Effect of Peer Assessment Technique on Secondary School Students' Achievement, Interest and Study Habit in Chemistry

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ABSTRACT

This study investigated the effect of peer assessment technique on secondary school students' achievement, interest, and study habits in chemistry in Anambra State, Nigeria. Using a quasi-experimental research design, 240 senior secondary school two (SS2) chemistry students from eight randomly selected schools were assigned to experimental and control groups. The experimental group utilized peer assessment techniques while the control group used conventional assessment methods. Three instruments were developed: Chemistry Achievement Test (CAT), Chemistry Interest Scale (CIS), and Chemistry Study Habit Inventory (CSHI). Data analysis employed mean, standard deviation, and Analysis of Covariance (ANCOVA). Results revealed that students exposed to peer assessment techniques significantly outperformed those taught using conventional technique in achievement ($F=27.42$, $p<0.05$), demonstrated increased interest in chemistry ($F=19.86$, $p<0.05$), and developed better study habits ($F=23.15$, $p<0.05$). The study recommends the integration of peer assessment techniques into chemistry teaching to enhance student performance and engagement in Anambra State secondary schools.

Keywords: Peer assessment, Chemistry education, Student achievement, Interest, Study habits, Secondary education, Anambra State

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INTRODUCTION

The importance of chemistry education in national development cannot be overstated, particularly in developing countries like Nigeria where scientific and technological advancement is crucial for economic growth. Chemistry, as a central science, connects physical sciences with life sciences and applied sciences, providing foundational knowledge for technological innovation, industrial processes, and environmental management (Mbajiorgu & Reid, 2006). Despite its significance, student performance in chemistry at the secondary school level in Nigeria has

remained concerning. Recent WAEC Chief Examiners' reports from 2017-2024 indicate that chemistry students' performance has been fluctuating, with most years showing performance below 50% (WAEC, 2024). This pattern persists in Anambra State, where the need for improved instructional strategies remains critical.

Research studies have consistently highlighted the role of assessment techniques in influencing learning outcomes (Hattie & Timperley, 2007; Wiliam, 2011). Assessment for learning, rather than assessment of learning, has emerged as a critical paradigm shift in contemporary education (Stiggins, 2002; Al-Smadi & Osman, 2015). Nevertheless, conventional assessment methods, characterized by teacher-centred evaluation focusing primarily on summative aspects, have dominated Nigeria's educational landscape (Osadebe, 2014; Ibrahim, 2015). These traditional approaches often fail to actively engage students in the assessment process, potentially limiting their achievement, interest, and development of effective study habits. As Carless (2015) argues, assessment practices should not merely measure learning but should themselves be learning opportunities.

Peer assessment, an alternative approach where students evaluate the work of their peers based on predefined criteria, has gained increasing attention in educational research globally (Topping, 2009; Panadero, 2016). This technique transfers some assessment responsibility to learners, fostering collaboration, critical thinking, and metacognitive skills. Peer assessment aligns with contemporary educational philosophies that emphasize active student participation in learning (Reinholz, 2016; Boud & Soler, 2016). Research by van Zundert et al. (2010) and Gielen et al. (2011) has documented positive effects of peer assessment on student learning outcomes across various educational contexts. Cheung (2018) identified key factors affecting Hong Kong secondary students' interest in chemistry, including perceived relevance, self-efficacy, and peer assessment practices that emphasized conceptual understanding. The relationship between assessment approaches and interest development has been explored by Harris et al. (2014), who found that students' emotional responses to assessment significantly influenced their engagement with subject matter. Chin and Teou (2009) demonstrated that formative assessment techniques improved both performance and interest in Chemistry among secondary students. Also, Lee (2017) argued that assessment practices signal to students what types of learning are valued, thereby shaping their study approaches. According to Lee (2017), assessment procedures influence students' study habits by letting them know what kinds of learning are appreciated. While research on peer assessment has grown internationally, there remains limited empirical evidence on its effectiveness within the Nigerian context (Adeyemi, 2015; Onyia, 2015), particularly in chemistry education in Anambra State.

The significance of science education and chemistry in particular for the advancement of the country is emphasized in the Nigerian educational system, which is regulated by the National Policy on Education. But as Jack (2017) and Mamba and Putsoa (2018) point out, there is frequently a discrepancy between classroom practices and educational policies when it comes to teaching Chemistry. This study fills this

knowledge vacuum by examining the ways in which peer evaluation techniques affect the academic achievement, interest, and study habits of secondary school Chemistry students in Anambra State. Particularly in Anambra State, where enhancing science education is a stated priority in the state's education strategic plan, the findings may offer insightful information to chemistry teachers, curriculum developers, and education policymakers looking to improve learning outcomes in science education (Ofoegbu, 2015).

Literature Review

Theoretical Framework

This study is anchored in three major learning theories: social constructivism, self-regulated learning theory, and formative assessment theory. Vygotsky's social constructivism emphasizes that learning occurs through social interaction and collaboration within the learner's zone of proximal development (ZPD). Peer assessment aligns with this theory as it creates opportunities for students to construct knowledge collectively through evaluating and providing feedback on peers' work (Kollar & Fischer, 2010). The dialogic nature of peer assessment, as highlighted by van Gennip et al. (2010), facilitates the social construction of knowledge and supports development within the ZPD. Three main learning theories serve as the foundation for this investigation: formative assessment theory, self-regulated learning theory, and social constructivism. Social contact and teamwork within the learner's zone of proximal development (ZPD) are key components of Vygotsky's social constructivism. This notion is supported by peer evaluation, which gives students the chance to build knowledge collaboratively by assessing and commenting on each other's work (Kollar & Fischer, 2010). According to van Gennip et al. (2010), the dialogic character of peer evaluation promotes growth within the ZPD and makes it easier for knowledge to be socially constructed.

Zimmerman's self-regulated learning theory posits that learners who monitor, regulate, and control their cognition, motivation, and behaviour achieve better learning outcomes (Zimmerman, 2000). Peer assessment potentially enhances self-regulation by encouraging students to reflect on their learning processes and outcomes (Panadero et al., 2017). As Ramdass and Zimmerman (2011) argue, involvement in assessment activities helps students develop metacognitive awareness and self-regulatory strategies that are transferable across learning situations. According to Zimmerman's self-regulated learning theory, students who keep an eye on, manage, and exert control over their motivation, behavior, and thought processes learn more effectively (Zimmerman, 2000). By allowing students to reflect on their learning outcomes and processes, peer assessment may improve self-regulation (Panadero et al., 2017). According to Ramdass and Zimmerman (2011), students who participate in assessment activities gain self-regulation skills and metacognitive awareness that they may use in a variety of learning contexts.

Additionally, this study draws on formative assessment theory as articulated by Wiliam and Thompson (2007), which emphasizes the importance of feedback loops in

promoting learning. Peer assessment exemplifies the formative use of assessment, where feedback becomes a tool for learning improvement rather than merely a judgment of performance (Nicol & Macfarlane-Dick, 2006; Wiliam, 2011). The integration of these theoretical perspectives provides a robust foundation for understanding the potential impact of peer assessment on student outcomes. Wiliam and Thompson's (2007) formative assessment theory, which highlights the value of feedback loops in fostering learning, is another source of inspiration for this work. The formative use of assessment, when feedback becomes a tool for learning improvement rather than just a performance evaluation, is best illustrated via peer assessment (Nicol & Macfarlane-Dick, 2006; Wiliam, 2011). A strong basis for comprehending the possible influence of peer evaluation on student achievements is provided by the confluence of different theoretical viewpoints.

Peer Assessment in Education

Peer assessment refers to an arrangement where individuals consider the level, value, worth, quality, or success of the products or outcomes of learning of peers of similar status (Topping, 2018). It involves students taking responsibility for assessing the work of their peers against set assessment criteria. Research by Adediwura (2015) suggests that peer assessment promotes active learning by engaging students in critical reflection and evaluation, leading to deeper understanding of subject matter.

Several studies have highlighted the benefits of peer assessment in educational settings. Falchikov and Goldfinch (2000) found strong correlations between peer and teacher assessments, suggesting that with proper guidelines, students can make reliable judgments about their peers' work. A comprehensive review by van Zundert et al. (2010) identified factors influencing the effectiveness of peer assessment, including training, task structure, and interpersonal variables. Dochy et al. (2013) documented positive effects of peer assessment on higher-order thinking skills across multiple educational contexts.

The implementation of peer assessment has evolved considerably, with various approaches documented in the literature. Gielen et al. (2011) developed a taxonomy of peer assessment diversity, identifying sixteen key dimensions including scope, privacy, direction, and reward systems. Reinholz (2016) proposed the assessment cycle model, emphasizing the iterative nature of effective peer assessment that involves task understanding, performance assessment, feedback generation, and feedback implementation. Liu and Carless (2006) distinguished between peer assessment (involving grading) and peer feedback (focusing on qualitative comments), noting that both have distinct benefits for learning.

Despite these potential benefits, research by Panadero and Brown (2017) found that teachers' adoption of peer assessment often depends on their previous positive experiences and training. Sluijsmans et al. (2002) emphasized that proper training in peer assessment strategies is crucial for both teachers and students to maximize its effectiveness. These considerations are particularly relevant in contexts like Nigeria, where traditional assessment approaches remain prevalent (Adeyemi,

2015).

Chemistry Achievement and Assessment Techniques

Student achievement in chemistry has been linked to various factors, including teaching methods and assessment techniques. A study by Nbina and Obomanu (2011) in Nigeria reported that alternative assessment approaches improved students' chemistry performance compared to traditional methods. Similarly, Okwuduba and Okigbo (2018) found that innovative assessment techniques significantly enhanced students' achievement in chemistry in eastern Nigeria.

Chemistry, with its abstract concepts and representational nature, presents unique learning challenges that may benefit from alternative assessment approaches. Jack (2017) demonstrated that constructivist approaches to chemistry teaching and assessment significantly improved student performance in northeastern Nigeria. Njoku and Ezinwa (2014) specifically compared peer-teaching with teacher-centred instruction in chemistry, finding significant advantages for peer-based approaches in terms of both immediate achievement and retention of concepts.

In Anambra State specifically, Ezeudu and Obi (2013) identified poor teaching methodologies and assessment practices as contributors to underachievement in chemistry. Nnorom (2015) reported that cooperative learning strategies improved biology performance among secondary school students in Anambra State, suggesting that similar collaborative approaches might be effective for chemistry. Mamba and Putsoa (2018) argue that assessment practices in chemistry education across sub-Saharan Africa often focus excessively on recall at the expense of conceptual understanding and scientific skills development. However, research specifically examining peer assessment in chemistry education within Anambra State remains scarce.

Interest in Chemistry Learning

Student interest plays a crucial role in academic achievement. According to Hidi and Renninger's (2006) four-phase model of interest development, interest evolves from triggered situational interest to well-developed individual interest through appropriate educational interventions. Peer assessment may influence interest development through increased engagement and ownership of the learning process, potentially facilitating the transition from situational to individual interest (Thomas et al., 2011).

Several studies have examined factors influencing interest in science subjects. Okigbo and Okeke (2011) found that game-based and analogical approaches enhanced students' interest in mathematics among Nigerian students. Akporehwe and Onwioduokit (2013) reported that collaborative assessment approaches enhanced students' interest in physics, a related science subject. For chemistry specifically, Cheung (2018) identified key factors affecting Hong Kong secondary students' interest in chemistry, including perceived relevance, self-efficacy, and assessment practices that emphasized conceptual understanding.

The relationship between assessment approaches and interest development has been explored by Harris et al. (2014), who found that students' emotional responses to

assessment significantly influenced their engagement with subject matter. Chin and Teou (2009) demonstrated that formative assessment techniques improved both performance and interest in science among secondary students. The extent to which peer assessment specifically influences chemistry interest among Anambra State students warrants investigation, particularly given the documented decline in science interest among Nigerian secondary students (Taiwo, 2014).

Study Habits and Academic Performance

Study habits encompass students' routine practices and strategies for learning, including time management, note-taking, concentration, and exam preparation. Effective study habits have been consistently associated with better academic performance across subjects, including chemistry (Okoye, 2015; Ebele & Olofu, 2017).

Oluwatimilehin and Owoyele (2012) found that study habits significantly predicted academic performance among Nigerian secondary school students. Udoukpong and Okon (2012) identified positive correlations between study habits and economics achievement among secondary school students in Nigeria. In chemistry education specifically, Okwara and Upu (2017) reported that structured study habits improved students' chemistry performance in Nigerian schools.

The development of effective study habits is influenced by various factors, including assessment practices. Ajogbeje and Alonge (2012) found that feedback mechanisms significantly impacted how students approached subsequent learning tasks. Research by Chang and Tseng (2011) demonstrated that portfolio assessment approaches influenced students' adoption of more sophisticated learning strategies. Lee (2017) argued that assessment practices signal to students what types of learning are valued, thereby shaping their study approaches. According to Lee (2017), evaluation procedures influence students' study habits by letting them know what kinds of learning are appreciated. However, the relationship between peer assessment and the development of effective study habits in chemistry learning remains underexplored, particularly in Anambra State.

While existing literature supports the potential benefits of peer assessment, research specifically examining its effects on chemistry achievement, interest, and study habits among secondary school students in Anambra State is limited. Most studies on peer assessment in Nigerian contexts have focused on higher education settings (Adediwura, 2015) or other subject areas (Adeyemi, 2015; Onyia, 2015). Furthermore, few studies have simultaneously investigated the impact of peer assessment on achievement, interest, and study habits—three critical dimensions of effective learning. This study aims to fill these gaps, providing evidence-based insights into the effectiveness of peer assessment in improving chemistry education outcomes in this specific context. The findings may contribute to both theoretical understanding of peer assessment dynamics and practical applications for chemistry education in Nigerian secondary schools.

Research Questions

The study addressed the following research questions:

1. What is the effect of peer assessment technique on secondary school students'

achievement in chemistry in Anambra State?
2. To what extent does peer assessment technique influence secondary school students' interest in chemistry in Anambra State?
3. What is the effect of peer assessment technique on secondary school students' study habits in chemistry in Anambra State?

Hypotheses

Three null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference in the mean achievement scores of students taught chemistry using peer assessment technique and those taught using conventional assessment methods.
2. There is no significant difference in the mean interest scores of students exposed to peer assessment technique and those exposed to conventional assessment methods in chemistry.
3. There is no significant difference in the mean study habit scores of students taught chemistry using peer assessment technique and those taught using conventional assessment methods.

METHODS

Research Design

The study employed a quasi-experimental research design, specifically the non-equivalent control group pretest-post-test design. This design was appropriate since it was not feasible to randomly assign individual students to experimental and control groups due to the administrative structure of schools. Instead, intact classes were used, with random assignment of schools to treatment conditions.

Population and Sample

The population comprised all senior secondary school two (SS2) chemistry students in public secondary schools in Anambra State for the 2023/2024 academic session. Using multi-stage sampling techniques, eight schools were randomly selected from the six education zones in Anambra State taking into consideration the number of schools in each zone. Zones having 55-65 schools, two schools are randomly selected, zones with 20-54 schools, one school is selected each. Awka and Nnewi zones, two schools were selected each while one school each was selected from the other four zones. From each school selected, one intact SS2 chemistry class was randomly selected. The schools were then randomly assigned to experimental and control groups, with four schools per group. A total of 240 students participated in the study, with 120 students in each group.

Instruments

Three instruments were developed for data collection:

1. **Chemistry Achievement Test (CAT):** A 50-item multiple-choice test covering selected chemistry concepts (chemical equilibrium, acids and bases, and rates of reaction). The test items were drawn from the senior secondary chemistry curriculum. The instrument was validated by three experts and had a reliability coefficient of 0.84 using Kuder-Richardson formula 20 (KR-20).
2. **Chemistry Interest Scale (CIS):** A 25-item Likert-type scale measuring students'

interest in chemistry. The scale included statements about enjoyment of chemistry lessons, willingness to pursue chemistry-related activities, and perceived relevance of chemistry, example: I am interested in acquiring further knowledge of chemistry content. The instrument had a reliability coefficient of 0.81 using Cronbach's alpha.

3. **Chemistry Study Habit Inventory (CSHI):** A 30-item inventory assessing students' study habits in chemistry, including time management, note-taking, preparation for tests, and completion of assignments, example: I set high standards for myself when studying chemistry concept, I concentrate well when studying chemistry concept in my room. The inventory had a reliability coefficient of 0.78 using Cronbach's alpha.

Experimental Procedure

The study was conducted over 10 weeks:

Week 1: Administration of pretest using CAT, CIS, and CSHI to both experimental and control groups.

Weeks 2-9: Implementation of treatments. Both groups were taught the same chemistry concepts by trained teachers using the same lesson plans and materials. The difference was in the assessment approach:

Experimental Group (Peer Assessment): Students were:

- Organized into heterogeneous groups of 4-5 members
- Trained on assessment criteria and providing constructive feedback
- Engaged in various peer assessment activities, including evaluating laboratory reports, reviewing homework solutions, and assessing concept explanations
- Provided with clear rubrics for assessment
- Required to justify their assessments with specific feedback
- Encouraged to discuss assessments in their groups

Control Group (Conventional Assessment): Students received:

- Conventional teacher-centred assessment
- Teacher-marked assignments and tests
- Conventional feedback on performance
- Standard correction of errors without peer involvement

Week 10: Administration of post-test using CAT, CIS, and CSHI to both groups.

Some extraneous variables were controlled in this study to strengthen the internal validity-the confidence that the observed effects are actually due to the independent variable (intervention or treatment) rather than other factors. Since quasi-experimental designs lack random assignment, they are inherently more vulnerable to threats to internal validity. These extraneous variables are initial group differences, this was the reason for the use od ANCOVA for analysis, Experimental bias, the school chemistry teacher served as the research assistant, pretest, post-test sensitization, the test instrument was reshuffled after 9 weeks of teaching, a different coloured paper was used also to distinguish the post-test from the pretest. Maturation was also controlled hence the experiment lasted only 10weeks.

Data Analysis

Data were analysed using both descriptive and inferential statistics. Mean and standard deviation were used to describe the performance of both groups on the three instruments. Analysis of Covariance (ANCOVA) was employed to test the null hypotheses at 0.05 level of significance, with pretest scores serving as covariates.

RESEARCH RESULTS

Research Question 1: What is the effect of peer assessment technique on secondary school students' achievement in chemistry in Anambra State?

Table 1: *Mean Achievement Scores of Experimental and Control Groups*

Group	N	Pretest		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Experimental	120	32.45	8.76	68.24	9.18	35.79
Control	120	31.98	8.83	51.37	8.93	19.39

Table 1 shows that students in the experimental group had a higher mean gain score (35.79) compared to those in the control group (19.39). This suggests that peer assessment had a positive effect on students' achievement in chemistry.

Research Question 2: To what extent does peer assessment technique influence secondary school students' interest in chemistry in Anambra State?

Table 2: *Mean Interest Scores of Experimental and Control Groups*

Group	N	Pretest		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Experimental	120	2.48	0.64	3.75	0.57	1.27
Control	120	2.52	0.62	2.91	0.59	0.39

Table 2 reveals that students exposed to peer assessment technique had a higher mean gain in interest (1.27) compared to those taught using conventional methods (0.39). This indicates that peer assessment positively influenced students' interest in chemistry.

Research Question 3: What is the effect of peer assessment technique on secondary school students' study habits in chemistry in Anambra State?

Table 3: *Mean Study Habit Scores of Experimental and Control Groups*

Group	N	Pretest		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Experimental	120	2.65	0.71	3.82	0.63	1.17
Control	120	2.61	0.69	2.94	0.67	0.33

Table 3 shows that students in the experimental group had a higher mean gain in study habit scores (1.17) compared to those in the control group (0.33). This suggests that peer assessment had a positive effect on students' study habits in chemistry.

Hypothesis Testing

Table 4: *ANCOVA Results for Achievement Scores*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Decision
Pretest (Covariate)	789.52	1	789.52	9.64	0.002	

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Decision
Between Groups	2246.38	1	2246.38	27.42	0.000	Reject H_0
Within Groups	19426.84	237	81.97			
Total	22462.74	239				

Table 4 shows a significant difference between the experimental and control groups in achievement scores ($F = 27.42$, $p < 0.05$). The F-ratio of 27.42 is substantially large, indicating that the between-group variance is 27 times greater than the within-group variance (error variance). In educational research, F-values exceeding 4.0 are typically considered significant; an F-value of 27.42 is exceptionally strong. This suggests a robust and substantial difference between the two groups. The probability that this difference occurred by chance is less than 0.1% (1 in 1,000). This exceeds conventional significance thresholds ($p < 0.05$ or $p < 0.01$). The result is highly statistically significant, providing strong confidence in the findings. Therefore, the first null hypothesis was rejected with 99.9% confidence

Table 5: *ANCOVA Results for Interest Scores*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Decision
Pretest (Covariate)	12.34	1	12.34	37.39	0.000	
Between Groups	6.55	1	6.55	19.86	0.000	Reject H_0
Within Groups	78.21	237	0.33			
Total	97.10	239				

Table 5 indicates a significant difference between the experimental and control groups in interest scores ($F = 19.86$, $p < 0.05$). The between-groups comparison reveals $F = 19.86$, $p = 0.000$, which is highly significant ($p < 0.05$). This means that after adjusting for pre-existing differences (pretest scores), there is a statistically significant difference in interest scores between the experimental and control groups. The probability that this difference occurred by chance alone is less than 0.05 (in fact, $p = 0.000$ suggests $p < 0.001$, making it highly significant. The intervention or teaching technique used with the experimental group had a genuine effect on students' interest that cannot be attributed to random variation or initial group differences. Therefore, the second null hypothesis was rejected.

Table 6: *ANCOVA Results for Study Habit Scores*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Decision
Pretest (Covariate)	15.62	1	15.62	42.21	0.000	
Between Groups	8.57	1	8.57	23.15	0.000	Reject H_0
Within Groups	87.68	237	0.37			
Total	111.87	239				

Table 6 shows a significant difference between the experimental and control groups in study habit scores ($F = 23.15$, $p < 0.05$). The between-groups comparison reveals $F = 23.15$, $p = 0.000$, which is highly significant ($p < 0.05$). This means that after adjusting for pre-existing differences (pretest scores), there is a statistically

significant difference in interest scores between the experimental and control groups. The probability that this difference occurred by chance alone is less than 0.05 (in fact, $p = 0.000$ suggests $p < 0.001$, making it highly significant. The intervention or teaching technique used with the experimental group had a genuine effect on students' study habit that cannot be attributed to random variation or initial group differences. Therefore, the second null hypothesis was rejected.

DISCUSSION

The findings of this study provide compelling evidence that peer assessment technique significantly enhances secondary school students' achievement, interest, and study habits in chemistry in Anambra State. Students exposed to peer assessment demonstrated greater improvement in all three areas compared to those taught using conventional assessment methods.

Effect on Achievement in Chemistry

The significant improvement in achievement scores among students in the experimental group aligns with previous studies by Okwuduba and Okigbo (2018) and Nbina and Obomanu (2011), who found that innovative assessment approaches enhanced chemistry performance in Nigerian contexts. Several factors may explain this positive effect:

First, peer assessment actively engages students in the learning process, promoting deeper understanding of chemistry concepts. When students evaluate their peers' work, they must thoroughly understand the content themselves, leading to enhanced comprehension and retention. This finding supports Nicol and Macfarlane-Dick's (2006) assertion that engagement in assessment processes facilitates deeper conceptual understanding. Second, the feedback component of peer assessment provides students with diverse perspectives on their work, helping them identify misconceptions and areas for improvement. As Harris et al. (2014) note, feedback from multiple sources can address different dimensions of understanding that might be missed by a single evaluator. Third, the collaborative nature of peer assessment creates a supportive learning environment where students learn from each other's strengths and weaknesses, aligning with Vygotskian principles of social learning (Kollar & Fischer, 2010).

These findings corroborate research by Topping (2018), who posited that peer assessment fosters critical thinking and metacognitive skills, both essential for academic achievement. The results also support Smith et al. (2019) and Njoku and Ezinwa (2014), who found that secondary school students who participated in peer assessment demonstrated improved conceptual understanding in science subjects. Moreover, the findings align with Jack's (2017) research demonstrating the effectiveness of constructivist approaches in chemistry education in Nigeria.

Interestingly, the magnitude of improvement observed in this study (mean gain of 35.79 for the experimental group versus 19.39 for the control group) is somewhat larger than that reported in similar studies in other Nigerian states (Onyia, 2015; Taiwo, 2014). This may suggest that students in Anambra State are particularly responsive to peer assessment approaches, possibly due to the state's educational context or

existing learning culture. As Mamba and Putsoa (2018) observed, the effectiveness of educational interventions can vary considerably across different regional contexts in Africa.

Effect on Interest in Chemistry

The significant increase in interest scores among students exposed to peer assessment is noteworthy. This finding resonates with Akporehwe and Onwioduokit's (2013) research, which found that collaborative assessment approaches enhanced students' interest in science subjects. Several mechanisms may explain this effect:

Peer assessment transforms students from passive recipients to active participants in the assessment process, increasing their sense of ownership and engagement, a phenomenon documented by Thomas et al. (2011) in their study of self- and peer-assessment. The interactive nature of peer evaluation creates a more dynamic and interesting learning environment compared to conventional teacher-centred assessment, echoing findings by Ifenthaler (2014) regarding the motivational benefits of collaborative assessment. Furthermore, the responsibility of evaluating peers' work may boost students' confidence and self-efficacy in chemistry, leading to increased interest—an effect documented by Panadero et al. (2017) in their meta-analysis of self-assessment effects.

These results align with Hidi and Renninger's (2006) four-phase model of interest development, which suggests that situational interest (triggered by specific learning activities) can develop into individual interest (a relatively enduring predisposition) through appropriate educational interventions. Peer assessment appears to trigger situational interest that, with sustained practice, may evolve into more enduring interest in chemistry. Okigbo and Okeke's (2011) research with Nigerian mathematics students similarly found that interactive learning approaches could positively influence subject interest.

The relatively large increase in interest scores in this study compared to those in Cheung's (2018) research with Hong Kong students suggests that Nigerian students in Anambra State may be particularly responsive to interventions that increase their active participation in the learning process. This may reflect the contrast between the intervention and the predominantly teacher-centred approaches that Ofoegbu (2015) identified as common in Nigerian secondary schools.

Effect on Study Habits in Chemistry

The significant improvement in study habits among students in the experimental group supports previous research by Okwara and Upu (2017) and Udoukpong and Okon (2012), who found that structured learning approaches improved Nigerian students' study habits in science and social science subjects. Several aspects of peer assessment may contribute to this effect:

The requirement to evaluate peers' work encourages students to develop systematic approaches to studying chemistry content, including more careful reading, note-taking, and organization of information. As Chang and Tseng (2011) observed in their study of portfolio assessment, engagement in evaluation activities promotes more strategic learning behaviours. The feedback component of peer assessment

helps students identify effective study strategies used by high-performing peers, which they may then adopt—a form of observational learning documented by Jiao and Brown (2012). Additionally, the collaborative element of peer assessment creates opportunities for students to observe and learn from peers' study techniques, which according to Ekwunife-Orakwue and Teng (2014), can reduce the transactional distance often experienced in traditional learning environments.

These findings align with Zimmerman's self-regulated learning theory, which emphasizes the importance of planning, monitoring, and evaluating one's learning (Zimmerman, 2000). As documented by Panadero et al. (2017), involvement in assessment activities promotes the development of self-regulatory skills, which transfer to independent study situations. The significant improvement in study habits observed in this study suggests that peer assessment functions not only as a learning activity but also as a scaffold for developing autonomous learning skills.

Notably, the improvement in study habits was consistent across the various dimensions measured in the Chemistry Study Habit Inventory, suggesting that peer assessment has a comprehensive rather than selective impact on students' approach to learning. This aligns with Ajogbeje and Alonge's (2012) findings that feedback-rich environments promote holistic changes in students' learning strategies.

Implications for Chemistry Education

The findings have several implications for chemistry education in Anambra State and beyond:

For chemistry teachers, the results suggest that incorporating peer assessment into teaching practices could significantly enhance student outcomes. Teachers should be trained in designing effective peer assessment activities, creating clear assessment criteria, and guiding students in providing constructive feedback. As Sluijsmans et al. (2002) demonstrated, teacher training in peer assessment methodologies is crucial for successful implementation. Lai and Hwang's (2015) research on structured peer assessment criteria development offers practical guidelines that could be adapted for chemistry education in Nigerian contexts.

For curriculum developers, the findings highlight the importance of embedding diverse assessment approaches, including peer assessment, in chemistry curricula. Assessment guidelines should move beyond traditional teacher-centred evaluation to include peer assessment components. This recommendation aligns with Carless's (2015) advocacy for "learning-oriented assessment" and Boud and Soler's (2016) concept of "sustainable assessment" that prepares students for future learning challenges. As Pat-El et al. (2013) note, assessment practices should explicitly connect to curriculum outcomes to maximize their effectiveness.

For educational policymakers, the results underscore the need for policies supporting innovation in assessment practices. Professional development programs should equip teachers with skills to implement peer assessment effectively. The Nigerian educational system, including Anambra State ministry of education, would benefit from policy reforms that acknowledge and support the formative role of assessment, as promoted by Wiliam and Thompson (2007). Stiggins (2002) argued

that there is an "assessment crisis" when policy focuses solely on assessment of learning rather than assessment for learning.

Peer evaluation helps students not only do better in chemistry classes but also acquire useful skills that they may use outside of the classroom, such as communication, self-control, and critical thinking. These transferable skills, which Andrade and Brown (2016) identify as critical outcomes of engagement in assessment processes, prepare students for higher education and employment contexts where collaborative evaluation is increasingly valued.

Conclusion

This study examined how Anambra State secondary school students' performance, interest, and study habits in chemistry were impacted by the peer assessment method. The results offer compelling proof that, in comparison to traditional assessment techniques, peer evaluation considerably improves all three outcomes. Pupils who participated in peer evaluation showed improved study habits, greater enthusiasm in the topic, and superior achievement in chemistry.

According to the findings, peer evaluation is a useful teaching strategy for enhancing chemistry instruction in secondary schools in Anambra State. Peer assessment encourages deeper comprehension, increased enthusiasm, and more productive study techniques by actively involving students in the evaluation process, which eventually improves learning outcomes.

Recommendations

Based on the findings, the following recommendations are made:

1. Chemistry teachers in Anambra State should integrate peer assessment techniques into their teaching practices to enhance student learning outcomes.
2. School administrators should organize professional development workshops to train chemistry teachers in effective implementation of peer assessment.
3. The Anambra State Ministry of Education should revise assessment guidelines for chemistry education to incorporate peer assessment components.
4. Curriculum developers should include peer assessment activities in chemistry textbooks and teaching materials.
5. Future research should investigate the long-term effects of peer assessment on students' performance in external examinations like WAEC and NECO.
6. Studies should explore the effectiveness of peer assessment in other science subjects and at different educational levels within Anambra State.
7. Research should examine factors that might influence the effectiveness of peer assessment, such as gender, school location, and socioeconomic background of students.

Conflict of interest statement:

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