Effects of Anchor Activities on Senior Secondary Two Students' Interest and Achievement in Chemical Kinetics in Shendam, Plateau State, Nigeria

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Abstract

This study investigates the effects of anchor activities on the interest and academic achievement of Senior Secondary Two (SS2) students studying Chemical Kinetics in Shendam, Plateau State, Nigeria. Forty students from two co-educational secondary schools in the Shendam Education Zone participated. A quasi-experimental design, guided by six research questions and four hypotheses, was employed. The experimental group engaged in lessons with anchor activities, while the control group was taught using traditional methods. The Chemistry Achievement Test (CAT) and the Chemical Interest Inventory (CII) were used as measurement tools. Over a period of four weeks, tailored lesson plans were implemented. The results revealed higher academic achievement among students exposed to anchor activities, suggesting that such activities could enhance learning outcomes in secondary school chemistry.

Keywords: Anchor, Anchor activities, Chemical kinetics, Achievement.

Introduction

Chemistry, an essential subject in Nigeria's senior secondary curriculum, plays a crucial role in shaping advancements in science and technology. Investigating the properties, composition, and transformations of matter, it influences both natural phenomena and societal progress. Referred to as the "central science," its principles underpin disciplines like biology and physics, driving innovations such as automobiles and computers (Chang, 2010). To foster sustainable development and nation-building, effective instructional methods are imperative to engage students and enhance their interest and achievement in Chemistry. However, concerns persist among science educators regarding students' consistently low performance and lack of enthusiasm in senior secondary Chemistry (Ifeakor, 2006; Mari, 2002; Njoku, 2002 and 2009; Nwachukwu 2008). Various factors contribute to this, including teaching approaches, complex topics, and inadequate resources (Nzewi, 2010). Often perceived as challenging due to its specialized vocabulary and abstract concepts, Chemistry suffers from declining enrollment in tertiary courses and recurring examination difficulties, hindering national progress in Science and Technology (West African Examination Council, 1992, 2003, 2006, 2012). Addressing these challenges

requires innovative pedagogical strategies to unlock students' potential and sustain their interest in Chemistry, ensuring a brighter future for Nigeria's scientific landscape (Nzewi, 2010).

Chemical kinetics, a crucial aspect of senior secondary school Chemistry, serves as a cornerstone in understanding the dynamic nature of matter. Despite its significance, its incorporation into the curriculum remains relatively limited. Studies conducted by Karous (2017, as cited in Maikano, 2010) underscore the challenge students encounter in comprehending abstract Chemistry concepts like chemical kinetics. Modern science educators, as highlighted by Chukwu, Mwanse, and Duguryil (2009), must adopt instructional approaches that promote comprehension and foster enthusiasm. Attamah (2012) emphasizes the importance of tailoring learning activities to match learners' attention spans and interests, taking their age into account. Agoro and Oyediran (2009) contend that traditional teaching methods fail to engage students effectively. Instead, a hands-on, minds-on approach advocated by Datom (2015) actively involves students in hypothesis formulation, experimental design, and data interpretation, enhancing their engagement and comprehension. Integrating practical demonstrations into Chemistry teaching augments student interest and understanding, aligning with contemporary pedagogical practices.

Gender dynamics significantly influence science education, shaping career choices and reinforcing stereotypes, as posited by Datom (2015) and several scholars. Science and technology are often perceived as male-dominated domains, with males exhibiting more favorable attitudes towards technical subjects compared to females, who may harbor negative perceptions due to societal gender myths (Babajide, 2010). School location emerges as a critical factor in ensuring quality education, especially for secondary students facing long commutes, as noted by Mhiliwa (2015) and Maizuwo (2011). Proximity to students' homes correlates with improved academic performance (Raychaudhuri et al., 2010), necessitating an understanding of and response to the impact of school location on student outcomes for effective education and workforce development.

Anchor activities, ongoing independent tasks linked to the curriculum, offer enrichment opportunities for students and can be pursued during downtime, as suggested by Tomlinson (2012). While not essential for successful group work, they establish expectations that encourage students to maximize learning opportunities. Investigating the impact of anchor activities on student interest and achievement in chemical kinetics is imperative given persistent challenges in teaching complex Chemistry concepts (Ezeliora, 2003; Ikechukwu, 2011). The adoption of innovative instructional strategies, such as the Anchor Activity approach, is essential for addressing recurring challenges in Chemistry education in Nigerian secondary schools (Nzewi, 2010; Tajuden, 2005; Kozma & Russell, 2004; Ezeliora, 2008). This study aims to explore the effect of anchor activities on senior secondary two students' interest and achievement in Chemical Kinetics in Chemistry.

The aim of the study is to determine the effects of anchor activities on senior secondary two students' interest and achievement in chemical kinetics. In specific terms, the specific objectives of the study are to:

1) determine the effects of anchor activities on the achievement of Senior Secondary Two students in chemical kinetics.
2) ascertain the effects of anchor activity on the interests of Senior Secondary Two students in chemical kinetics.

3) find out the effects of anchor activity on the achievement of Senior Secondary Two male and female students in chemical kinetics.
4) investigate the effects of anchor activity on the interest of Senior Secondary Two male and female students in chemical kinetics.
5) explore the effects of anchor activity on the achievement of Senior Secondary Two urban and rural students in chemical kinetics.
6) examine the effects of anchor activity on the interests of Senior Secondary Two urban and rural students in chemical kinetics.

The research will raise the following questions:

1. What are the mean achievement scores of Senior Secondary School Two students taught chemical kinetics using anchor activities and conventional teaching method?
2. What are the mean interest scores of Senior Secondary School Two students taught chemical kinetics using anchor activities and conventional teaching method?
3. What are the mean achievement scores of Senior Secondary School Two male and female students taught chemical kinetics using anchor activities and conventional teaching method?
4. What are the mean interest scores of Senior Secondary School Two male and female students taught chemical kinetics using anchor activities and conventional teaching method?
5. What are the mean achievement scores of Senior Secondary School Two urban and rural students taught chemical kinetics using anchor activities and conventional teaching method?
6. What are the mean interest scores of Senior Secondary School Two urban and rural students taught chemical kinetics using anchor activities and conventional teaching method?

The following hypotheses will be tested at 0.05 level of significance:

Ho_1: There is no significant difference in the mean achievement scores of students taught chemical kinetics using anchor activities and those taught with conventional teaching method.

Ho_2: There is no significant difference in the mean achievement scores of male and female students taught chemical kinetics using anchor activity and conventional teaching method.

Ho_3: There is no significant difference in the mean interests scores of students taught chemical kinetics using anchor activity and conventional teaching method.

Ho_4: There is no significant difference in the mean achievement scores of urban and rural students taught chemical kinetics using anchor activity and conventional teaching method.

Methodology

The research study utilized a quasi-experimental design. Due to constraints subjects were assigned to experimental and control groups based on existing class groupings, resulting in a non-equivalent control group design. This approach aligns with Njoku (2009:391) and Ikechukwu

(2011), who noted the feasibility of deliberate control and manipulation in quasi-experimental designs. The study population consisted of 759 Senior Secondary Two (SS2) students studying Chemistry in sixteen Public Secondary Schools in Shendam LGA of Plateau State during the 2017/2018 academic session. SS2 was chosen as the population because the concepts under investigation (chemical kinetics) are part of the SS2 curriculum. The sample comprised 40 SS2 Chemistry students from four schools, with 24 students in the experimental group and 16 in the control group. The experimental and control groups were drawn from different schools: CKCC Shendam (14 respondents), OLFGSS Shendam (11 respondents), GSS Yelwa (7 respondents), and GSS Kalong (8 respondents).

Three instruments were employed in gathering data for the research. These are:

1. Chemistry Achievement Test (CAT).
2. Chemistry Interest Inventory (CII).
3. Lesson plans for anchor-activity and conventional teaching methods.

The Chemistry Achievement Test (CAT) and Chemistry Interest Inventory (CII) underwent face validity with two University of Jos experts—one from science education (Chemistry) and another from measurement and evaluation. CAT's content validity relied on the test blueprint. Pilot testing on SS2 students at Government Secondary School Zomo, Mikang Education Zone, established internal consistency using Kuder-Richardson Formula 20 (K-R, 20), yielding a reliability index of 0.85. CII underwent trial testing at the same school, resulting in a high reliability index of 0.87 via Cronbach's Alpha Reliability Coefficient. (References: University of Jos experts, Government Secondary School Zomo, Mikang Education Zone)

Results

Data was collected from chemistry students in selected senior secondary schools in Plateau State to examine the impact of anchor activities on chemical kinetics achievement and interest. The study involved 40 students, with 24 in the experimental group and 16 in the control group. Analysis of the data, presented in appendices, included frequency and percentages of personal variables, answers to research questions using anchor activities mean and standard deviations, and interpretation of four null research hypotheses using inferential statistical techniques. The findings revealed that anchor activities significantly improved both interest and achievement in chemical kinetics.

Research Question One

What are the mean achievement scores of Senior Secondary School Two students taught chemical kinetics using anchor activities and conventional teaching method?

Table 1: Pre-test and Post-test Mean Achievement Scores and Standard Deviations by Treatment

Treatment group	Pre – achievement		Post – achievement		Mean Gain score	No. of Students
	Mean	Std. deviation	Mean	Std. deviation		
Anchor activity	20.79	3.39	30.25	3.36	9.46	24
Conventional learning	18.69	2.06	21.88	2.99	3.19	16

Table 1 illustrated that students instructed with anchor activities had the highest mean score of 20.79 in the pretest, deviating most from the mean with a standard deviation of 3.39. Conversely, those taught conventionally scored lowest at 18.69, with the least deviation of 2.06. In the post test, anchor activity students scored highest at 30.25, deviating most at 3.36, while conventional method students scored 21.88 with a deviation of 2.99. Mean gains for anchor activities and conventional methods were 9.46 and 3.19 respectively, suggesting anchor activities are more effective in teaching chemical kinetics.

Research Question Two:

What are the mean interest scores of Senior Secondary School Two students taught chemical kinetics using anchor activities and conventional teaching method?

Table 2: Mean Interest Scores and Standard Deviations Before and After Treatments

Treatment group	Pre – Interest		Post – Interest		Mean gain score	No. of Students
	Mean	Std. deviation	Mean	Std. deviation		
Anchor activity	21.63	2.87	27.83	5.87	6.20	24
Conventional learning	20.31	1.52	17.00	2.46	3.31	16

Table 2 indicates minimal difference between mean interest scores of students taught via anchor activity strategy and conventional teaching method in the pretest (21.63 vs. 20.31). However, in the post test, students taught with anchor activities had higher mean interest scores (27.83 vs. 17.00) with greater deviation from the mean (6.20 vs. 3.31). Anchor activities showed higher mean gain scores (9.46 vs. 3.19), suggesting effectiveness in enhancing student interest in chemical kinetics and other chemistry concepts.

Research question 3:

What are the mean achievement scores of Senior Secondary School Two male and female students taught chemical kinetics using anchor activities and conventional teaching method?

Table 3: Pretest and Post-test Mean Achievement Scores by Treatment for Male and Female Students

Treatment group	Gender	Pre – achievement		Post - achievement		Mean gain score	No. of Students
		Mean	Standard deviation	Mean	Standard deviation		
Anchor activity	Male	21.85	8.82	30.00	4.81	8.15	13
	Female	19.55	12.24	29.64	5.01	10.09	11
Conventional learning	Male	21.43	4.28	21.71	2.89	0.28	7
	Female	19.56	2.65	20.67	2.11	1.11	9

In Table 3, male students taught using the anchor activity teaching strategy achieved the highest pretest mean score of 21.85, with the lowest deviation from the mean (standard deviation: 8.82). Conversely, female students under the same treatment scored 19.55 on average, deviating the most from the mean (standard deviation: 12.24). Similarly, in the post-test, males taught using the anchor activity learning had the highest mean score (30.00) with a slightly lower deviation

(standard deviation: 4.81), while females scored 29.64 (standard deviation: 5.01). Notably, after treatment, male students demonstrated the greatest improvement in the anchor activity learning group, indicating its superiority over the lecture method in enhancing male students' understanding of Chemical Kinetics in chemistry.

Research Question 4:

What are the mean interest scores of Senior Secondary School Two male and female students taught chemical kinetics using anchor activities and conventional teaching method?

Table 4: Post-Treatment Mean Interest Scores and Standard Deviations by Gender

Treatment group	Gender	Pre – interest		Post – interest		Mean gain score	No. of Students
		Mean	Standard deviation	Mean	Standard deviation		
Anchor activity	Male	21.77	7.74	30.00	4.81	8.23	13
	Female	21.07	4.43	30.55	3.87	9.48	11
Conventional learning	Male	21.42	4.11	21.43	6.49	0.10	7
	Female	21.14	2.63	21.11	4.50	0.03	9

Table 4 findings indicate that male students taught with the anchor activity method had the highest mean interest score (21.77) in the pretest, but also the highest deviation from the mean (7.74). Conversely, females under the same method scored slightly lower (21.07) with less deviation (4.43). Male students taught via lecture had a mean interest score of 21.42, females 21.14. Post-treatment, males with anchor activity scored lower (30.00, deviation 4.81), while females scored higher (30.55, deviation 3.87), suggesting its effectiveness, especially for females in learning Chemical Kinetics.

Research Question 5:

What are the mean achievement scores of Senior Secondary School Two urban and rural students taught chemical kinetics using anchor activities and conventional teaching method?

Table 5: Mean achievement scores and standard deviations of students in pre-tests and post-tests due to treatments

Treatment group	Location	Pre – achievement		Post - achievement		Mean gain score	No. of Students
		Mean	Standard deviation	Mean	Standard deviation		
Anchor activity	Urban	20.79	3.39	31.62	2.06	10.83	13
	Rural	19.55	3.15	28.63	2.24	9.08	08
Conventional learning	Urban	18.69	2.06	21.88	2.99	3.19	12
	Rural	16.24	3.30	21.49	3.69	5.25	08

Table 5 illustrates that urban school students taught with anchor activities had the highest mean achievement score of 20.79 (SD = 3.39) in the pretest, while rural school students using the same strategy had the lowest mean score of 19.55 (SD = 3.15). Conversely, in conventional teaching,

urban students scored 18.69 (SD = 2.06) compared to rural students at 16.24 (SD = 3.30). Post-test results showed urban anchor activity students scored 31.62 (SD = 2.06) versus rural students at 28.63 (SD = 2.24). In the conventional method, urban students scored 21.88 (SD = 2.99) and rural students scored 21.49 (SD = 3.69). Urban students' anchor activity mean gain was 10.83, while rural students gained 9.08. Overall, anchor activities appear more effective in teaching chemical kinetics and other chemistry concepts in urban schools compared to rural ones.

Research Question 6:

What are the mean interest scores of Senior Secondary School Two urban and rural students taught chemical kinetics using anchor activities and conventional teaching method?

Table 6: Mean Differences in Interest Scores for SS2 Urban and Rural Students Taught Chemical Kinetics.

Treatment group	Location	Pre – interest		Post – interest		Mean gain score	No. of Students
		Mean	Standard deviation	Mean	Standard deviation		
Anchor activity	Urban	20.11	3.30	30.25	3.36	7.14	13
	Rural	22.25	3.87	30.71	2.88	9.16	08
Conventional learning	Urban	18.69	2.16	22.01	2.99	3.19	12
	Rural	18.40	2.05	21.54	3.69	5.25	08

Table 6 illustrates the interest levels of Urban and Rural Senior Secondary School Students using the Anchor Activity teaching method. In the pretest, Urban students had a mean interest score of 20.11, while Rural students had 22.25. Both locations showed similar interest levels. Post-test scores increased significantly, with Urban students at 30.25 and Rural students at 30.71. These scores surpassed those of the conventional learning group. The Anchor Activity method evidently enhances student interest, irrespective of location.

Testing Research Hypotheses

Hypotheses One

There is no significant difference in the mean achievement scores of students taught chemical kinetics using anchor activities and those taught with conventional teaching method.

Table 7: T-Test Sample Statistics: Chemistry Achievement in Experimental vs. Control Groups Post-Treatment.

Variable	N	Mean	Std. Dev	Df	t – Calculated	t – Critical
Experimental	24	30.25	3.36	78	12.15	1.99
Control	16	21.88	2.99			

Calculated t > 1.99

Table 7's t-Test shows a notable difference in academic performance between senior secondary students. Those taught with Anchor Activity (experimental) scored differently from those taught traditionally (control). With a t-calculated value (12.15) exceeding the t-critical value (1.99) at df 78, the null hypothesis is rejected. This confirms the significance of the difference in mean achievement scores.

Hypotheses Two

There is no significant difference in the mean achievement scores of male and female students taught chemical kinetics using anchor activity and conventional teaching method.

Table 8: Gender Comparison: CAT Posttest Mean Scores for Experimental Group in Chemistry

Variable	N	Mean	Std. Dev	Df	t – Calculated	t – Critical
Experimental (Male)	13	30.00	4.81	46	0.23	2.01
Experimental (Female)	11	29.64	5.01			

Calculated t < 2.01

Table 8's t-Test findings suggest minimal difference in academic achievement between male and female senior secondary school students. This is supported by a calculated t-value of 0.23 (df 46), lower than the critical t-value of 2.01. Mean achievement scores in chemical kinetics for males (30.00) and females (29.64) also align. Thus, hypothesis two, indicating insignificant gender-based score differences, is accepted.

Hypotheses Three:

There is no significant difference in the mean interests scores of students taught chemical kinetics using anchor activity and conventional teaching method.

Table 9: T-Test Comparison of Posttest Mean Interest Scores: Experimental vs. Control Groups in CII

Variable	N	Mean	Std. Dev	Df	t – Calculated	t – Critical
Experimental	24	27.83	5.87	78	10.77	1.99
Control	16	17.00	2.46			

Calculated t > 1.99

Table 9's t-Test results show a notable difference in senior secondary students' interest scores between Anchor Activity and conventional teaching methods. With a calculated t-value of 10.77 surpassing the critical value of 1.99 at df 78, hypothesis three is rejected. This confirms the significant impact of Anchor Activities on students' interest in chemical kinetics in Shendam, Plateau State.

Hypotheses Four

There is no significant difference in the mean achievement scores of urban and rural students taught chemical kinetics using anchor activity and conventional teaching method.

Table 10: T-Test Comparison of Urban and Rural Students' Posttest Achievements in Chemistry CAT with Anchor Activity

Variable	N	Mean	Std. Dev	Df	t – Calculated	t – Critical
Experimental (Urban)	13	31.62	2.06	40	6.22	2.02
Experimental (Rural)	8	28.63	2.24			

Calculated t > 2.02

Table 10's t-Test results reveal a notable variance in mean achievement scores between Urban and Rural senior secondary school students. Those taught via Anchor Activity (experimental) differed

significantly from the conventional method (control), with t-calculated (6.22) exceeding t-critical (2.02) at df 40. Urban students achieved a mean score of 31.63, while Rural students scored 28.63. The 0.05 significance level indicates the urban group benefited significantly from the Anchor Activity method, rejecting Null hypothesis 4.

Discussion

Table 7 demonstrates a notable enhancement in students' achievement in Chemical Kinetics through the implementation of the Anchor Activity learning approach compared to traditional lectures. This suggests that adopting a learner-centered and interactive strategy like Anchor Activity could effectively bolster Chemistry education objectives across various concepts. This finding aligns with the advocacy for innovative teaching methods in science, technology, and mathematics education, as learner-centered approaches actively involve students and aid comprehension of complex concepts. Furthermore, it resonates with the National Policy on Education's emphasis on learner-centered teaching in Chemistry for self-development and fulfillment. Given the practical nature of chemical kinetics and other intricate Chemistry concepts, active learner participation is crucial; a component often lacking in traditional lecture-based teaching. Table 8 indicates that gender did not significantly influence students' achievement in Chemical Kinetics across instructional approaches, affirming that teaching strategies do not favor one gender over another. Anchor Activity had a comparable effect on both male and female students, suggesting that both genders respond positively to activity-based teaching. Conversely, traditional lectures may hinder achievement in Chemical Kinetics regardless of gender. Similarly, Table 5 reveals that gender had no notable effect on students' interest, and teaching strategies did not significantly influence interest levels. Both sexes exhibited equal enthusiasm for Anchor Activity, likely due to its engaging nature, while students' pre-existing interest in Chemistry mitigated the impact of teaching strategies relative to gender. Table 9 demonstrates that Anchor Activity substantially increased students' interest in learning challenging Chemistry concepts compared to traditional lectures. The interactive nature of Anchor Activity captivated students, fostering engagement despite the subject's complexities. Conversely, traditional teaching methods failed to engage students due to their limited interactivity. Lastly, Table 10 indicates no significant difference in achievement between urban and rural students when taught using Anchor Activity, highlighting its consistent effectiveness across diverse educational settings. In conclusion, these findings underscore the efficacy of the Anchor Activity teaching strategy in enhancing both achievement and interest in learning challenging Chemistry concepts, advocating for more learner-centered approaches in science education.

Conclusion

The study's comprehensive findings determined that employing a student-centered teaching approach known as the Anchor Activity is effective in enhancing academic achievement in Chemical Kinetics for both male and female students. Gender did not influence the effectiveness of this strategy, indicating its universality in teaching challenging Chemistry concepts. Regardless of school location—urban or rural—the Anchor Activity approach proved highly effective in improving academic performance. Furthermore, it significantly increased SS2 students' interest in Chemistry, irrespective of gender or location. Compared to conventional lecture methods, Anchor Activity learning consistently yielded superior academic outcomes, highlighting its value in sustaining student engagement and comprehension. Given its proven effectiveness, prioritizing the integration of Anchor Activity learning in the Chemistry curriculum is essential for achieving

educational objectives and addressing persistent challenges in student performance. Teachers are encouraged to leverage this approach to enhance Chemistry education outcomes at the senior secondary level.

Recommendations

Based on the research findings, the following recommendations are proposed to address the consistent underperformance of senior secondary school students in Chemistry:

1) Integrate Anchor Activity into the Chemistry curriculum to supplement traditional lecture-based teaching methods, as it has shown to improve academic outcomes. This approach should be emphasized in curriculum materials such as textbooks.
2) Implement Anchor Activity teaching across genders and school types, including both urban and rural settings.
3) Facilitate teacher training workshops and seminars on Anchor Activity teaching methods, sponsored by relevant stakeholders in Chemistry education, including education ministries, school boards, and professional associations like STAN.
4) Promote Anchor Activity learning through professional associations like STAN, utilizing platforms such as seminars, workshops, conferences, and publications to raise awareness and provide training.
5) Advocate for the inclusion of Anchor Activity in teacher training standards set by bodies like NCCE and NUC, ensuring future educators are equipped to effectively utilize this method in teaching Chemistry and other challenging subjects.
6) Allocate resources to ensure schools in Plateau state have the necessary facilities and support for implementing Anchor Activity teaching methods effectively in Chemistry classes.

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