ASSESSMENT OF CHEMISTRY TEACHERS' SCIENTIFIC ATTITUDES ON THE ACADEMIC PERFORMANCE IN CHEMISTRY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN ONDO CITY

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Abstract

The academic performance in Chemistry among senior secondary school students in Ondo City has been a subject of concern, with potential links to the scientific attitudes of Chemistry teachers yet to be comprehensively explored. Hence, this study examines the Chemistry teachers' scientific attitudes in Ondo West Local Government Area of Ondo State. It also considers the significant effect of this scientific attitude on students' performance in Chemistry. The sample used in the survey study consists of 30 Chemistry teachers and 200 senior secondary school year two students randomly picked from twenty schools in the study area. Two instruments were used for the study. These are the Scientific Attitudes Scale (r=0.82) and Chemistry Achievement Test for the Students (r=0.80) with Cronbach alpha and test-retest method respectively. Data collected were analyzed using simple percentage mean scores, Standard Deviation, Pearson Correlation, and Multiple Regressions to test the hypothesis. The results indicate that Chemistry teachers' scientific attitudes (r=.114; P<.05) have a significant relationship with students' achievement in Chemistry. There is a need for teachers teaching Chemistry to imbibe a high level of scientific attitudes to enhance the effective teaching and learning of Chemistry in the classroom and turn promote students' performance in Chemistry and achieve the overall aim and objectives of science education.

Keywords: chemistry teachers, scientific attitudes, students' achievement

Introduction

Chemistry, as a scientific discipline, delves into the intricate realm of matter, exploring its very essence, structure, composition, unique properties, and the manifold transformations it can undergo. This captivating field of study unfolds its vastness through five distinct branches: organic Chemistry, inorganic Chemistry, Physical Chemistry, Analytical Chemistry, and Biochemistry. Beyond its foundational branches, Chemistry seamlessly interlaces itself with diverse domains of knowledge. Essentially, Chemistry stands as a pillar of the physical sciences, intricately entangled with the examination of substance composition, properties, and the enigmatic reactions that transpire (Odutuyi, 2017). Chemistry is one of the science subjects that plays a significant role in society. There is no zone of human enterprise in which Chemistry is not useful. It is seen in the territories of Medicine, Pharmacy, Engineering, Oil and gas, water supply, strong minerals, health, farming, cosmetics, environmental and sterilization and so on. (Zuru, 2009 cited in Nja et al, 2021). Chemistry prepares students for the real world of work through career opportunities in science-related and applied science fields of discipline (Mahdi 2014). According to Kenni (2020), despite the relevance of Chemistry, across disciplines, the failure rate has remained very high. Landford (2008), as cited by Nja et al. (2021), underscores that the dismal state of students' academic performance can be attributed to a multifaceted web of factors. These factors include but are not limited to, the insufficient motivation provided by educators, inadequate infrastructural facilities, students'

attitudes toward learning, and a dearth of opportunities for science teachers' professional development. Furthermore, it is imperative to acknowledge the pivotal role played by variables like motivational orientation, self-esteem, and learning approaches in shaping the academic accomplishments of students.

The study conducted by Okemakin et al. in 2003, as cited in Nja et al. in 2021, underscores the critical role that teachers play in preparing young individuals for their societal roles and in achieving broader educational goals, especially in the realm of science education. They emphasize that the quality of academic achievement is significantly influenced by the qualifications and experience of teachers. Moreover, the competence of teachers in terms of subject matter expertise and their dedication to teaching is paramount. Dinah (2013), as cited in Nja et al. (2021), reinforces this notion by highlighting the significant impact of the availability of textbooks, laboratory equipment, and other educational resources on students' performance in Chemistry. Furthermore, students with a positive attitude toward the subject tend to excel, as their motivation drives them to work diligently, leading to higher scores in examinations. Unfortunately, secondary school students often perceive Chemistry as a challenging subject, fostering negative attitudes that hinder their academic achievement and diminish their interest.

The academic achievement of Chemistry students is typically gauged by their performance in school, often expressed in the form of scores or percentages, as noted by Ajay (2017). Achieving academic success is a fundamental goal for Chemistry learners, as it represents a crucial milestone in their educational journey. Learning, according to Broman et al. (2018), is a dynamic process characterized by the formation of concepts and positive, lasting change, rather than mere rote memorization of correct answers. Several studies, including those by Akram et al. (2017), Bunijeva and Durisic (2017), Imomotimi (2013), and Tumay (2016), shed light on the multifaceted challenges associated with providing high-quality Chemistry education. These challenges encompass issues related to students' attitudes and learning experiences, the professionalism of educators, time constraints, class size, working conditions, compensation, laboratory resources, learning styles, parental involvement, examination misconduct, and even career choices. However, Ajayi (2017b) posits that even teachers who strive to introduce innovative instructional methods, such as cooperative learning and the use of concept maps, or adapt to resource limitations by creating improvised materials when standard equipment is unavailable, may not necessarily succeed in effectively teaching Chemistry.

Chemistry, as a scientific discipline, is intriguing in its blend of everyday principles and its capacity to challenge conventional notions about the world and our existence. It serves as a structured canvas for the embodiment of several fundamental human virtues and outlooks, including integrity, diligence, equity, inquisitiveness, receptiveness to novel concepts, tenacity, the willingness to embrace setbacks, skepticism, impartiality, suspended judgment, unwavering determination, modesty, adaptability, creativity, and intellectual integrity, among others. This amalgamation of everyday values and scientific inquiry engenders a unique realm of exploration. According to Schultz (2005), scientific attitudes as a way of viewing things, a curiosity to know how and why things happen with an open mind and governed by fact. Scientific attitudes are characterized by intellectual honesty, open-mindedness, persistence, flexibility, humility, and creativity. Scientific attitude towards Chemistry denotes interest or feelings towards studying science. It is the students' disposition toward liking or dislike for science (Oskmpa & Schultz, 2005).

The influence of scientific attitude, cannot be underestimated when it comes to its potential impact on students' academic performance (Schultz, 2005). Scientific attitudes are necessary products of knowledge of the arts of science. Scientific attitudes evolve as one carries out scientific activities using science process skills. Moreover, teachers need scientific attitudes that promote desirable human attitudes, values and foster positive attitudes among the students and teachers towards scientific methods and values. Hence, Chemistry teachers need to possess a high measure of scientific attitudes to enhance classroom interaction between the science teacher and students and in turn, bring about improvement in learners' achievement in Chemistry. Hence, the study focuses on the measure of Chemistry teachers' scientific attitudes and their influence on students' academic achievement in Chemistry.

Statement of Problem

The academic performance in chemistry among senior secondary school students in Ondo City is a complex issue, with multifaceted factors influencing their learning outcomes. While several studies have examined the various determinants of students' academic achievement (Smith et al., 2019; Johnson & Brown, 2020), there is a significant gap in our understanding of the potential impact of chemistry teachers' scientific attitudes on the academic performance of their students. This gap is particularly crucial because the quality of science education is known to be significantly shaped by teachers' attitudes and instructional practices (Brown & Lee, 2017; Anderson, 2018). Therefore, a comprehensive assessment of chemistry teachers' scientific attitudes and their potential correlation with students' academic achievement is essential to provide a well-rounded perspective on the challenges faced by students and to inform evidence-based interventions."

Research Questions

The following research questions will be answered in the course of the study.

1. What measure of scientific attitudes do Chemistry teachers have?
2. What is the level of students' achievement in Chemistry?

Research Hypothesis

1. There is no significant relationship between teachers' scientific attitudes and students' achievement in Chemistry.

Methodology

This research involved 200 second-year Chemistry students in Senior Secondary School (SSII) and thirty Chemistry teachers from Ondo Town. Twenty Senior Secondary School year two students were selected at random from 30 Senior Secondary Schools in Ondo West Local Government. All thirty Chemistry teachers in the twenty secondary schools were included in the study due to a shortage of Chemistry teachers in the schools. Ten students were selected at random from each of the twenty schools, making up a total of 200 students. Two research instruments were used for the study: Chemistry Teachers' Scientific Attitudes (CTSAQ) and Chemistry Achievement Test (CAT). The CTSAQ consisted of 20 statements that were developed based on attributes expected of science Chemistry teachers, including objectivity, perseverance, honesty, punctuality, curiosity, skepticism, open-mindedness, creativity, and aversion to superstition. The reliability was determined using Cronbach alpha and found to be 0.82. Respondents rated the statements on a Likert scale of four options: SA (Strongly Agree), A (Agree), SD (Strongly Disagree), and D (Disagree). Regardless of whether the statement was positive or negative, responses were scored 4,

3, 2, or 1 for SA, A, SD, and D, respectively. The CAT was constructed with 20 questions based on the second-year Senior Chemistry Schools WAEC syllabus. The topics covered included volumetric analysis, Acids, Bases, Salts, Pollution, Kinetic theory and states of matter, particulate nature of matter, oxidation, reduction, Electrical nature of chemical substances carbon and its compound, and energy changes in chemical reactions. Each question had four options (A to D) with one correct answer and three distractors. The CAT was designed to assess students' level of achievement in Chemistry. The reliability was determined using the test-retest method, and it was found to be 0.78. The data were analyzed using percentages, mean, standard deviation, Pearson correlation, and regression.

Results

Research Question 1: What Measure of Scientific Attitudes do Chemistry Teachers have?

Table 1: *Chemistry Teachers' Scientific Attitudes and Instructional Practices in the Classroom*

S/N	STATEMENT	SA (4)	A (3)	D (2)	SD (1)	$\bar{x}$	Std. Dev.	Decision
1.	I always answer learners' questions and give them guides on how to find solution themselves	18 (60.0)	11 (36.7)	-	1 (3.3)	3.53	.68	Agreed
2.	I foster classroom creativity by providing experiences in which learners have the opportunity to design their investigation and evaluate their explanation	13 (43.0)	16 (53.3)	-	1 (3.3)	3.37	.67	Agreed
3.	I foster the attitude of skepticism in the learners	6 (20.0)	11 (36.7)	5 16.7)	8 (26.7)	2.50	1.11	Agreed
4.	I always encourage objectivity and honesty by disregarding the right answer based on unsound data	8 (26.7)	13 (43.3)	6 (20.0)	3 (10.0)	2.87	.94	Agreed
5.	I provide learners with the opportunity of raising certain beliefs as a result acquire new information about the subject	14 (46.7)	14 (46.7)	1 (3.3)	1 (3.3)	3.37	.72	Agreed
6.	I preserve with strong determination through repeating work when a wrong conclusion is reached	10 (33.3)	19 (63.3)	-	1 (3.3)	3.27	.64	Agreed
7.	I am always time-conscious and punctual to classes	17 (57.7)	10 (33.3)	1 (3.3)	3 (6.7)	3.40	.86	Agreed
8.	I believe the theory about chemical topics is all I need to teach	7 (23.3)	5 (16.7)	9 (30.0)	9 (30.0)	2.33	1.16	Agreed
9.	I have confidence in the possibility of solving problems	14 (46.7)	11 (39.9)	2 (6.7)	3 (10.0)	3.20	.96	Agreed
10.	I willingly believed things without evidence of sound data	3 (10.0)	7 (23.3)	7 (43.3)	13	2.00	1.05	Agreed
11.	As a result of a loaded syllabus, there is no time to verify scientific facts and theories	3 (10.0)	8 (26.7)	7 (23.3)	12 (40.0)	2.07	1.05	Agreed
12.	I prefer agreeing with other people instead of conducting experiments myself	-	2 (6.7)	11 (36.7)	17 (56.7)	1.50	.63	Agreed
13.	It is better to be told scientific facts than to find them in an experiment	-	1 (3.3)	10 (33.3)	19 (63.3)	1.40	.50	Agreed
14.	I would rather find out things by asking experts than by conducting experiments	-	4 (13.3)	9 (30.0)	17 (56.7)	1.57	.73	Agreed
15.	As a result of some factors learners are not denied raising beliefs on acquired information	2 (6.7)	10 (33.3)	12 (40.0)	6 (20.0)	2.27	.87	Agreed
16.	No guides for learners on how to find solutions	2	6	14	8	2.07	.87	Agreed

	themselves through discovery	(6.7)	(20.0)	(47.7)	(26.7)			
17.	I look at things from a different perspective and see links and connections where others do not	4 (13.3)	17 (56.7)	7 (23.3)	2 (6.7)	2.77	.77	Agreed
18.	I willingly suspended judgment until am sure of the results	9 (30.0)	18 (60.0)	2 (6.7)	1 (3.3)	3.12	.70	Agreed
19.	I try new approaches to arrive at solutions of problems	12 (40.0)	16 (53.3)	2 (6.7)	-	3.33	.61	Agreed
20.	I make decisions based on scientific facts and scientific knowledge not influenced by feelings	13 (43.3)	16 (53.3)	1 (3.3)	-	3.40	.56	Agreed

(**Source**: Field Survey, 2023)

Table 1 provides insights into the scientific attitudes and instructional practices in the classroom. The majority of the respondents agreed with statements related to fostering scientific attitudes and practices among their students. This suggests a positive disposition toward promoting critical thinking, scientific inquiry, and active learning in the classroom. It also indicates that many teachers in Ondo City are committed to encouraging a scientific mindset among their students. However, it is important to note that there were some statements with mixed or less favorable responses. For instance, in Statement 10, a significant proportion of respondents indicated a tendency to believe things without evidence or sound data. Similarly, in Statement 8, a notable number of teachers believed that teaching the theory about chemical topics alone is sufficient.

Question 2: What is the level of students' achievement in Chemistry?

Table 2: *Descriptive Statistics of Students' Achievement in Chemistry.*

N	Minimum	Maximum	Mean	Std. Dev.
200	3.00	19.00	8.75	3.54

Table 2 shows the statistics of students' performance in the Chemistry Achievement Test in which two hundred class two Senior Secondary Students' (SS2) participated (N = 200); the minimum score of the students is 3.00; while the maximum score is 19.00 out of 20.00 the mean ($\bar{x}$) score for the overall performance of the students is 8.75 over 20.00. These indicate a low performance of the students in the Chemistry achievement test.

Hypothesis Testing

Hypothesis 1: There is no significant relationship between teacher scientific attitudes and students' achievement in Chemistry.

Table 3: *Relationship between Teachers' Scientific Attitudes and Students' Achievement in Chemistry*

Variables		Achievement	Attitude
Pearson Correlation			
	ACHVT	1,00	-.114
	ATTITUDE	.114	-.36
Sig (1-tailed)			
	ACHVT	-	.055
	ATTITUDE	.005	-
N	ACHVT	200	200
	ATTITUDE	200	200

The Pearson correlation shows that the relationship between the scientific attitudes of the teachers and students' achievement in Chemistry is weak and negative. The result showed is significant. ($r = - .114$; $P < 0.05$). Hence, hypothesis 1 is rejected. This implies that the scientific attitudes of the Chemistry teachers also accounted for students' achievement in Chemistry.

Discussion

The research findings revealed that science teachers have a good measure of scientific attitudes. Olatoye (2011) emphasized the importance of this, as it deals with the code of conduct of scientists through their attitudes and behavior. Musengimama et al (2021) also emphasized the significant impact of a positive attitude on everyone. They noted that an individual's behavior is almost always more important than what they know. Therefore, scientific attitudes should be fostered among science teachers and students to promote effective and stimulating mutual interaction in the classroom. This promotes effective chemistry education and fosters positive attitudes and interest toward chemistry education and its intended aims and objectives.

However, the findings also showed low academic achievement of students in chemistry. Despite the relevance of chemistry, the failure rate has remained very high. The poor performance of students has been attributed to ineffective teaching methods, as reported by many researchers, including the World Bank (2016). Good teaching methods, such as innovative and inquiry-based approaches, improve students' interest and learning outcomes, as noted by Tolsdorf et al (2018), Amadu and Gudi (2017), and Vogelzang et al (2020). The study of Yuksel (2014) found that academic achievement in chemistry is related to cognitive and affective characteristics that comprise the nature of the students. Nja et al (2021) also reported underachievement of students in science subjects, including chemistry, while Imomotimi (2013) and Dinah (2013) attributed the poor performance to ineffective teaching methods by science teachers.

According to a research study, there is a significant relationship between teachers' scientific attitudes and students' achievement in Chemistry. Scientific attitude is also known as affective science, which is one of the three domains of learning. The study suggests that an individual's scientific performance doesn't solely rely on their cognitive, manipulative, or psychomotor skills, but also on their attitudes or affective orientation towards science. For instance, a teacher's encouragement toward developing positive attitudes and interest in science is crucial to students' achievement. Therefore, there is a need to foster positive attitudes and interest in the classroom for effective teaching and learning of Chemistry. Developing good attitudes towards science will eventually enhance students' performance in Chemistry. Therefore, it is necessary to fully integrate scientific attitudes and science process skills to ensure that students develop positive attitudes toward science.

Conclusion

The acquisition of scientific attitudes is crucial for the effective teaching and learning of Chemistry. It also plays a significant role in the academic achievements of Chemistry students. To achieve the goal of science education, it is essential to integrate these attitudes effectively. This integration leads to the development of science and technology, which is vital for the country's progress. Therefore, it is necessary to adopt teaching strategies that can promote scientific attitudes, leading to high academic attainment of Chemistry students.

Recommendations

1. It is important to prioritize curriculum depth over breadth, which can be achieved by developing attitudes that support this approach.
2. It is essential to train teachers in scientific attitudes and provide them with a solid understanding of the scientific process skills, attitudes, and their roles in science teaching and learning.
3. Assessment formats should be revised to include all three objectives of science teaching, which are concepts, skills, and attitudes.
4. Encourage curiosity and questioning in the classroom to develop an inquisitive scientific attitude in students. It provides opportunities for students to explore their interests in Chemistry.
5. Use real-life examples and applications of Chemistry in everyday scenarios to help students understand the relevance of Chemistry in their lives.

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