the views of nature of science between experienced and inexperienced science teachers as well as professionally trained and non-professionally trained science teachers.

Statement of the Problem

Science teaching involves guiding and directing students' science activities in order to produce learning. This is the contemporary approach to science teaching. But, observation has shown that most science teachers embrace the traditional methods of instruction to teach concepts in science. This approach starts with the definition of a topical idea by the teacher and finishes with a problem. This means, science teachers still believe that science bases on truth, to be told. Such instruction did not bring into account the misconceptions of the learners. Hence, students encounter difficulties in understanding certain concepts of science and are also unable to extend the knowledge of ideas to fix problems outside the classroom.

There are indications in science education literature that learning science by secondary school science students in Nigeria seems to be a problem as manifested in their continuing poor performances at the Senior School Certificate

Examinations conducted by WAEC and NECO (Omoifo, 2012., Nworgu & Ortum, 2013., Egbo, 2014., Abimbola, 2015., WAEC Chief Examiners' report, 2019). There is also a serious concern about factors that underline secondary school students' achievement in science. Factor such as in-service science teachers' views of the nature of science are major barriers to learning of scientific facts, concepts, theories and laws by the students (Sambo & Eggari, 2015., Adedoyin & Bello, 2017., Upahi & Ishola, 2020). Science teachers' mastery of the distinct nature of science is required in providing explanations of scientific facts, concepts, theories and laws to students, thereby enhancing meaningful learning by the students. It is therefore necessary to find out if science teachers hold appropriate views of the nature of science as part of efforts to enhance their pedagogical content knowledge.

Research Questions

The following research questions were raised to guide the study:

1. What are science teachers' views of the nature of science?
2. Do views of the nature of science differ between experienced and inexperienced science teachers?
3. Do views of the nature of science differ between professionally trained and non-professionally trained science teachers?

Hypotheses

Based on the research questions, question 1 were answered while research questions 2and 3 were hypothesized and tested at 0.05 alpha level of significance as follows:

1. There is no significant difference in the views of nature of science between experienced and in-experienced science teachers.
2. There is no significant difference in the views of nature of science between professionally and non-professionally trained science teachers.

Methodology

The study adopted a descriptive survey employing ex-post-facto design. The independent variables of the study are teaching experience and professional training; the dependent variables are in the five key realms of the nature of science: scientific knowledge, scientific theory, scientific method, scientific laws and the role of a scientist. The population of the study comprised 211 secondary school in-service science teachers in Egor Local Government Area of Edo State, Nigeria. The study was carried out in both public and private secondary schools in Egor local government area of Edo state, Nigeria. Eighteen (18) secondary schools were randomly selected. The sample consists of 100 science teachers, 60 (60%) experienced and 40 (40%) in-experienced science teachers. Sixty- two (62%) are professional teachers having taken courses in principles of teaching and class management during pre-and in-service teacher preparation programmes in the faculty and institute of education, while 38 (38%) are non-professionals. Data for the study were collected through a Likert scale instrument titled "Views of Nature of Science Questionnaire" (VONOSQ). The instrument (VONOSQ) adapted from Palmquist and Finley (2007), consists of two major sections: section A seek for competency statements on the five board categories of the nature of science, as characterized by the traditional and contemporary views. Section B is made up of science teachers demographic information like teaching experience and professional training. The VONOSQ instrument was validated and the reliability was determined using Cronbach alpha reliability procedure that yielded a reliability coefficient of 0.70. Data for the study were analyzed using percentages to compare groups

and chi-square (x^2) test of significance. Attempt was made to answer the question: what views of the nature of science do the science teachers who participated in the study held'? The percentages of teachers with traditional/ naïve view, contemporary/ informed view and mixed view were determined by classification of teachers' views for each aspect of the NOS as on table 1 below. All the decisions to accept or reject null hypotheses were made at the 0.05 level of significance. Tables are used to present statistical results.

Results

Research question 1: What are the science teachers' views of the nature of science?
The group with the highest percentage was taken as having the view of the nature of science.

Table 1: Classification of Teachers for each Aspect of the Nature of Science (NOS)

S/N	Area of Nature of Science (NOS)	Views: Traditional N	Traditional %	Contemporary N	Contemporary %	Mixed N	Mixed %	Decision (Highest Percentage)
1.	**Scientific theory**							
	1. Theories are based directly on observations or theory-dependent.	37	37.0	9	9.0	54	54.0	Mixed
	2. New theories are improvements over old theories because observations improve and increase over time or one invention of scientists.	23	23.0	6	6.0	71	71.0	Mixed
	3. An entire theory is rejected if subject to a single contradictory fact or does not necessarily compel the abandonment of a theory.	31	31.0	48	48.0	21	21.0	Contemporary
	4. A theory is a hypothesis that has been proven to be correct or is a tool used to describe, explain and predict scientific phenomena.	20	20.0	27	27.0	53	53.0	Mixed
	5. Old theories are no use to scientists or fit within contained scientific scope.	29	29.0	40	40.0	31	31.0	Contemporary
2.	**Scientific Knowledge**							
	1. Scientific knowledge corresponds directly to reality or increases in parts from observations.	37	37.0	20	20.0	43	43.0	Mixed
	Scientific knowledge is temporal or progresses by an accumulation of observations.	-	-	29	72.5	11	27.5	Contemporary

S/N	Area of Nature of Science (NOS)	Views Traditional N	%	Contemporary N	%	Mixed N	%	Decision (Highest Percentage)
2.	Scientific knowledge is created and validated by common acceptance within the scientific community or is proven or disproved owing to the direct influence of observations.	20	20.0	18	18.0	62	62.0	Mixed
3.	Scientists create knowledge based on prior knowledge, observations and logic or scientific knowledge is unchanging	39	97.5	-	-	1	2.5	Traditional
4.	The tentativeness of knowledge is related to how much people work on it or the progression or scientific knowledge is not continuous.	30	75	-	-	10	25	Traditional
3.	**Scientific Law**							
1.	Scientific law are found directly in nature or are created by scientists.	34	34.0	25	25.0	41	41.0	Mixed
2.	Scientists interprets the laws found in nature or laws are validated within the scientific community	36	36.0	2	2.0	62	62.0	Mixed
3.	Scientific laws can be proven to be absolutely true or are a scientist's best attempt part of nature.	13.	13.0	12	12.0	75	75.0	Mixed
4	**Scientific Method**							
1.	Science relies on precise control of experiments (and match with prediction) for proof or scientists are not compelled to the traditional scientific method.	29	29.0	1	1.0	70	70.0	Mixed

S/N	Area of Nature of Science (NOS)	Views: Traditional N	Traditional %	Contemporary N	Contemporary %	Mixed N	Mixed %	Decision (Highest Percentage)
2.	The use of traditional scientific method is necessary to discover and validate theories or there is no single scientific method.	11	11.0	36	36.0	53	70.0	Mixed
3.	There is a single method of doing science or methods said by scientists depend on circumstances.	7	7.0	59	59.0	34	34.0	Contemporary
4.	The scientific method is a step-by-step process or knowledge can be gained by other means than the scientific method.	9	19.0	1	1.0	80	80.0	Mixed
5.	The method must be planned out in advance of the inquiry or scientists can adjust their method of inquiry in the middle of an investigation and still obtain valid results.	20	20.0	12	12.0	68	68.0	Mixed
5.	**Roles of Scientists**							
	1. A Scientist evaluates scientific claims exclusively through empirical evidences or the primar7y act of scientist is often a leap of imagination or creativity	22	22.0	7	7.0	71	71.0	Mixed
	2. All actions of a scientist are assumed to be open-minded and objective or a scientist interprets results based on prior knowledge, observations, logic and social factors.	16	16.0	6	6.0	78	78.0	Mixed
	3. A scientist is someone who uses the traditional scientific method or creates theories based on prior knowledge, observation and logic.	2	2.0	70	70.0	28	28.0	Mixed
	4. A scientist strives to discover the absolute truth or works within the scientific community and contemplates the work of other scientists.	6	6.0	10	10.0	84	84.0	Mixed
	5. Scientists must avoid being influenced by anything outside of pure science or making decisions before inquiry based on prior knowledge, observations, logic and social factors.	39	39.0	18	18.0	43	43.0	Mixed

Table 1 shows that most teachers have mixed views of the nature of science. This decision was taken using group with the highest percentage. Most teachers, particularly those who participated in the study, however, held traditional views of the nature of science realms except for scientific theory 3 and 5, scientific knowledge 2, scientific method 3 and Roles of Scientists 3 where majority of the teachers exhibited more of the modern or informed view. Results also show that no teacher who participated in the study had any traditional view of the nature of science knowledge 2 while 79 teachers representing 79.0% had contemporary view. However, 21 teachers representing 21.0% had mixed views of scientific knowledge 2. On the contrary, 71 teachers representing 71.0% held traditional view for scientific knowledge 5 while non-had any contemporary view, 29 teachers representing 29.0% mixed views.

Hypothesis 1 There is no significant difference in the views of the nature of science between experienced and inexperienced science teachers.

Table 2: Chi-square(x^2) test of significance between Percentages of Inexperienced and Experienced Science Teachers views of the nature of Science (N=100)

S/N	Nature of Science (NOS)	Views: Traditional (%) Inexperienced (0-5) years	Traditional (%) Experienced (6 years and above)	Contemporary (%) Inexperienced (6 years and above)	Contemporary (%) Experienced (6yrs and above)	Mixed (%) Inexperienced (0-5) years	Mixed (%) Experienced (6years and above)	X^2 (df=2)	Deci-sion
1	**Scientific theory**								
1	Theories are based directly on observations or theory dependent.	11.0	26.0	6.0	26.0	28.0	-	0.193	NS
2	New theories are improvements over old theories because observations improve and increase over time or one invention of scientists.	6.0	17.0	4.0	2.0	30.0	41.0	0.151	NS
3	An entire theory is rejected if subject to a single contradictory fact or does not necessarily compel the abandonment of a theory.	6.0	5.0	20.0	34.0	14.0	21.0	0.558	NS
4	A theory is a hypothesis that has been proven to be correct or is a tool used to describe, explain and predict scientific phenomena.	2.0	1.0	2.0	6.0	36.0	53.0	0.439	NS
5	Old theories are of no use to scientists or fit within contained scientific scope	2.9	1.0	26.0	40.0	12.0	19.0	0.631	NS
2.	**Scientific Knowledge**								
1	Scientific knowledge corresponds directly to reality or increases in parts from observations.	3.0	5.0	2.0	12.0	35.0	43.0	0.098	NS
2	Scientific knowledge is temporal or progresses by an accumulation of observations.	-	-	29.0	50.0	11.0	10.0	0.193	NS
3	Scientific knowledge is created and validated by common acceptance within the scientific community or is proven or	5.0	9.0	4.0	13.0	31.0	38.0	0.256	NS

	disproved owing to the direct influence of observations.								
4	Scientists create knowledge based on prior knowledge, observations and logic or scientific knowledge is unchanging	39.0	43.0	-	5.0	1.0	12.0	0.004	Sig.
	5. The tentativeness of knowledge is related to how much people work on it or the progression of scientific knowledge is not continuous.	30.0	41.0	-	-	10.0	19.0	0.472	NS

		Views						**X^2 (df=2)**	**Deci-sion**
		Traditional (%)		**Contemporary (%)**		**Mixed (%)**			
S/N	**Nature of Science (NOS)**	**Inexperienced (0-5) years**	**Experienced (6 years and above)**	**Inexperienced (6 years and above)**	**Experienced (6yrs and above)**	**Inexperienced (0-5) years**	**Experienced (6years and above)**		
3.	**Scientific Law**								
	1. Scientific laws are found directly in nature or are creative by scientists.	14.0	20.0	8.0	17.0	18.0	23.0	0.623	NS
	2. Scientists interpret the laws found in nature or laws are validated within the scientific community.	17.0	19.0	-	2.0	23.0	39.0	0.311	NS
	3. Scientific laws can be proven to be absolutely true or are scientists are a scientist's best attempt to explain part of nature.	6.0	8.0	3.0	9.0	32.0	43.0	0.507	NS
4.	**Scientific Method**								
	1. Science relies on precise control of experiments (and match with prediction) for proof or scientists are not compelled to use the traditional scientific method.	16.0	13.0	-	1.0	24.0	46.0	0.111	NS
	2. The use of traditional scientific method is necessary to discover and validate theories or there is no single scientific method.	10.0	1.0	9.0	27.0	21.0	32.0	0.000	Sig.
	3. There is a single method of doing science or methods used by scientists depend on circumstances	3.0	4.0	23.0	36.0	14.0	20.0	0.111	NS
	4. The scientific method is a step-by-step process or knowledge can be gained by other means than the scientific method.	10	9.0	-	1.0	30.0	50.0	0.343	NS
	5. The method must be planned out in advance of the inquiry or scientists can adjust their method of inquiry middle of an investigation and still obtain valid results.	7.0	13.0	3.0	9.0	30.0	38.0	0.404	NS
5.	**Roles of Scientists**								

1.	A scientist evaluates scientific claims exclusively through empirical evidences or the primary act of scientist is often a leap of imagination or creativity.	8.0	14.0	1.0	6.0	31.0	40.0	0.294	NS

		Views							
		Traditional (%)		Contemporary (%)		Mixed (%)		X^2 (df=2)	Deci-sion
S/N	Nature of Science (NOS)	Inexperienced (0-5) years	Experienced (6 years and above)	Inexperienced (6 years and above)	Experienced (6yrs and above)	Inexperienced (0-5) years	Experienced (6years and above)		
2.	All actions of a scientist are assumed to be open-minded and objective or a scientist interprets results based on prior knowledge, observations, logic and social factors.	3.0	13.0	1.0	5.0	36.0	42.0	0.061	NS
3.	A scientist is someone who uses the traditional scientific method or creates theories based on prior knowledge, observation and logic.	-	2.0	31.0	39.0	9.0	19.0	0.274	NS
4.	A scientist strives to discover the absolute truth or works within the scientific community and contemplates the work of other scientists.	4.0	2.0	3.0	7.0	33.0	51.0	0.331	NS
5.	Scientists must avoid being influenced by anything outside of pure science or making decisions before inquiry based on prior knowledge, observations, logic and social factors.	12.0	127.0	100	8.0	18.0	25.0	0.196	NS

Considering teachers with different experiences, results on table 2 under views on scientific theory show chi-square (x^2) values of 0.193, 0.151, 0.558,0.439 and 0.631 for scientific theories 1,2,3,4 and 5 respectively, df = 2, significant at 0.05. This means no significant difference exists ¡n the views of NOS between novice or inexperienced (0-5) years and experienced (6 years and above) science teachers. Therefore, null hypothesis is retained.

Views of novice and experienced teachers on scientific knowledge 4 produce a x^2- value of 0.004, df =2, significant at 0.05. This means there is a significant difference. Therefore null hypothesis is rejected but retained on the views of scientific knowledge 1, 2,3 and 5 with x^2 - values of 0.098, 0.193, 0.256 and 0.472 respectively, df = 2, significant at 0.05.

There is no significant difference in the views of teachers with different experiences as regards scientific laws. Results on table 4.3 under scientific law proves this, with x^2 –values of 0.623, 0.311 and 0.507 for scientific law 1, 2 and 3 respectively, df =2, significant at 0.05, meaning that the null hypothesis is retained.

From the results, difference ¡n views between novice and experienced teachers is significant at scientific method 2 with a X^2 – value of 0.000, df = 2, significant at 0.05. Therefore, null hypothesis is rejected, but retained at scientific method 1, 3, 4 and 5. where there is no significance at 0.05 level of significance

Results show that difference in views between inexperienced and experienced teachers is not significant at the roles of scientists' realm of the NOS. Chi-square (x^2) values of 0.294, 0.061, 0.274, 0.331 and 0. 196 for views on roles of scientists 1, 2, 3, 4 and 5, df = 2, not significant at 0.05 show that the null hypothesis ¡s retained.

Hypothesis 2: There is no significant difference in the views of the nature of science between professionally non-professionally trained science teachers.

S/N	Nature of Science (NOS)	Traditional (%) Professional	Traditional (%) Non Professional	Contemporary (%) Professional	Contemporary (%)	Mixed (%) Professional	Mixed (%) Non Professional		Decision
1.	**Scientific Theory**								
1	Theories are based directly on observations and theory-dependent	14.0	23.0	9.0	-	390	15.0	0.000*	Sig.
2	New theories are improvements because observations improve and increase over time or one inventions of scientists.	6.0	17.0	4.0	2.0	52.0	19.0	0.000*	Sig.
3	An entire theory is rejected if subject to a single contradictory fact or does not necessarily compel the abandonment of a theory.	7.0	4.0	29.0	25.0	9.0	19.0	0.147	NS
4	A theory is a hypothesis that has been proven to be correct or is a tool used to describe, explain and predict scientific phenomena.	3.0	-	6.0	2.0	53.0	36.0	0.267	NS
5	Old theories are of no use to scientists or fit within contained scientific scope	3.0	-	38.0	28.0	21.0	10.0	0.244	NS
2.	**Scientific knowledge**								
1.	Scientific knowledge corresponds directly to reality or increase in parts from observations.	7.0	1.0	7.0	7.0	48.0	30.0	0.215	NS
2.	Scientific knowledge is temporal or progresses by an accumulation of observations.	-	-	52.0	27.0	10.0	11.0	0.217	NS

S/N	Nature of Science (NOS)	Traditional (%) Professional	Traditional (%) Non Professional	Views Contemporary (%) Professional	Views Contemporary (%)	Mixed (%) Professional	Mixed (%) Non Professional		Decision
3.	Scientific knowledge is created and validated by common acceptance within the scientific community or is proven or disproved owing to the direct influence of observations.	6.0	8.0	12.0	5.0	44.0	25.0	0.246	NS
	4. Scientists create knowledge based on prior knowledge, observations and logic or scientific knowledge is unchanging.	50.0	32.0	-	5.0	12.0	1.0	0.001 *	Sig
	5. The tentativeness of knowledge is related to how much people work on it or the progression or scientific knowledge is not continuous.	34.0	32.0	-	-	23.0	6.0	0.023	Sig

There is a significant difference in the views of professional and non-professional science teachers on scientific theories 1 and 2 with the results of x^2 _ values of 0.000 and 0.000 respectively, df=2, significant at 0.05. to the contrary, there is no striking difference in the views of professional and non-professional science teachers on scientific theories 3,4 and 5 with the results of x^2 _ values of 0. 147, 0.267 and 0.244 respectively, df= 2, significant at 0.05. This means the null hypothesis is retained.

There is no significant difference in the views of professional and non-professional science teachers' scientific knowledge 1, 2 and 3 following the results of x^2 _values of 0.215 and 0.246 respectively, df=2, significant at 0.05. this means the null hypothesis is retained. Hence, there is a significant difference in the views of professional and non-professional science teachers on scientific knowledge 4 and 5 with the results of x^2 _ values of 0.001 and 0.023 respectively, df=2, significant at 0.05. This means the null hypothesis is rejected.

From table 3, the x^2 _ values of 0.066and 0.226 for scientific laws 1 and 2 respectively at df=2 are not significant at 0.05. This shows that there is a difference in the views of professional and non-professional science teachers on scientific laws 1 and 2, but the difference is not significant. Hence, the hypothesis of no significant difference is therefore retained. The null hypothesis is rejected at scientific law 3 with a x^2_ values of 0.042, df=2 and significant at 0.05, indicating a significant difference.

Views of professional and non-professional science teachers on scientific method 3 produced a x^2_ values of 0.003, df=2, significant at 0.05. This means there is a significant difference. Therefore, null hypothesis is rejected, but retained on the views of scientific method 1,2,4 and 5 with x^2 - values of 0.381, 0.101, 0.164 and 0.091 respectively, df= 2 but not significant at 0.05.

Also from the results, views of professional and non-professional science teachers' views on the roles of scientists' realm of the NOS have a x^2 _ values of 0.001at df= 2, significant at 0.05 for roles of scientists 1. This means. There is a striking difference in the views as regards roles of scientists 1, but this difference is not significant at roles of scientists 2,3,4 and 5 with x^2 values of 0.412, 0.087,0.438 and 0.780 respectively, df= 2 but not significant at 0.05. at this point, the null hypothesis is retained.

Discussion

This study investigated the Nigerian secondary school science teachers' views of the nature of science (NOS). This study is most significant in the sense that it has thrown more light on what our science teachers know and their views of nature of science. Table 1 shows that most science teachers have mixed views on the NOS. Therefore it is in record that science teachers generally have little or no formal exposure to contemporary ideas from history, philosophy and sociology of science, which are the basis to science education. The findings were related to those of Ajaja (2012), Dorsah (2020), Dorji and Jatsho (2022) who found out that secondary school science teachers' conceptions of the nature of science are mixed, unsolified and confused. Most have traditional view while a lot have contemporary view. However, the results of the findings fails to agree with Demirel, Sungur and Cakiroglu (2022) and Chuene and Singh(2023) in their separate studies all the science teachers who participated in the study had contemporary view of the NOS meaning that they are aware of the social context of science in Oyo State, Nigeria showed that all the teachers who participated in the study had traditional view of the NOS. The study also showed that most science teachers lack clear understanding of the NOS in terms of

scientific knowledge, scientific method and scientists' work. These findings agree with the findings of Omoifo and Urevbu (2005), Dorji and Jatsho (2022), Schofield and Takriti (2023).

Hypothesis 1 addressed the issue of no. significant difference in the views of NOS between experienced and inexperienced science teachers. The result is that there is no significant difference. This finding is in line with the finding of most researchers amongst whom are Omoifo and Moemeke (2003), Adegboye, Bello and Abimbola (2017) but contrary to the finding of Sambo, Mahmud and Eggari (2015) who claimed that experienced science teachers have contemporary views of the NOS.

The level of insignificance was confirmed in certain aspects of NOS. Hence, the null hypothesis 2 which states that there is no significant difference in the views of the NOS between professionally and non-Professionally trained science teachers was retained. These aspects are mainly in scientific methods and role of scientists. This findings agrees with those of Palmquist and Finley (2007), Sambo, Mahmud and Eggari, (2015), Adedoyin and Bello (2017), Dorji and Jatsho (2022), but contrary to the finding of Sambo, Mahmud and Eggari (2015) who asserted that professionally trained science teachers have contemporary view of the nature of science.

Conclusion

Based on the findings, most in-service science teachers generally have mixed views of the nature of science. Teaching experience and professionalism do not influence the views of science teachers on the nature of science.

Recommendations

Based on the findings of the study and conclusion drawn, the following recommendations were made: .

- Method courses in teachers' preparation programme should portray a contemporary view of the NOS and this may be achieved through the use of strategies such as inquiry-based learning.
- Conferences, seminars, workshops, in-service training should be periodically organized for science teachers and made compulsory where teachers can be given formal exposure to contemporary ideas from the history, philosophy and sociology of science.
- Secondary school science curriculum should be restructured to emphasize the contemporary approach to the teaching of science.

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