



KWASU

The University for Community Development

ISSN: 2384-6801



KWASU INTERNATIONAL **JOURNAL OF EDUCATION (KIJE)**

Published by the ► College of Education,
Kwara State University, Malete.

Volume 3 No. 1

KWASU International Journal of Education (KIJE)

| Vol. 3 No. 1

***KWASU INTERNATIONAL
JOURNAL OF EDUCATION (KIJE)***

ISSN NO: 2384-6801

***A PUBLICATION OF COLLEGE OF
EDUCATION, KWARA STATE
UNIVERSITY, MALETE, NIGERIA.***

***Production
@ Lawanson Prints, Ilorin
08065696597***

KWASU INTERNATIONAL JOURNAL OF EDUCATION (KIJE)

Published by the

College of Education,

Kwara State University, Malete, P.M.B. 1530, Ilorin, Nigeria.

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**FROM THE DESK OF THE EDITOR IN CHIEF
KWASU INTERNATIONAL JOURNAL OF EDUCATION
(KIJE)**

KWASU International Journal of Education (KIJE) is an international and interdisciplinary journal that publishes scholarly articles, research based findings and position papers with relevance to Education. It is expected that this Journal would provide the platform where scholars in education and its allied disciplines all over the world would make contributions to knowledge, practices and policy formation that would impact on quality education and society at large.

The articles in this edition of the Journal focused on issues and trends in the general education of learners across all levels of education. Some of the areas covered by the contributors include Information and communication technology as it affects learning behavior and development of children, learning difficulties, particularly in science education, curriculum development, issues and trends in the education of children with special needs, enhancing positive life living through sporting activities among others.

I like to thank all the contributors for making the publication of this maiden edition a reality. I also wish to commend particularly the efforts of the Editorial Board of this edition of the Journal. This Journal is the brainchild of the College of Education, Kwara State University, Malete, Nigeria.

To all our contributors, I look forward to your continued patronage please.

Professor Muhammed Baba Gambari
Editor In - Chief

KWASU INTERNATIONAL JOURNAL OF EDUCATION (KIJE)

Calls for papers

The Editorial Board of Kwasu International Journal of Education (KIJE) invites articles from scholars for consideration and publication in her Journals which will be published twice in a year, January and July respectively.

Guidelines for manuscripts

1. Manuscripts submitted for publication should be 15 pages maximum, including references, using New Times Romans, 12.Font. Articles must be typewritten, double spaced on one side only and on A4 paper. Author's name, contact address, email, telephone number(s), and a brief bibliographical note should be typed on a separate sheet and attached to the article.
2. Articles should be preceded by an abstract of not more than 200 words
3. Figures, tables and drawings should be clearly drawn and the positions marked in the text. Pictures where applicable should be very few black and white glossy print
4. Quoted passages of more than three lines should be extracted. Shorter quotations should be enclosed in double inverted commence.
5. Footnotes are not permitted. The Journal follows the author/ date system of station, by which reference is made in the text by citing the authors surname and date of publication. Generally, authors are expected to follow the American psychological Associations writing style.
6. All works sighted in the text must be listed under references in alphabetical order of author's surnames.
7. The editorial Board reserves the right to accept or reject manuscripts after peer review
8. An author of a published work will receive one copy of the Journal free.
9. An author is to submit a self-addressed A4 size envelope with postage stamp for mailing the Journal.
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Abstract

In developing nations like Nigeria, where most students have limited or no access to supplementary sources of learning materials, they often rely solely on knowledge gained from their teachers. Thus, students' achievement depends, to a vast extent, on their teachers' mastery of disciplinary knowledge. This study assessed the level of knowledge of the nature of science amongst Nigerian senior secondary school professional science teachers. The researchers adopted the descriptive survey method to conduct the study. The simple random sampling technique was used to select the sixty science teachers from 22 secondary schools within Kwara State that took part in the study. The instrument used for data collection in the study was an achievement test entitled 'Nature of Science Mastery Scale'. The t-test statistical technique was used to analyze the data gathered in the study. The results of the study clearly indicated that many (85%) science teachers had a fairly adequate mastery of the nature of science. Also, gender difference does not exist, in the teachers' level of mastery of the nature of science (t-value : $t(58, 0.05) = 0.103$). The study concluded that the science teachers' level of mastery of the nature of science was fairly

adequate. The researchers called for the inclusion of the nature of science as a core course in the science teacher education curriculum. Also, the practice of sharing science as part of measures to enhance social transformation was recommended.

Keywords. *Nature of science, Science teachers, Teacher education, Misconceptions, and Nigeria.*

Background to the Problem

Teaching and learning occupy the centre of the education enterprise worldwide. This accounts for teachers' pivotal roles as facilitators of learning. However, to successfully carry out their tasks, teachers must possess adequate knowledge in their respective area of specialization. This fact accounts for the general notion that the level of education in a nation cannot rise above the level of the teachers in the country. Indeed, the Teachers Registration Council of Nigeria (TRCN, 2004) also noted that "no education system can rise above the quality of its teachers" (p.8). It is obvious that teachers can only teach what they know. Hence, teachers' mastery of a discipline does significantly impact upon the level of students' achievement. In developing nations like Nigeria where most students have limited access to supplementary sources of learning materials, students often rely only on knowledge gained from their teachers during class instructions. Thus, teachers' inadequate mastery of pedagogy and disciplinary knowledge could result in devastating impacts on the students' academic achievement. The results of the study conducted by Agharuwhe (2013) in Nigeria revealed that effective teachers produced students with better academic achievement, meaning that quality teachers beget quality students. The nature of science (NOS) is an inseparable part of the disciplinary knowledge in science that every competent professional science teachers must have adequate knowledge of. Indeed, the American Association for the Advancement of Science (1993) identified the understanding of NOS as one of the four basic knowledge, skills and attitudes that citizens in a scientifically literate society must possess.

There is no doubt that advancements in science and its applications in digital technologies marked the current post-modern epoch. It is hard to conceive of any socio-economic, political, religious and other daily activities in the current post-modern epoch that is not driven by science and its applications

in digital technologies as rightly observed by Bello and Abimbola (2015). Hence, globally science disciplines are prominent components of the curriculum at all levels of the education ladder. The primary function of science is that of explanations of nature (Abimbola and Omosewo 2006; Frolov, 1984). The Wisconsin Department of Public Instruction (1986) as reported by Meichtry (1999) put forward a working definition of science as follows:

Science is a human activity through which problems and questions dealing with natural phenomena can be identified and defined, and solutions proposed and tested. In this process, data are collected and analyzed, and available knowledge is applied to explaining the results. Through this activity, investigators add to the store of knowledge, thereby helping people better understand their surroundings. Applications of this knowledge also may bring about changes in society and the cultural order and may have a direct bearing on the quality of life. (Meichtry, 1999, p.25-35)

The enormous scope and complexity of science most probably account for the fact that a universally acceptable definition is yet to emerge. However, structurally, science is composed of products, processes, and ethical components. Scientific knowledge in the form of concepts, facts, laws, principles and theories constitute the product component while the scientific methods used by scientists to probe nature culminating in scientific knowledge is the process component of science. The ethics and motives that guide the daily activities of the scientific community constitute the ethical component (Abimbola, 2013)

To successfully facilitate meaningful learning of science, science teachers must possess adequate disciplinary and pedagogic knowledge in science. A good mastery of disciplinary knowledge in science requires an understanding of the NOS. For instance, scientific concepts cannot be adequately taught without understanding the tentative nature of scientific knowledge. Without a clear understanding of the NOS, students would indeed find it difficult to learn science meaningfully (Clough and Olson, 2004).

Like the concept of science, the notion of the NOS is still nebulous. The definition of science put forward by the Wisconsin Department of Public

Instruction (1986) according to Meichtry (1999) helps to explain the difference between the NOS and scientific knowledge. The definition viewed the NOS as a human activity where problems and questions about natural phenomena are sought for; defined, feasible solutions are proposed and tested. In the definition, scientific knowledge is conceived as a product of the human process of science within its social context. The major components of the NOS identified by the US National Council on Science and Technology Education as reported by Meichtry are:

1. Scientific worldview - the world is understandable, scientific ideas are subject to change, scientific knowledge is durable, and science cannot provide complete answers to all questions;
2. Scientific methods of inquiry - science demands evidence, science is a blend of logic and imagination, science explains and predicts, scientists try to identify and avoid bias, and science is not authoritarian; and
3. Nature of the scientific enterprise - science is a complex social activity, science is organized into content disciplines and is conducted in various institutions, there are accepted ethical principles in the conduct of science, and scientists participate in public affairs both as specialists and as citizens. (Meichtry, 1999, p.25-35)

According to Meichtry (1999), this model is consistent with the views of some other philosophers of science. It is evident from the preceding conceptions of the NOS that it is a multidimensional concept. Without an adequate understanding of the concept, neither the teacher nor the students can effectively teach and meaningfully learn science, respectively. Martin (1998) was of the view that NOS is a crucial component of the working science. The domain, limits, social aspect, level of uncertainty and bias as well as the reasons for its reliability are integral parts of NOS. According to Martin (1998), lack of understanding these features of NOS has resulted in misconceptions and abuses of science. Science education literature indicated that students and teachers alike held misconceptions about science (Abimbola, 2013). Similarly, research in science education shows that science is often misrepresented by the media, textbooks and in classrooms where science teachers do overemphasize what we

already know (scientific knowledge) instead of how we know it (NOS). Students, therefore, more often than not, perceive science as a compendium of facts about nature that is difficult and tedious to rote-learn. Also, they equally held the notion that science lacks imagination and creativity since there is a scientific method that scientists must employ when conducting investigations into natural objects, events, and phenomena (Science Learning, 2011, October 7th).

Several studies have been carried out to probe into students' understanding of the NOS. For instance, Moss (2001), conducted a study to examine students' conceptions of the NOS. Results of the study indicated that although students knew that scientific knowledge is tentative and also viewed science as a social activity. They held some misconceptions about the NOS. Khishfe and Abd-El-Khalick (2002) studied the development of students' conceptions of the NOS among secondary school students. Findings from the study revealed that several students conceived science as mainly concerned with technological advancement; that theories are proven facts, and that scientific knowledge is not constructed, but discovered.

Science teachers' mastery of the NOS is a *sine qua non* to successful teaching in the science classroom. Hamza (2014) rightly observed that teachers' instructional decisions and classroom practices rest on their conceptions of the NOS. It is, therefore, not astounding that several studies were conducted on the pre-service and in-service science teachers' conceptions of the NOS over several decades. For instance, Mir (2009) investigated the beliefs and understanding of the NOS of science teachers from the city of Karachi. The researcher employed document analysis, interview, and observation technique to gather data in the study. Results of the study revealed that the teachers' learning experiences and knowledge about learning how to teach others governed their beliefs on the NOS. The study indicated that misconceptions and informed conceptions of the NOS coexisted in the teachers' cognitive structure. The result of the case study carried out by Hamza (2014) in a school located in the rural area in Limpopo; South Africa also revealed that a teacher held a mixture of misconceptions and correct conceptions of the NOS as reflected in the teacher's classroom teaching.

Monther and Abeer (2013) studied the level of understanding of NOS among fifty-six randomly selected Jordanian physics teachers. The physics teachers' level of understanding of the nature of science was reported weak. Also, results of the study indicated a significant difference in the teachers' level of understanding of the nature of science for teachers with higher

qualification. Gulcan and Alev (2013) conducted a study to determine the science teachers' views and level of knowledge of NOS as well as their opinions of the place of NOS in science teaching. Most of the teachers that took part in the study admitted that their knowledge of NOS is insufficient and that NOS is necessary for science teaching and personal use.

Also, Vazquez, Antonia, Antonia, and Antonio, (2011) conducted a study on teachers' conceptions of NOS. Findings of the study indicated that the science teachers held admixture of misconceptions and correct conceptions of the NOS. But significant difference does not exist in conceptions of both the pre-service and in-service science teachers. The study concluded that decisive evidence does not exist to support the contribution of science teaching practice to improvement in mastering NOS. Furthermore, the results of the study conducted by Suleyman and Hasret (2010) equally revealed that prospective science teachers held misconceptions of NOS. Results of the study showed that the teachers' views correlate significantly with their gender and grade level. Findings, of the study conducted by Omoifo (2004) showed that males had better syntactic structural knowledge and more informed views in three of the five aspects of NOS. The female students had a better substantive fundamental knowledge and more informed views in 2 of the 5 tenets of NOS. The pre-service science teachers were noted to possess weak content knowledge.

The preceding reviewed studies brought to light the coexistence of informed conceptions and misconceptions of the tenets of NOS in the cognitive structure of the science teachers. The studies illuminated the unsatisfactory level of understanding of NOS by the science teachers, the consequences of which could be devastating to teaching and learning outcome. Indeed, there is sufficient empirical evidence in science education literature that students' performances in science disciplines at the final Senior School Certificate Examinations in Nigeria remain far below the desired level (Abimbola, 2013; Bello, 2000 and Olorundare, 2014). Reasons adduced for students' poor achievement in science disciplines include students, teachers and textbook misconceptions in science poor attitude of students to science, inadequate mode of instruction, and lack of science laboratory among many others (Abimbola and Baba, 1996; Bello, 2014; and Olorundare, 2014).

Series of studies conducted on conceptions of science and scientific concepts among Pre-service and In-service science teachers in Ilorin, Kwara State, indicated that the science teachers held admixture of misconceptions,

alternative conceptions, and correct conceptions of science and scientific concepts (Adeboye, 2015; Bello, 1997, 2002, 2003; Bello and Abimbola, 2015; Olatunji, 2004). The existence of misconceptions related to science concepts in science teachers' cognitive structure could be a reflection of their level of mastery of science curricular knowledge. A good mastery of the NOS is essential to the meaningful understanding of curricular knowledge in any discipline. It is, therefore, imperative to determine if science teachers possess adequate mastery of the nature of science as parts of efforts to improve science teaching and learning. This was the focus of the study.

Science Teachers and Social Transformation

Social transformation is a process of qualitative change occurring at both individual and society level. Change is the only form of being of matter and social phenomena because it embraces all interactions and motion in a matter and the society (Frolov, 1984). Social transformation is a social motion, a process leading to alterations in the existing socio-economic, cultural, political and technological attributes of the society, amongst others. Social transformation is the societal response to upheavals in the inherent characteristics of the society such as economic growth, political, scientific and technological development, and so forth. It encompasses 'the process of change in values, norms, institutionalized relationships, and stratification hierarchies over time. It affects patterns of interaction and institutional arrangements within a society' (Kimeu, 2011, September). At the personal level, social transformation refers to the process through which individuals achieve a status that is different from the socially ascribed social status of their parents. However, it is important that others validate the achieved social status of the individual and that the individual should exhibit the sociocultural expectations of the achieved social status (Wikipedia, n.d.).

Science teachers are professionally trained personnel task with the responsibility of facilitating meaningful learning of science by the students and the society. Science teachers also undertake the task of continuous production of scientists and technologists of all kinds to ensure sustainable scientific, socio-economic, and technological development in the society. Also, they are equally concerned with producing scientific and technological literate citizens. The import of this task is to ensure that citizens can adequately make informed scientific choices on socio-economic, personal and societal issues based on sound fundamental scientific knowledge and attitude. The socio-economic

power of a country is the hub of its social transformation. Since the socio-economic, technological and sociocultural development of a state cannot rise above its level of scientific and technical development, it is obvious that science teachers (and, by extension, science education) are important elements in social transformation.

Statement of the Problem

In recent time, there is a growing public outcry on the quality of products of Nigerian tertiary education institutions including teacher education institutions where teachers are produced (Anho, 2011 & Tosanwumi, 2011, March 25). The continuing abysmal performance of Nigerian senior secondary school students in public examinations has equally stimulated major stakeholders in the education sector to beam search light into the quality of secondary school teachers in the country. Wadup (2014, 7th September) noted that major stakeholders in education identified poor teacher quality as a significant factor responsible for the worrisome poor performance of students in public examinations in the country. Indeed employers of teachers in both public and private sectors now frequently subject teachers to various ridiculous tests before and after employment. For instance, Ladipo (2013) reported that in 2008, Kwara State Ministry of Education administered a test on 19,125 teachers. Results of the test showed that less than 1% passed. The result of a similar assessment conducted by the Oyo State government among primary school teachers revealed that the teachers are deficient in both disciplinary (especially science) and pedagogic knowledge (Agoro, 2013). It is, however, important to state that learning outcome in science classroom is not entirely dependent on teacher quality. Decades ago, constructivist psychologists (Novak, 1991; Yager, 1991) revealed that students do construct their idiosyncratic knowledge before and after class instructions. Consequently students often hold pre-instructional and post-instructional misconceptions and alternative conceptions of science concepts.

It is apparent from the foregoing discussion that there is a need to further beam search light on the various aspects of teacher's professional competencies especially mastery of disciplinary knowledge. In the field of science, disciplinary knowledge has two major dimensions namely, the NOS and scientific knowledge. Abd-El-Khalick (2012) argued that an adequate mastery of the NOS by the teachers would enable them to convey to the students appropriate conceptions of science and scientific practices. In other words, a robust understanding of the NOS is an integral component of science

teachers' quality. It is thus not astounding that several studies have been carried out on NOS among science students and teachers alike (Abd-El-Khalick, 2012; Hamza, 2014; & Moss, 2001). Although findings from the studies seem to be consistent on the teachers' knowledge and misconceptions of NOS, there appears to be a dearth of studies on Nigerian science teachers' mastery of NOS. The task undertaken in this study therefore, was to assess Nigerian secondary school science teachers' mastery of the NOS.

Purpose of the Study

This study attempted to determine whether science teachers possess adequate mastery of the NOS. Specifically, the study sought to determine:

- (1) The science teachers' level of mastery of NOS,
- (2) If gender difference exists in science teachers' level of mastery of the NOS, and
- (3) If the science teachers held misconceptions on the NOS.

Research Questions

Attempt was made to provide answers to the under-listed research questions in this study:

- (a.) What is the science teachers' level of mastery of the NOS?
- (b.) Is there a gender difference in the science teachers' level of mastery of the NOS?
- (c.) Do the science teachers hold misconceptions on the NOS?

Research Hypothesis

Only one research hypothesis was raised and tested in the study. The hypothesis is as follows:

There is no significant gender difference in the science teachers' level of mastery of the NOS

Significance of the Study

High-quality teachers are more likely to beget quality students than incompetent teachers. Findings of this study could contribute to the much-needed improvement in the quality of science teachers. When science teachers are made aware of their level of mastery of the NOS through the findings of this study, they may likely take steps to update regularly their knowledge thereby improve their quality. Improvement in the quality of science teachers is directly beneficial to science students because it could enhance students'

meaningful learning of nature of science. Consequently, they would be able to make use of scientific and technological knowledge to enhance social transformation at both individual and societal level. Curriculum experts could find the results of this study as a useful literature material when reviewing or developing science and science teacher education curriculum. The results could indicate the need to include the NOS explicitly in science and science teacher education curricula. Findings of the study could sensitize science teacher educators to devise means to uplift the quality of science teachers that they are producing. Science textbook authors could also be stimulated to revise their books to improve or include the presentation of the NOS in science textbooks. Continuous research and criticism form the bedrock of revolution in science. Hence, results of this study could stimulate other science education researchers to replicate and improve upon this study in other areas and among larger sample and population size.

Methodology

This study is a descriptive one, which employed the survey research method. All the science teachers teaching in public secondary schools within Ilorin Metropolis constituted the population of the study. Sixty science teachers from 22 randomly selected secondary schools within Ilorin Metropolis took part in the study. All the professionally trained graduate science teachers (Biology, Chemistry, Physics and Integrated Science teachers) in the selected schools were purposively chosen as the representative sample of the population.

The instrument used for data collection in the study was an achievement test entitled 'Nature of Science Mastery Scale' (NOSMS). There were 40 items in NOSMS, many of which were adapted from the works of Martin (1998) and Meichtry (1999). Twenty (20) of the items were correct statements about the basic tenets of the NOS, while the remaining 20 statements were commonly held misconceptions of the NOS reported in many studies. The science teachers that took part in the study were required to identify the statements that are consistent with NOS and those that are not compatible with NOS. Each correctly identified statement attracted 1 mark. Evaluation of the adequacy of the science teachers' mastery of NOS was based on scores obtained in NOSMS as follows; (a) scores below 20 was considered to be inadequate mastery level, (b) scores between 20 and 35 was regarded as a fairly adequate mastery level, and (c) scores above 35 was regarded as a very adequate mastery level. The face and content validation of the instrument was carried out by two senior lecturers in the field of Science Education and one experienced Senior

Secondary School biology teacher. Suggested amendments by the validators was carried out by the researchers to produce a final version of the instrument. The reliability coefficient of the instrument (NOSMS) was calculated using the test-retest procedure and was found to be 0.72.

The instrument was administered personally to the selected science teachers in their schools by the researchers. Simple descriptive statistical technique such as the percentage and mean computation were used to analyze the data gathered in the study. This was, however, in addition to the use of t-test statistical technique to test the single hypothesis raised in the study.

Data Analysis and Results

The scores obtained by the science teachers in NOSMS were subjected to descriptive and inferential statistical analyses. Specifically, the percentage, range, and mean score computation and t-test were the statistical tools used to analyze the data gathered in the study. The results were summarized and presented in tables in line with the research questions and the hypothesis stated in this study.

Research Question 1. What is the science teachers' level of mastery of the NOS?

The range of scores obtained by the science teachers in the NOSMS test was between 13 and 33, while the mean scores was 25.06 as indicated Table 1. Also, as many as 95% of the science teachers passed the NOSMS test. The mean score lies in the range of 20 to 35 which was considered to be a fairly adequate mastery level. The result of the analysis signified that the science teachers possessed a fairly adequate mastery of NOS, and it provided the answer to research question 1. The result appeared to be inconsistent with other similar studies (Gulcan & Alev, 2013; Monther & Abeer, 2013; Vazquez, Antonia, Antonia, & Antonio, 2011) that indicated low level of mastery of NOS among science teachers. It is, however, pertinent to note that the mean score obtained by the science teachers was relatively low. Hence, the teachers' mastery of NOS is unimpressive.

Table 1
Science Teachers' Performance on the Nature of Science Mastery Scale.

Number of teachers	Score obtained	Mean Score	Passed	Failed	Range
60	1504	25.06	51 (85%)	9 (15%)	13-33

Research Hypothesis: There is no significant gender difference in the science teachers' level of mastery of the NOS

The only hypothesis raised in the study was tested using the t-test statistical technique. The result of the test shown in Table 2 indicated that the calculated t value ($t(58, 0.05) = 0.103$) was not significant at 0.05 alpha level. Hence, the researcher failed to reject the research hypothesis. The result seems to suggest that male and female science teachers do not differ significantly in their level of mastery of the nature of science. It equally provides the answer to the second research question raised in this study. The result is not consistent with findings of studies conducted by Suleyman and Hasret (2010), but it is a variance in the outcome of the study carried out by Omoifo (2004.).

Table 2
t-test of Significant Gender Difference in Science Teachers' Level of Mastery of the Nature of Science.

Gender	N	X	$\bar{x}$	SD	t- value
Male	33	826	25	18.3	0.103*
Female	27	678	25.1	11.5	

Research Question 3. Do the science teachers held misconceptions of the NOS?

The responses of the science teachers to the items in the NOSMS were subjected to qualitative analysis. It was observed that none of the science teachers was able to identify all the 20 statements that reflect the basic tenets of NOS. Also, all the science teachers considered some misconceptions to be correct conceptions, indicating that they held misconceptions of the NOS. This finding provides the answer to research question 3. It equally tends to lend support to the findings of Gulcan and Alev (2013) and Vazquez, Antonia, Antonia, & Antonio, (2011) among others. Table 3 presents the summary of the misconceptions of the NOS held by the science teachers.

Table 3***Common Misconceptions of the Nature of Science Held by the Science Teachers***

No.	Misconceptions	Frequency
1	Critical testing of scientific ideas is to prove them	39
2	There is a scientific method that all scientists use to study nature	36
3	Scientific knowledge is free from bias	32
4	Gathering facts is the most important focus of science	31
5	Scientific knowledge is derived from experiments only	31
6	Astrology is a science discipline	30
7	Science is not a social process	29
8	Whatever is done scientifically is always accurate and reliable	25
9	Science sometime provides supernatural explanations	23
10	Most medical doctors and engineers are real scientists.	23
11	Any educated guess about anything is an hypothesis	22
12	The primary focus of science is the pursuit of truth	21
13	Creativity and imagination are unnecessary when developing scientific knowledge	20
14	Science cannot be done poorly	19
15	Disagreement among scientists is a weakness of science	19
16	Scientific theories are just guesses about nature	17
17	The answer to any question can be provided by science	11

Summary of Major Findings.

1. Science teachers possess fairly adequate mastery of the NOS.
2. There is no significant gender difference in the science teachers' level of mastery of NOS
3. Science teachers hold admixture of informed conceptions and misconceptions of NOS

Discussion, Conclusion, and Recommendations.

A major finding of this study revealed that most of the science teachers in Ilorin, Kwara State, Nigeria had a fairly adequate knowledge of NOS. Although the finding appeared to be inconsistent with the reports of similar studies conducted outside Nigeria as earlier stated, it is crucial to consider the fact that only professional graduate science teachers took part in this study. It is arguable that such caliber of science teachers is expected to possess a much higher level of mastery of NOS than what was observed in this study. The teachers' level of mastery of NOS cannot be adjudged to be impressive.

Currently, the goals of teaching and learning science disciplines at secondary level include the development of scientific literacy, independent learning skills and the application of scientific knowledge to address societal issues and enhance social transformation as rightly noted by the National Open University of Nigeria (2008). It is doubtful if science teachers without a good mastery of NOS can accomplish the goals mentioned above. Indeed, Abd-El-Khalick (2012) also opined that only science teachers with a high degree of understanding of NOS can design and implement best practices in science teaching required to achieve the goals of science education. Even though only a small percentage of the science teachers that took part in this study possessed inadequate knowledge of NOS, the classroom implications could be very devastating to learning outcomes. Teachers with inadequate knowledge of NOS would most likely misrepresent science to the students. Consequently, the students would be unable to develop an appropriate level of scientific literacy, positive attitude towards science and ability to make informed decisions to address science-related personal and societal issues. Furthermore, misrepresentation of science by the teachers could re-enforce the stereotypic negative image of science disciplines in the students' mindset resulting into decline in enrollment in science and underachievement. Such situation is tantamount to diminishing the utility value of science education and science teachers in the process of social transformation.

The preceding discussion brought to light pertinent issues on the quality of the in-service science teachers that should attract the scholarly attention of the science education community. The Federal Government of Nigeria (FRN) recognizes the pivotal role of teachers in the provision of high-quality education for the citizens as expressed in the national policy on education (FRN, 2013). The goals of teacher education stated in the national policy on education (FRN, 2013) include: to, 'provide teachers with the intellectual and professional base adequate for their assignment and to make them adaptable to changing situations (p.30)'. Findings in this study tend to suggest that the attainment of this goal, among others, has not been adequately addressed by science teacher educators in various teacher education institutions in the country. The aspiration of the Federal Government of Nigeria to provide high-quality education for Nigerians could be jeopardized if the quality of the science teachers remains unimpressive. Indeed, the Teachers Registration Council of Nigeria (TRCN) stated that "no education system can rise above the quality of its teachers" (p.8) (TRCN, 2004). It is thus imperative for the science teacher education institutions to introduce NOS as an important core course

into the science teacher education curriculum.

The continuous paradigm shift and knowledge explosion in the field of science and science teaching could overwhelm science teachers without institutional support. Thus, it is necessary to make mandatory professional retraining workshop an integral component of science teacher education programme as an avenue for the in-service science teachers to update their knowledge. Sharing science programme is another avenue where science teachers can update their knowledge of science and NOS. It is thus incumbent upon the science education community in the nation to embrace the practice of sharing science in collaboration with scientists and other stakeholders. Science teachers should embrace the culture of collaboration among peers at school and wider science education community level to support each other, address challenges and share ideas and information to enhance their quality as an agent of social transformation.

The multidimensional nature of gender inequality in the society and the need to eradicate it partly accounts for the sustained interest of researchers in the field of education to study the influence of gender on many teaching and learning variables. Bello (2002) noted that gender difference is a socio-cultural phenomenon that permeates every aspect of the society including social transformation. It is characterized by under achievement and enrolment of female students. The fact that male and female students are receiving a lesson in the same class, taught by the same teacher and using the same textbook does not mean that they are receiving the same contents. The level of comprehension and assimilation of the contents of the lesson may vary due to subtle patterns of gender inequality that often shape teacher instruction and by extension student learning (Ohio Literacy Resource Center, 2014, March). Results of this study indicated that gender difference does not exist in the science teachers' level of mastery of NOS. The result suggests that the tenets of NOS appealed equally to both genders.

Research studies on misconceptions in science started several decades ago during the early works of Piaget (1929 and 1930) on children's conceptions of natural phenomena (Boo, 2006). Researchers' interest in misconceptions in science is far from waning. The sustained interest of the science education community in conducting researches on misconceptions in science rests on the fact that knowing students' misconceptions is crucial to effective teaching and meaningful learning. Decades ago cognitive psychologists postulated that learning is a process of conceptual change where individual learners construct their personal meanings (Novak, 1991; Yager, 1991). It thus seems that

misconceptions in science are inevitable.

Results of this study brought to light the various misconceptions of the NOS in the cognitive structure of the science teachers that took part in the study. It is pertinent to state here that all the misconceptions held by the science teachers that participated in this study were also noted to be held by science students. It is not implausible to infer from the result of this study that science teachers in Kwara State most probably have been misrepresenting science to their students. The result implies that the misconceptions were not only common but also widely held by science students and teachers across nations. It equally seems to suggest that the misconceptions were most likely to be highly resistant to change.

Arguably the consequences of misrepresenting science to students by their teachers could include misconceptions created by the teacher, and poor achievement in science by the students. Students could develop a poor attitude towards science due to underachievement. Also, misrepresentation of science by the teachers could reinforce some students' preconceptions of science as a difficult discipline. Science teachers with distorted knowledge of NOS are prone to use inappropriate instructional strategies to implement the science curriculum thereby contribute to students' underachievement in science. To achieve social transformation, therefore, science teachers and students should possess adequate knowledge of the nature of science.

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