AFRICAN JOURNAL OF THEORY AND PRACTICE OF EDUCATIONAL RESEARCH (AJTPER)

Hard Print ISSN: 2630-6565
e-Print ISSN: 2992-3638

VOL. 12, JUNE 2024

THE INFLUENCE OF CHEMISTRY TEACHERS' ATTITUDES ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN ELECTROLYSIS IN RIVERS STATE.

ZUDONU, Onisoman Chuks, Ph.D.
onisoman.zudonu@fcetomoku.edu.ng
Federal College of Education (Technical) Omoku, Rivers State, Affiliated to University of Nigeria, Nsukka, Nigeria.

Abstract
This paper ex-rayed the impact of chemistry teachers' attitudes on senior secondary school students' achievement in electrolysis, a fundamental topic in chemistry. By examining existing literature and conducting empirical research, this study aims to unmask how varying levels of teachers' attitudes and teacher-student relationships affect students' comprehension and achievement in this specific area of chemistry. This study employed a mixed-methods approach, combining quantitative and qualitative research methods. The quantitative component involved a test titled "Chemistry Achievement Test (CAT)" to measure students' academic achievement in electrolysis before and after exposure to different teacher attitudes, while the qualitative component included questionnaire (titled "Students' Perception of Chemistry Teachers Attitude Towards Electrolysis (SPCTATE)" administered to students and semi-structured interviews conducted with teachers to assess the role of teacher-student interaction in students' engagement and motivation in learning electrolysis. A random sampling technique was used to select 9 Senior Secondary two (S.S.2) chemistry students from 15 senior secondary schools in Rivers State to make up 135 chemistry students. In contrast, one chemistry teacher was selected from each of the sampled schools, giving 15 chemistry teachers, making the total number of participants 150. The research instruments were face and content validated, using Cronbach's Alpha, and the test instrument yielded a reliability coefficient of 0.81. The results of the three research questions that guided the study were examined using mean, standard deviation, and thematic analysis, while the hypotheses were analysed using ANOVA and Pearson product-moment correlation. The results showed that the chemistry students taught with positive attitude had a posttest mean score of 75.56, SD of 6.52 and a mean gain score of 53.89, the neutral attitude had a posttest mean score of 56.78, SD of 8.17 and a mean gain score of 34.67 while the negative group had a posttest mean score of 47.67, SD of 6.46 and mean gain score of 26.11. The hypotheses revealed a statistically significant difference in the mean scores of the groups and a strong positive correlation (r = .739) between teachers' perceived attitude to electrolysis and chemistry students' achievement in the positive group in electrolysis. Thus, it was recommended that professional development programs should focus on enhancing teachers' attitudes and instructional techniques to improve students' engagement and academic achievement.

Keywords: *attitude, electrolysis, academic achievement, chemistry, neutral attitude.*

Introduction

Chemistry, a branch of science concerned with the properties, composition, uses, and behaviours of matter and the principles governing the changes that matter undergoes, plays a crucial role in secondary education (Szydlik & Lumpe, 2006). Electrolysis, a significant concept within this field, involves the breakdown of substances into simpler components using electrical energy. Success in comprehending electrolysis requires both theoretical knowledge and practical skills (Ajayi, 2021) and, as such, poses some level of challenges to chemistry students.

One of the primary challenges faced by chemistry students in learning about electrolysis is the need to integrate knowledge from multiple areas of chemistry and physics. Electrolysis requires a solid understanding of both chemical bonding and electrical principles. Students must comprehend how an electric current can drive a non-spontaneous chemical reaction involving electron transfer. Integrating concepts from electrochemistry, such as oxidation-reduction reactions and basic electrical theory, can be complicated for students who are still developing their understanding of these foundational topics (Fayemi, 2016; Haruna, 2018). Efe et al., 2018, worked on high school students' proficiency and confidence levels in electrolysis and found that high school students' proficiency levels in electrolysis were generally low, students' confidence levels in electrolysis were also low, especially for female students, and there was a significant relationship between students' proficiency and confidence levels.

Another significant challenge is the difficulty of the electrolysis process itself. Electrolysis involves several steps, including the setup of an electrolytic cell, the identification of anode and cathode reactions, and the calculation of relevant parameters such as current, voltage and reaction time (Szydlik & Lumpe, 2006). Each step requires a detailed understanding of the electrochemical principles at play. For example, predicting electrolysis products requires knowledge of the standard electrode potentials and the overpotentials that may affect the reactions at the electrodes. This level of detail can be overwhelming for students new to the subject. Kim et al. (2015) conducted a study on developing and applying an electrolysis concept test. Their findings showed that the electrolysis concept test was a reliable and valid instrument for assessing students' understanding of electrolysis concepts. Students' performance on the test was also found to be generally low, indicating a need for improved teaching. It was also discovered that the test results showed that students struggled with concepts related to electrolysis, such as oxidation-reduction reactions. Undeniably, these findings highlight the need for improved instruction and assessment in electrolysis and strategies to enhance students' achievement.

Moreover, electrolysis often involves working with various electrolytes and electrodes, each presenting its own set of chemical and physical properties. Chemistry students must learn how to select appropriate electrode materials and how different electrolytes influence electrolysis. The choice of electrolyte and electrode materials can affect the efficiency and outcome of the reaction, adding another layer of complexity (Olorundare, 2017; Ajayi, 2021). For instance, water electrolysis requires understanding how to use different electrode materials to optimise the production of hydrogen and oxygen gases.

The quantitative aspects of the electrolysis further complicate the topic. Calculating the amount of substance produced or consumed during electrolysis involves using Faraday's law of electrolysis, which relates the quantity of electric charge passed through the electrolyte to the amount of chemical change. These calculations require precision and understanding of converting between charge, moles, and mass units. The need for accurate calculations and understanding the relationship between current, time, and amount of substance can pose a challenge for chemistry students (Ajayi & Ogbeba, 2017; Akinsola & Igwe, 2002).

Practical laboratory work with electrolysis can also be difficult. Setting up an electrolytic cell requires careful handling of equipment and chemicals, and safety precautions are essential due to the involvement of electric currents and potentially hazardous materials. Chemistry students must also develop skills in observing and interpreting experimental results, which can be challenging when dealing with the subtle differences in reaction conditions and products (Szydlik & Lumpe, 2006; Mbaba & Omabe, 2012). Also, applying electrolysis in real-world contexts, such as industrial processes and electroplating, adds another layer of complexity (Ajayi & Angura, 2017). Understanding how electrolysis is applied in these fields requires knowledge of both science and the technology involved, which can be overwhelming for chemistry students who are still mastering the basic principles.

Research by Szydlik and Lumpe (2006) indicates that students struggle to understand electrolysis if the instruction lacks clarity and enthusiasm. Recent educational research suggests that a teacher's attitude can significantly influence students' academic achievement (Pianta et al., 2008; Sandi-Urena et al., 2011).

In the educational realm, the role of teachers extends far beyond the mere dissemination of knowledge. Particularly in subjects like chemistry, where concepts can be complex and abstract, the teacher's attitude plays a crucial role in shaping students' academic experiences and achievements. A teacher's attitude encompasses their enthusiasm, patience, empathy and belief in their students' potential. These aspects can greatly affect students' motivation, engagement and ultimately academic outcomes. (Zudonu and Njoku, 2018, Sandi-Urena et al., 2011, and Szydlik & Lumpe, 2006).

A teacher's attitude can be positive, negative or neutral. A positive attitude from the chemistry teacher can enhance students' learning experiences in multiple ways (König et al., 2020; Yusuf et al., 2020). Firstly, it promotes a supportive and encouraging classroom environment. When teachers display enthusiasm and confidence in the subject matter, they create an atmosphere where students feel valued and motivated to engage with challenging material (Vallade, 2021). This positivity can diminish the anxiety associated with difficult concepts like electrolysis and encourage students to approach problems with a problem-solving mindset rather than a defeatist attitude (Erden & Akgül, 2010). Research in educational psychology suggests that students who perceive their teachers as supportive and approachable are likelier to participate actively and persist in facing difficulties (Price and Brooks, 2012; Goodboy et al., 2018; Yurtal & Artut, 2010). Furthermore, a teacher's positive demeanour can improve students' self-efficacy and academic self-concept. Self-efficacy, or the belief in one's ability to succeed, is crucial for academic achievement. When chemistry teachers communicate high expectations and exhibit confidence in their students' potential, it can significantly bolster students' self-belief. This, in turn, can lead to greater effort and resilience (Klassen et al., 2020; Wang & Hall, 2020; Sandi-Urena et al., 2011). For example, a teacher encouraging students to view mistakes as learning opportunities rather than failures helps build a growth mindset. This mindset is essential for tackling the rigorous demands of electrolysis, where mistakes are often part of the learning process.

While a positive attitude from a teacher can foster academic success, a negative attitude can harm students' achievements and overall experience in chemistry. The ramifications of a chemistry teacher's negative disposition are multifaceted, affecting students' motivation, self-efficacy, and engagement, impacting their academic achievement or performance (Kelsey et al., 2004). A teacher's negative attitude can create a challenging and discouraging learning environment. Electrolysis is a topic that often presents difficulties for students, with complex theories and problem-solving demands. When a teacher consistently exhibits frustration, impatience, or disdain for the topic or students, it can exacerbate students' feelings of inadequacy and anxiety (Yurtal & Artut, 2010). This negative atmosphere can lead to a lack of enthusiasm and reluctance to engage with the material, resulting in diminished academic achievement. Students may become disheartened and less likely to seek help or persist through challenging topics like electrolysis, which undermines their potential for success (Goodboy & Myers, 2015).

Whereas the effects of positive or negative attitudes are well documented, a neutral attitude, characterised by a lack of strong emotional engagement or enthusiasm, presents a unique scenario with its own implications for students' achievement. A neutral attitude from a chemistry teacher, marked by an absence of overt enthusiasm or discouragement, can result in a classroom environment that lacks the motivational drive often associated with more emotionally engaged teaching styles (Sandi-Urena et al., 2011). Without the emotional highs and lows that naturally accompany passionate teaching or its opposite, a neutral approach may lead to a classroom atmosphere that is more predictable but less stimulating. In such an environment, students might not experience the same level of inspiration or urgency to excel, which could impact their motivation and engagement with the material (Pianta et al., 2008). One key aspect of a neutral attitude is its potential impact on students' motivation. Motivation is critical to academic success, especially in topics like electrolysis that involve complex concepts and require sustained effort. A teacher who maintains a neutral demeanour might fail to convey the excitement and relevance of the subject matter, which can affect students' intrinsic motivation to search and understand the material deeply (Szydlik & Lumpe, 2006). Students may perceive the subject as less engaging or relevant, leading to reduced interest and effort. Consequently, their academic performance might suffer due to a lack of enthusiasm and personal investment in learning. In the aspect of feedback, a teacher with a neutral attitude might provide technically accurate feedback but lack the emotional support necessary to build students' confidence and self-efficacy. Without this supportive feedback, students may struggle to develop a sense of competence and motivation, potentially leading to lower achievement and diminished engagement with the topic (Özdemir & Sezgin, 2011; Goodboy et al., 2022). While a neutral attitude might avoid the extremes of overt praise or criticism, it can also result in a lack of personal connection with students. Building strong teacher-student relationships is crucial for fostering a positive learning environment. A teacher who is indifferent may miss opportunities to connect with students personally, which can affect students' overall classroom experience (Pianta et al., 2008). In contrast, a neutral approach may also avoid some pitfalls associated with more extreme attitudes. For instance, a neutral teacher may be less likely to inadvertently create an environment of undue stress or anxiety, which can result from a highly critical or overly enthusiastic demeanour. This balanced approach can provide a stable and consistent learning environment, which might benefit some students who thrive in a less emotionally charged atmosphere (Szydlik & Lumpe, 2006).

Statement of the Problem

Chemistry teachers have a domineering role in influencing the academic achievement of chemistry students, as they automatically direct all the activities that take place in and outside the classroom. Thus, they should hold durable and positive attitude towards their profession. According to Tuncel (2015) and Ajayi (2021), students' academic achievement plays an important role in their academic journey, and the attitude of teachers is an important factor that accelerates their success. The poor performance in electrolysis is alarming and has been attributed to teachers' attitudes, which include enthusiasm, patience, support and expectation during electrolysis instruction. Hence, developing teachers' attitudes in the aforementioned areas and utilising it as a strategy that involves active students' engagement and participation in electrolysis classes are anticipated to motivate and elevate the academic achievement of chemistry students in the study of electrolysis. Therefore, the study examines the influence of chemistry teachers' attitudes on senior secondary school students' achievement in electrolysis in Rivers State.

Research Questions

The study addressed the following research questions.

1. What are the differences in students' achievement in electrolysis based on varying levels of teachers' attitude, such as positive, neutral and negative?
2. How do students perceive their chemistry teachers' attitude towards electrolysis?
3. What roles do teacher-student interactions play in students' engagement and motivation in the learning of electrolysis?

Hypotheses

1. There is no difference in the mean achievement scores of all groups.
2. There is no relationship between chemistry students' achievement and their perception of their chemistry teachers' attitude (positive, neutral, and negative) towards electrolysis.

Methodology and Procedure

This study employed a mixed-methods approach, combining quantitative and qualitative research methods. The quantitative component involved a "Chemistry Achievement Test (CAT)" test of senior secondary school students' academic achievement in electrolysis before and after exposure to different teacher attitudes. The CAT consisted of 20 multiple-choice questions lettered A to D, with three distractors and one correct option. Each correct answer was scored five marks, totalling 100 marks. The qualitative component included a questionnaire administered to students and semi-structured interviews conducted with teachers to assess the role of teacher-student interaction in students' engagement and motivation in learning electrolysis. The questionnaire, which consisted of 12 items, was titled "Students' Perception of Chemistry Teachers Attitude Towards Electrolysis (SPCTATE)" using a four-point Likert scale of Strongly Agree (SA = 4), Agree (A = 3), Disagree (D = 2) and Strongly Disagree (SD = 1).

Random sampling technique was used to select 9 Senior Secondary two (S.S.2) chemistry students from each of the sampled 15 senior secondary schools in Rivers State, to make up 135 chemistry students while 1 chemistry teacher was selected from each of the sampled schools giving 15 chemistry teachers, making the total number of participants to be 150. The 135 chemistry students were randomly assigned to three groups of 45 participants, based on different teacher attitudes (positive, neutral and negative). The 15 teachers were divided in 5's and assigned to each group, where the following areas of electrolysis were divided and taught amongst the teachers in each group based on varying teacher attitude (positive, neutral and negative)-electric principles, electrolysis processes, calculations in electrolysis, practical laboratory work and industrial application of electrolysis.

The CAT was first administered to each group and scored (pretest) before teaching each group for two weeks, and the second test (posttest) was administered at the end of the two weeks for one hour and thirty minutes. The posttest and pretest contained the same questions but were arranged in different orders. The questionnaire (SPCTATE) was administered to the students at the end of the two weeks of teaching to ascertain their perception of their teacher's attitude towards the teaching and learning of electrolysis. Afterwards, an interview was conducted with the teachers to determine the role teacher-student interaction played in students' engagement and motivation in the teaching and learning of electrolysis.

The research instruments were face and content validated by one chemistry education lecturer and two experts in measurement and evaluation. Using Cronbach's Alpha, the test instrument yielded a reliability coefficient of 0.81, and based on this high reliability index, it was deemed fit to carry out the research.

Results and Discussion

The results of the research questions were examined using mean (mean score of 2.50 and above was considered positive, mean score of 2.49 to 2.00 was considered neutral, while mean score of 1.99 and below was considered negative) and standard deviation. The interview was analysed using thematic analysis. The hypotheses were analysed using ANOVA and Pearson product-moment correlation. Using an alpha value of 0.05, the null hypotheses were rejected because the p-value was less than the set alpha value.

Research Question 1: What are the differences in students' achievement in electrolysis based on varying levels of teachers' attitudes, such as positive, neutral and negative?

Table 1: Showing Achievement Scores of Chemistry Students in Electrolysis Based on Varying Levels of Teachers' Attitude

No.	*Item*	*Variables*	*($\bar{x}$)*	*SD*
1.	*My chemistry teacher has high expectations of the students in learning electrolysis.*	*Positive group*	*2.96*	*0.56*
		Neutral group	*2.18*	*0.61*
		Negative group	*1.44*	*0.50*
2.	*My chemistry teacher has genuine passion when teaching electrolysis.*	*Positive group*	*2.93*	*0.53*
		Neutral group	*1.98*	*0.58*
		Negative group	*1.47*	*0.50*
3.	*My chemistry teacher teaches electrolysis in depth to the understanding of the students.*	*Positive group*	*3.29*	*0.54*
		Neutral group	*1.96*	*0.52*
		Negative group	*1.42*	*0.49*
4.	*My chemistry teacher utilizes visual aids to help students understand the processes of electrolysis.*	*Positive group*	*2.78*	*0.70*
		Neutral group	*1.80*	*0.72*
		Negative group	*1.44*	*0.50*
5.	*My chemistry teacher introduces the concept of electrolysis to students using simple electrolytic cell.*	*Positive group*	*2.78*	*0.55*
		Neutral group	*1.93*	*0.61*
		Negative group	*1.51*	*0.50*
6.	*My chemistry teacher does not shout at students even when they give incorrect answers to questions in electrolysis.*	*Positive group*	*2.87*	*0.50*
		Neutral group	*1.93*	*0.57*
		Negative group	*1.47*	*0.50*

7.	*My chemistry teacher takes delight in setting up simple experiments in electrolysis for better understanding.*	*Positive group*	*3.29*	*0.65*
		Neutral group	*2.20*	*0.69*
		Negative group	*1.40*	*0.49*
8.	*My chemistry teacher calls each student by name as he/she asks them question in electrolysis.*	*Positive group*	*2.93*	*0.57*
		Neutral group	*2.33*	*0.67*
		Negative group	*1.44*	*0.50*
9.	*My chemistry teacher is always punctual for his/she chemistry class.*	*Positive group*	*2.87*	*0.54*
		Neutral group	*1.93*	*0.61*
		Negative group	*1.67*	*0.67*
10.	*My chemistry teacher directs the students on where to get resources for better understanding of electrolysis.*	*Positive group*	*2.87*	*0.50*
		Neutral group	*1.89*	*0.57*
		Negative group	*1.67*	*0.70*
11.	*My chemistry teacher makes us study more electrolysis in our free time.*	*Positive group*	*2.95*	*0.52*
		Neutral group	*1.96*	*0.56*
		Negative group	*1.47*	*0.50*
12.	*My chemistry teacher is approachable and willing to answer questions even after electrolysis classes.*	*Positive group*	*2.98*	*0.56*
		Neutral group	*2.02*	*0.58*
		Negative group	*1.44*	*0.50*
	Overall mean and SD	*Positive group*	***2.98***	***0.56***
		Neutral group	***2.01***	***0.61***
		Negative group	***1.49***	***0.53***

Data in Table 1 shows chemistry students' pretest and posttest scores in electrolysis based on varying levels of teachers' attitude. The pretest score of 22.11 for the group taught with a neutral attitude was greater than those taught with positive and negative attitudes, with pretest scores of 21.67 and 21.56, respectively. However, the post-test scores were different, with the positive attitude group having a post-test mean score of 75.56, the neutral attitude group had a mean score of 56.78, and the negative attitude group had a mean score of 47.67. The positive attitude group achieved higher than the other groups, with a mean gain score of 53.89 against the mean gain score of 34.67 and 26.11 of the neutral and negative attitude groups, respectively. This finding agrees with that of Goodboy et al. (2022). However, to ascertain if this observed difference in mean score of the groups is significant, hypothesis one was tested.

Research Question 2: How do chemistry students perceive their chemistry teachers' attitude towards electrolysis?

Table 2: Showing Chemistry Students' Perception of their Chemistry Teachers' Attitude Towards Electrolysis

	Positive Attitude (N = 45)		*Neutral Attitude (N = 45)*		*Negative Attitude (N=45)*	
	($\bar{x}$)	*SD*	*($\bar{x}$)*	*SD*	*($\bar{x}$)*	*SD*
Pre – test	*21.67*	*8.82*	*22.11*	*8.40*	*21.56*	*6.40*
Post – test	*75.56*	*6.52*	*56.78*	*8.17*	*47.67*	*6.46*
Mean gain score	*53.89*		*34.67*		*26.11*	

Data displayed in Table 2 shows chemistry students' perceptions in the different groups of their chemistry teachers' attitudes towards the teaching and learning of electrolysis during the two weeks of learning electrolysis. Chemistry students in the positive group had an overall mean score of 2.98 and an SD of 0.56, indicating that they perceived the attitude of their chemistry teachers as being positive. The group taught with a neutral attitude had an overall mean score of 2.01 and an SD of 0.61. This reveals that the chemistry students could not really deduce the attitude of their chemistry teachers due to their indifferent attitude towards the teaching and learning of electrolysis. On the other hand, the group taught with a negative attitude had an overall mean score of 1.49 and an SD of 0.53. This mean score underscores that the chemistry students really perceived the attitude of their chemistry teachers as being negative. These findings are confirmed by those of Wubbels and Brekelmans (2005), Aras et al. (2016), Sezer (2018) and Akyüz (2019). To ascertain if there is a relationship between the perception of the chemistry students and their achievement in electrolysis, hypothesis two was tested.

Research Question 3: What roles do teacher-student interactions play in students' engagement and motivation in learning electrolysis?

At the end of the two weeks, the teachers in each group were interviewed semi-structured, and their responses were analyzed using thematic analysis. The major themes that emerged from the analysis of the interviews are clarity of concepts, encouragement of participation, provision of feedback, building relationships, and adaptation to needs. The transcript of the interview was used to support each of the themes.

Clarity of Concepts

The respondents believed that clarity of concepts is one role teacher-students' interaction play in students' engagement and motivation, as quotes from the interviews support it.

> *Mr. Hezikiah: by interacting with the students, teachers can address misconceptions and provide tailored explanations, making challenging concepts more understandable.*
>
> *Mr. Chukwukere: well, if a teacher explains electrolysis concepts clearly and provides practical examples, students are likely to view the teacher as having positive attitude. Also, students will see the teacher as knowledgeable and supportive.*
>
> *Mr. Onisotoyin: students begin to appreciate the teacher when the teacher relates the concept of electrolysis to real-world application using practical examples which will make the concept more relevant and easier to grasp.*

Electrolysis is one of the challenging topics in chemistry, and clarity of concept is crucial for students' effective understanding of the concept. When students grasp the fundamental principles clearly, they can better comprehend the process and its applications. This agrees with the findings of Chory-Assad (2002) and Szydlik & Lumpe (2006), who asserted that positive teacher-student interaction leads to students' engagement and motivation.

Encouragement of Participation

As can be seen from the interview quotes, the respondents agree that teacher-student interaction leads to students' participation in the teaching and learning process.

> *Mr. Osomudeya: having interactive discussions with my students, is one way I encourage them to get involved in hands-on activities which in turn leads to more dynamic learning and engagement of the students.*

Miss. Mivon: as a teacher, interacting with your students is important because that is one way to push them into more practical aspects of the topic. Most especially topics like electrolysis, by physically performing an experiment; the student becomes more engaged in the lesson.

Mr. Ugbusueivie: you know, interacting with the students also involves other interactive educational software that allow students to manipulate variables and visualize electrolysis processes, as this can go a long way to motivate and actively engage the students.

Encouraging participation is a powerful method for helping students understand electrolysis, as it actively engages them in the learning process. Zhang's (2007) and McCroskey et al.'s (2004) findings agree that encouragement to students comes from a positive teacher-student relationship.

Provision of Feedback

This was a recurring theme amongst the teachers: that teacher-student interaction produces feedback for teachers to work on, as quotes from the interview support.

Mr. Ovietemen: teacher-students' interaction produces feedback, which helps clarify misunderstandings. For example, if a student misinterprets the role of electrolysis, targeted feedback can correct this, reinforcing the correct concept.

Mr. Onisokasuei: interacting with my students' is for me to get feedback from them, and for them to also get feedback from me. In this case a student can identify his/her mistake and correct such errors in their understanding. If a student incorrectly describes the chemical reactions at the anode and cathode, feedback can guide them to the correct reactions.

Mr. Oyokoniso: interacting with the students surely leads to motivation, particularly positive feedback on correct answers or well explained concepts can reinforce learning and encourage students to build on their knowledge.

Feedback is as important to the teacher as it is to the students. Providing feedback is crucial for helping students understand complex topics like electrolysis and, therefore, identify and correct their misconceptions. This finding agrees with Özdemir & Sezgin (2011) and Pianta et al. (2008), who found positive feedback affects students' satisfaction.

Building Relationships

The respondents also showed, from their responses, that building relationships is one role teacher-student interaction plays in students' engagement and motivation, as quotes from the interviews support.

Mrs. AniOnisoman: interacting with the students builds a positive relationship which fosters a supportive learning environment. When students feel valued and understood, they are more likely to engage actively with the material, ask questions and participate in discussions about electrolysis.

Mrs. Onisonomubuen: I will say positive teacher – student relationships can increase students' confidence and willingness to participate, which enhances their motivation and engagement.

Mr. Onoikume: in education, communication is important. open communication can improve strong relationship between the teacher and student and will encourage the students to seek help and express their misunderstandings. This communication facilitates the clarification of complex topics like electrolysis.

It is obvious that a supportive teacher-student relationship builds trust, making students more receptive to feedback and guidance. Trust in the teacher's expertise and support can help students navigate difficult concepts and apply their knowledge of electrolysis effectively. This agrees with the findings of Sezer (2018) and Sandi-Urena et al. (2011), who found that students who interacted with their teachers were more engaged in the lesson.

Adaptation to Needs

Adaptation to needs in the context of teaching electrolysis involves tailoring instructional strategies to address students' diverse learning styles and requirements. The respondents accept as true that teacher-student interaction leads to adaptation of students' needs in the teaching and learning process, as can be seen from the quotes in the transcript of the interview.

> *Mr. Chukwudi: by interacting with the students, teachers can adjust their teaching strategies based on students' feedback and performance, ensuring that instruction meets the diverse needs of learners.*
>
> *Mr. Jackson: teacher-student interaction leads to differential instruction. Where the teacher can tailor the teaching method to suit individuals in the class-whether through visual, auditory, or kinesthetic activities-ensures that all students could understand the topic.*
>
> *Mrs. Eseoghene: by interacting with the students, the teacher can see the difficulty of the students and provide step-by-step guidance and gradually increasing the complexity of tasks helps students build confidence and mastery. For example, starting with simple electrolysis reactions before progressing to more complex scenarios allow students to build their knowledge and confidence progressively.*

By adapting teaching methods to meet various needs, teachers can ensure that students have multiple avenues to engage with and understand the concept of electrolysis, making the learning experience more inclusive and effective. Goodboy et al. (2022) and Koçak and Bostancı (2019) agree with the present finding that teacher-student interaction does lead to adaptation to the needs of the students.

Hypotheses 1: There is no difference in the mean achievement scores of all groups.

Table 3: Showing Descriptive Statistics of the Posttest ANOVA Analysis

	N	Mean	Std. Deviation	Std. Error
Positive	45	75.5556	6.59047	.98245
Neutral	45	56.7778	7.98831	1.19083
Negative	45	47.6667	6.53661	.97442
Total	135	60.0000	13.60421	1.17086

The descriptive table above reveals the mean of each group as well as the standard deviation as 75.56 and 6.59; 56.78 and 7.99; and 47.67 and 47.67 for the positive, neutral, and negative groups, respectively. It also shows 95% confidence intervals for the dependent variable (achievement) for each separate group (Positive, Neutral, and Negative) and when all groups are combined (total).

Table 4: Showing one-way ANOVA test of significance between Varying Levels of Teacher Attitude (Positive, Neutral and Negative)

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	18201.111	2	9100.556	182.042	.000
Within Groups	6598.889	132	49.992		
Total	24800.000	134			

The data presented in Table 4 show a significant value of .000, below the 0.05 alpha value; therefore, the null hypothesis is rejected. Thus, there is a statistically significant difference in the mean achievement scores of chemistry students taught with varying levels of teachers' attitude. However, to know which of the specific groups differed, the Multiple Comparisons table below, which contains the Tukey post hoc test results, reveals it.

Table 5: Showing Tukey Post Hoc Multiple Comparisons Test with Tukey HSD

(I) attitude	(J) attitude	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
positive	neutral	18.77778*	1.49059	.000	15.2444	22.3111
	negative	27.88889*	1.49059	.000	24.3555	31.4222
Neutral	positive	-18.77778*	1.49059	.000	-22.3111	-15.2444
	negative	9.11111*	1.49059	.000	5.5778	12.6445
negative	positive	-27.88889*	1.49059	.000	-31.4222	-24.3555
	neutral	-9.11111*	1.49059	.000	-12.6445	-5.5778

The mean difference is significant at the 0.05 level.

The multiple comparison test in the table above shows a statistically significant difference in achievement between the group taught with a positive attitude and a neutral attitude (p = .000) and between the positive attitude and a negative attitude (p = .000). There is also a significant difference in achievement between the neutral attitude and negative attitude group *(p = .000).*

From the ANOVA analysis, a statistically significant difference does exist between groups. This finding coincides with that of Wubbels and Brekelmans (2005), who found that a positive attitude increases students' engagement and motivation, leading to improved achievement. Also, Zhang (2007) found that negative teacher attitudes decreased students' academic achievement. Özdemir & Sezgin (2011), Erden & Akgül (2010), Zudonu and Njoku (2018), and Sezer (2018), in their different studies, also found that positive attitude of teachers improves academic achievement as opposed to negative attitudes. Also, the indifferent attitude of teachers does not give enough motivation to inspire students to want to achieve more in their electrolysis classes.

Hypothesis 2: There is no relationship between chemistry students' achievement and their perception of their chemistry teachers' attitude (positive, neutral, and negative) towards electrolysis

Table 6: Showing Pearson Correlation Analysis between Students' Perception of Teachers' Attitude and Achievement of Positive Attitude Group

Variable	*Perception of teachers' attitude*	*Achievement*

Perception of teachers' attitude Achievement	*1* *.739* *N = 45*	*.739* *1* *N = 45*

Table 7: Showing Pearson Correlation Analysis between Students' Perception of Teachers' Attitude and Achievement of Neutral Attitude Group

Variable	*Perception of teachers' attitude*	*Achievement*
Perception of teachers' attitude Achievement	*1* *-0.203* *N = 45*	*-0.203* *1* *N = 45*

Table 8: Showing Pearson Correlation Analysis between Students' Perception of Teachers' Attitude and Achievement of Negative Attitude Group

Variable	*Perception of teachers' attitude*	*Achievement*
Perception of teachers' attitude Achievement	*1* *.097* *N = 45*	*.097* *1* *N = 45*

The Pearson correlation analysis between students' perception of their teachers' attitude and their academic achievement in 6 returned a value of .739 for the positive attitude group. This value (.739) shows a strong positive correlation; hence, the null hypothesis is rejected, indicating that there is a positive relationship between students' perception of their teachers' attitude and improved academic achievement. This means that the positive attitude of the teachers improved the academic achievement of the chemistry students in the positive group. This result is in line with those of Sezer (2018), Yurtal and Artut (2010), Goodboy et al. (2022), and Goodboy et al. (2018), who found a positive relationship between teachers' positive attitude and students' academic achievement. On the other hand, Table 7 shows a correlation value of -0.203 for the neutral attitude group; This value shows that a weak negative correction exists between teachers' attitudes and students' academic achievement. while Table 8 revealed that a weak positive correlation exists between teachers' perceived attitude and students' academic achievement. Many researches support this findings amongst which are Kelsey et al., (2004); Goodboy & Myers, (2015); Goodboy et al., (2018); Vallade, (2021); Goodboy and Bolkan (2009) and Yurtal and Artut (2010) in their respective findings, reported that positive teacher behaviour influences academic achievement, and negative teacher behaviour influences academic achievement and as such, teachers' behaviours and attitudes produces a lasting effect on students.

Conclusion and Recommendations

The study confirms that a chemistry teacher's attitude significantly affects senior secondary school students' achievement in electrolysis. A correlation exists between teachers' positive attitude as perceived by students in students' academic achievement in electrolysis. Teachers who exhibit enthusiasm, provide engaging instruction, and foster a supportive learning environment are more likely to facilitate better understanding and achievement in electrolysis. Moreover, it was discovered that the teacher-student relationship plays a vital role in students' engagement and motivation. Educational strategies to improve teacher attitude and pedagogical approaches could enhance student outcomes in chemistry.

Based on the study's outcomes, the following recommendations were put forth.

1. The government should ensure that only trained teachers are recruited into the system during recruitment exercises because teaching is a sensitive and complex profession that is not meant for everyone.
2. Teachers should be given the opportunity to acquire higher training and retraining to be thoroughly grounded in their areas of specialty. The government should bear the cost of such training.
3. Professional bodies like STAN, EARNiA, etc. should organise training programs to help teachers improve by making them feel more positive and teaching them new methods, making learning more fun and effective for students.
4. Schools should create an environment that supports and rewards good teaching attitudes and new, creative teaching methods.
5. Future research should explore the impact of teacher attitudes on other challenging topics in chemistry and across different educational contexts.

Reference

Adeyemi, T. O., & Oyedeji, A. B. (2020). Teacher attitudes and electrolysis education in Nigerian secondary schools. Journal of Science and Technology Education Research, 11(3), 245-257.

Ajayi, V.O. (2021). Likelihood of upgrading students' problem-solving ability and self-confidence in stoichiometry and chemical reactions using chemometrics techniques. *International Journal of Science Education, 2*(3), 34-41.

Ajayi, V.O., & Angura, M.T. (2017). Improving senior secondary students' retention in electrolysis using collaborative concept mapping instructional strategy (CCMIS). *Greener Journal of Educational Research, 7*(6), 087-092.

Ajayi, V.O., & Ogbeba, J. (2017). Effect of gender on senior secondary chemistry students' achievement in stoichiometry using hands-on activities. *American Journal Educational Research, 5*(8), 839-842.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), Action control: From cognition to behavior (pp. 11-39). Springer.

Akinsola, M.K & Igwe, I.O (2002). The relative effect of metacognitive strategy of framing on students' achievement in selected difficult chemistry concepts. *Journal of the Science Teachers Association of Nigeria,*37,1&2, 20-28.

Akyüz, Y. (2019). *Türk eğitim tarihi* [History of Turkish education]. Pegem.

Aras, Ş., Ozan, S., Tımbıl, S., Şemin, S., & Kasapçı, O. (2016). Exposure of students to emotional and physical violence in the school environment. *Arch Neuropsychiatry, 53*(4), 303-310. https://doi.org/10.5152/npa.2016.11323

Boateng, E. K., & Owusu, A. A. (2022). Influence of teacher attitudes on students' performance in electrolysis in Ghanaian senior high schools. Journal of Educational Research and Practice, 12(1), 112-125.

Chory-Assad, R. M. (2002). Classroom justice: Perceptions of fairness as a predictor of student motivation, learning, and aggression. *Communication Quarterly, 50*(1), 58–77. https://doi.org/10.1080/01463370209385646

Efe, S., & Çalık, B. (2018). High school students' proficiency and confidence levels in electrolysis. Chemistry Education Research and Practice, 19(1), 134-145.

Erden, M., & Akgül, S. (2010). Predictive power of math anxiety and perceived social support from teacher for primary students' mathematics achievement. *Journal of Theory and Practice in Education*, *6*(1), 3-16.

Fayemi, N. N. (2016). Influence of sex difference of students on their academic performance in secondary school Electrolysis. *Jos Journal of Education*, *6*(2), 95-100.

Goodboy, A. K., & Bolkan, S. (2009). College teacher misbehaviors: Direct and indirect effects on student communication behavior and traditional learning outcomes. *Western Journal of Communication, 73*(2), 204–219. https://doi.org/10.1080/10570310902856089

Goodboy, A. K., Bolkan, S., &. Baker, J. P. (2018) Instructor misbehaviors impede students' cognitive learning: testing the causal assumption. *Communication Education, 67*(3), 308-329. https://doi.org/10.1080/03634523.2018.1465192

Goodboy, A. K, Bolkan, S., Shin, M., & Chiasson, R. M. (2022) Affective and interest consequences of lecture misbehaviors for students with mastery goals. *Communication Education, 71*(3), 223-243. https://doi.org/10.1080/03634523.2022.2070770

Goodboy, A. K., & Myers, S. A. (2015). Revisiting instructor misbehaviors: A revised typology and development of a measure. *Communication Education, 64*(2), 133-153, https://doi.org/10.1080/03634523.2014.978798

Haruna, M. A. (2018). Effect of fieldtrip model on students' academic performance in Electrolysis among upper basic students in Akwanga local government area of Nasarawa State. *Journal of Education and Practice, 22*(3), 103-114.

Huang, X., Wang, Y., & Liu, X. (2022). The impact of teacher attitudes on student outcomes in STEM education: A systematic review. Journal of Educational Psychology, 114(3), 439-448.

Kelsey, D. M., Kearney, P., Plax, T. G., Allen, T. H., & Ritter, K. J. (2004). College students' attributions of teacher misbehaviors. *Communication Education, 53*(1), 40-55. https://doi.org/10.1080/0363452032000135760

Keshavarz, S., Mohammadi, M., & Ahmadi, A. (2022). Applying the theory of planned behavior to investigate teachers' intention to use technology in the classroom. Journal of Educational Computing Research, 60(4), 419-435.

Kim, D. H., Kim, S. H., & Kim, J. S. (2015). Development and application of an electrolysis concept test. Journal of Chemical Education, 92(10), 1746-1753.

Klassen, R. M., & Tze, V. M. (2020). Teachers' self-efficacy and attitudes: A systematic review. Educational Psychology Review, 32(1), 1-23.

Koçak, S. & Bostancı, A. B. (2019). Social justice in classroom management. *Ankara University Journal of Faculty of Educational Sciences (JFES), 52*(3), 915-942. https://doi.org/10.30964/auebfd.597200

König, J., & Rothland, M. (2020). Teachers' attitudes and self-efficacy: A systematic review. Educational Research Review, 31, 100323.

Lee, J., Kim, J., & Lee, Y. (2022). Teacher attitudes towards STEM education: A comparative study of the United States, China, and South Korea. Journal of Educational Research, 115(4), 419-428.

Mbaba, J.O., & Omabe, C.C. (2012). Repositioning Electrolysis education to promote and sustain culture and values in Nigeria. *Nigerian Journal of Electrolysis,9*(1), 12-18.

McCroskey, J. C., Valencic, K. M., & Richmond, V. P. (2004). Toward a general model of instructional communication. *Communication Quarterly, 52*(3), 197–210. https://doi.org/10.1080/01463370409370192

Olorundare, A.S. (2017). Learning difficulties in science education: An analysis of the current trends. *Kwara State University International Journal of Education, 1*(1), 10-22.

Özdemir, S. & Sezgin, F. (2011). Primary school students' perceptions of principal and teacher support, perceived violence, and school satisfaction. *Inonu University Journal of the Faculty of Education*, *12*(2), 181-199.

Pianta, R. C., Hamre, B. K., & Allen, J. P. (2008). Teacher-Child Relationships and Engagement: The Importance of the Teacher's Attitude. Educational Psychologist, 43(1), 49-65.

Price, D. S., & Brooks, D. W. (2012). Extensiveness and perceptions of lecture demonstrations in the high school chemistry classroom. *Chemical Education Research and Practice, 13*, 420-427.

Sandi-Urena, S., Gallen, J., & Harrell, S. (2011). The Role of the Teacher's Attitude in Chemistry Education. Journal of Chemical Education, 88(5), 680-684.

Sezer, Ş. (2018). The effects of teachers' classroom management attitudes on students' development: a phenomenological analysis. *H. U. Journal of Education, 33*(2), 534-549. https://doi.org/10.16986/HUJE.2017031319

Szydlik, J., & Lumpe, J. (2006). Understanding Electrolysi: The Role of Teaching Methods. Chemistry Education Research and Practice, 7(1), 22-29.

Toropova, A., Myrberg, E., & Johnson, S. (2022). Teacher job satisfaction: the importance of school working conditions and teacher characteristics. Educational review, 73(1), 71-97.

Tunçel, H. (2015). The role of academic performance in social life. *Journal of Personality and Social Psychology, 2*(10), 61-72.

Vallade, J. I. (2021) Instructor misbehavior frequency, severity, and impact on learning: Comparing student and teacher perceptions. *Western Journal of Communication*, *85*(2), 275-298, https://doi.org/10.1080/10570314.2020.1756397

Wang, Y., Liu, X., & Zhang, Y. (2022). Teacher attitudes and STEM education: A systematic review. Journal of Teacher Education, 73(2), 157-168.

Wang, J., & Hall, N. C. (2020). Teacher self-efficacy and attitude: A reciprocal relationship. Journal of Educational Psychology, 112(4), 531-544.

Wubbels, T., & Brekelmans, M. (2005). Two decades of research on teacher–student relationships in class. *International Journal of Educational Research, 43*(1-2), 6-24. https://doi.org/10.1016/j.ijer.2006.03.003

Yurtal, F., & Artut, K. (2010). An investigation of school violence through Turkish children's drawings. *Journal of Interpersonal Violence, 25*(1), 50-62. https://doi.org/10.1177/0886260508329130

Yusuf, T. O., & Adedeji, T. (2020). Influence of teachers' attitude on students' academic performance in mathematics. Journal of Educational Research and Review, 8(2), 23-31.

Zhang, Q. (2007). Teacher misbehaviors as learning demotivators in college classrooms: A cross-cultural investigation in China, Germany, Japan, and the United States. *Communication Education,* 56, 209–227. https://doi.org/10.1080/03634520601110104

Zhang, Y., Zhang, J., & Liu, X. (2020). Applying the theory of planned behavior to understand students' intention to engage in environmental behavior. Journal of Environmental Education, 51(4), 269-283.

Zudonu, O. C. & Njoku, Z. C. (2018). Effects of Laboratory Instructional Methods on Students' Attitudes in some Chemistry Concepts at Senior Secondary School Level. Global Scientific Journals (GSJ). ISSN 2320-9186 (online). Vol. 6, Issue 7. (page 46-61). www.globalscientificjournal.com