



Research Article

Enhancing Senior Secondary School Students' Academic Performance in Chemistry Through the Implementation of Think-Pair-Share Strategy

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Abstract: This study investigates the impact of the Think-Pair-Share (TPS) strategy on students' academic performance in Chemistry at the Awka Education Zone, establishing its significance in addressing persistent poor performance in the subject. A quasi-experimental design was employed, with Chemistry taught to the experimental group via TPS and to the control group by traditional lecture methods. The study's population consisted of all Chemistry students in public secondary schools within the Awka Education Zone, totalling 1,298 students, from which a sample of 120 students (60 males and 60 females) was drawn using purposive sampling and straightforward balloting. Data were collected using the Achievement in Chemistry Test, a validated instrument with a reliability factor of 0.83. Mean and standard deviation were used to analyze the research questions, while a t-test was used to examine the hypotheses. Results showed that students taught Chemistry using TPS outperformed those taught by lecture. Male students taught using TPS outperformed female students, whereas, with the lecture method, male students also outperformed female students. There was a significant difference in achievement scores between students taught with TPS and those taught with the lecture method, as well as between Male and Female Students taught with TPS. Students of all sexes did badly when taught using the lecture method. The study recommends the implementation of TPS in teaching Chemistry and calls for the provision of resources by the government to enhance its effectiveness.

Keywords: senior secondary school, students, academic performance, chemistry, Think-Pair-Share, strategy

1. Introduction

Education has been recognized as a tool to help citizens acquire values, knowledge, and skills that enable them to contribute useful ideas to their societies. It also shapes individuals to behave in ways that lead to their personal development and the development of their communities. According to Izuakor et al. (2022), education, as the bedrock of human development, is an essential instrument a nation uses to facilitate the total enlightenment of its citizens and enhance all its socio-economic and political parameters for sustainable development. Daramola (2019) defined education as the process by which individuals acquire the necessary skills to be useful and live peacefully in their society.

According to Nnoli (2022), science is an accumulated and systematized body of knowledge about natural phenomena. Scientific facts are based on objective data collection and empirical evidence, which are open to verification. To be qualified as a science subject, the knowledge and skills disseminated must be based on verifiable facts and empirical evidence. Egolum and Igboanugo (2022) stressed that science education is a crucial instrument for

national development.

Chemistry is an important science subject and occupies a vital position in science education. According to Nnoli and Samuel (2023), chemistry is the study of the composition, properties, structures, interactions, and transformation of matter, either in isolation or combination. As a school subject, chemistry involves studying natural and artificially produced substances, their composition, their reactions and interactions, and their effects on humans and the environment. The effects of chemical reactions are observed daily, such as rusting kitchen utensils and individual allergic reactions to particular medicines (Ani et al., 2015). Industrial chemical processes also lead to the production of substances like perfume and paint. Researchers like Iyang (2021) and Chikendu (2022) have blamed the massive failure in Chemistry on ineffective teaching methods.

Teaching methods as are strategies used to deliver knowledge. They range from teacher-centered approaches like lectures and demonstrations to student-centered methods like group work, inquiry, and problem-solving (Mitchell et al., 2024). The choice depends on learning objectives and student needs. Teaching methods may also be referred to as pedagogic approaches a teacher applies in the classroom to achieve lesson objectives. Chikendu (2022) and other researchers have opined that using effective teaching methods, such as collaborative methods, would curb persistent failures in Chemistry examinations.

The Think-Pair-Share (TPS) strategy as a collaborative method of teaching has gained prominence in educational settings for its potential to improve academic performance across various subjects. This collaborative learning technique involves students thinking individually about a question, pairing up to discuss their thoughts, and then sharing their knowledge with the larger group (Tarigan, 2022). This approach has been specifically examined in the context of enhancing academic performance in chemistry among senior secondary school students. Theoretical foundations of TPS suggest that it supports deeper cognitive processing by encouraging individual reflection followed by social interaction. According to Li et al. (2024), TPS fosters critical thinking and problem-solving skills, which are important in complex subjects like chemistry. This method aligns with Vygotsky's (1978) sociocultural theory, which emphasizes the role of social interaction in cognitive development. In chemistry education, this interaction is particularly beneficial due to the subject's abstract nature and complex problem-solving requirements.

Research indicates that the TPS strategy enhances students' understanding and retention of chemistry concepts. For example, a study by Zul and Kemal (2023) demonstrated that students who engaged in TPS activities showed improved grasp of chemical principles and problem-solving abilities compared to those who received traditional instruction. Their study revealed that the structured peer discussions enabled students to clarify misconceptions and reinforce their learning through collaborative explanation. Further supporting this, a study by Susanto et al. (2021) found that TPS not only improved students' conceptual understanding but also increased their engagement and motivation. The authors highlighted that the interactive nature of TPS helped students feel more involved in their learning process, which translated into better academic performance. This increased engagement can be particularly beneficial in subjects like chemistry, where motivation is often a barrier to learning complex concepts.

Moreover, the implementation of TPS in chemistry classrooms has been associated with positive changes in students' attitudes towards the subject. According to a study by Suci and Zainul (2023), students reported higher levels of confidence and reduced anxiety related to chemistry after participating in TPS activities. This shift in attitude is important for fostering a positive learning environment and encouraging continued academic effort (Jatmiko et al., 2018). Recent studies have demonstrated that the Think-Pair-Share (TPS) strategy significantly enhances students' academic performance by fostering active engagement, critical thinking, and collaborative learning. Sudibyo and Nurteteng (2021) found that TPS involves three stages: individual thinking, pairing to discuss ideas, and sharing with the larger group, which collectively deepen students' understanding of the subject matter. Wallace et al. (2021) reported that students taught using TPS consistently outperform those taught by traditional lecture methods, indicating the strategy's effectiveness in improving comprehension and retention of information.

The strategy's collaborative nature allows students to benefit from peer interactions, which can clarify concepts and provide diverse perspectives. Bamiro (2015) noted that such interactions are particularly beneficial in complex subjects like Chemistry. Shafqat and Habib (2022) confirmed that students taught Chemistry using TPS scored higher than their peers taught through lectures, highlighting TPS's potential to address persistent poor performance in the subject.

Furthermore, Li and Tu (2024) found that while TPS promotes gender equity in learning, male students performed slightly better than female students when taught using this method, suggesting a need for further investigation into

gender-specific learning dynamics. Overall, Samaila et al. (2024) reported that TPS is a valuable pedagogical tool that enhances academic performance through structured, collaborative learning environments. The learners are required to listen passively and answer questions when asked, while the teacher is more actively involved in the class activities. Febrina and Efendi (2022) state that achievement in learning which they also call learning achievement is, a person's success in the efforts he carried out in earnest, in learning activities. The yardstick for measuring success in school learning is usually scores obtained in school tests and examinations.

The motivation for the present study arised from persistent challenges in chemistry education. Despite the subject's importance, students often struggle with its abstract concepts and problem-solving demands (Tan et al., 2023). Traditional instructional methods frequently fail to address these difficulties effectively, leading to disengagement and low performance (Tsai et al., 2016). Research has shown that TPS can facilitate deeper understanding and retention by promoting active engagement and collaborative learning (Ugwuanyi et al., 2020). However, there is limited empirical evidence on how TPS specifically impacts chemistry learning outcomes at the senior secondary level. Prior studies have often focused on general STEM subjects or other educational stages, leaving a gap in understanding its effects in the context of high school chemistry (Fitriyana et al., 2024). Addressing this gap is important for developing effective teaching strategies tailored to chemistry. The study aims to provide actionable knowledge for educators and contribute to more effective pedagogical practices in chemistry education.

1.1 Statement of the problem

Various researchers have conducted researches and made recommendations about how to curb the problem of massive poor performance in Chemistry, but the problem has persisted. Researchers like Egolum and Igboanugo (2022) recorded that there has been a persistent high rate of failure in Chemistry in Senior School Certificate examinations and other external examinations for years. Students in Awka education zone are among the candidates who took those examinations. The need to curb this ugly trend cannot be over stretched.

Another unpleasant situation, which researchers have noted is that many people are not qualified to get admission to study their dream courses in science disciplines in tertiary institutions, because they could not obtain credit passes in Chemistry at their ordinary level certificate examinations. This problem is confirmed by Okeke and Samuel (2022) who recorded that obtaining of a good grade in Chemistry at 'O' level external certificate examinations is a requirement for getting admission to study many science disciplines. According to them, reports released by WAEC chief examiner in 2018 reveal that, for the past six years, poor performance in Chemistry had been prevalent among Chemistry candidates. This is definitely an unpleasant educational problem.

The problem of this study therefore is, what could be the effect of teaching Chemistry with Think-pair-share method on achievement in Chemistry among Senior Secondary class two students in Awka education zone?

1.2 Purpose of the study

The general purpose of this study is to verify the effect of Think-pair-share (TPS), on Senior Secondary class two students' achievement in Chemistry in Awka education zone.

Specifically, the study sets out to:

Determine the difference between the mean achievement scores of Senior secondary school class two (SS2) students taught Chemistry using Think-pair-share and those taught with lecture method.

Determine the difference between the mean achievement scores of senior secondary school class two, Male and Female Students taught Chemistry using Think-pair-share method.

Determine the difference between the mean achievement scores of Senior secondary school class two, Male and Female Students taught Chemistry using lecture method.

1.3 Scope of the study

Geographically, this study is delimited to Awka education zone. Think-Pair-Share which is a collaborative learning method was used for teaching. The Chemistry topics taught were delimited to, types of chemical reactions and rate of chemical reactions. The research design is delimited to use of Quasi experimental Pretest-Posttest control group design.

1.4 Research questions

This study was guided by the following research questions.

What is the difference between the mean achievement scores of students taught Chemistry using Think-pair-share and those taught with lecture method?

What is the difference between the mean achievement scores of Male and Female Students taught Chemistry with Think-pair-share method?

What is the difference between the mean achievement scores of Male and Female Students taught Chemistry using lecture method?

1.5 Hypotheses

The following hypotheses which were tested at 0.05 level of significance, guided the study.

Ho₁: There is no significant difference between the mean achievement scores of students taught Chemistry using Think-pair-share and the mean achievement scores of those taught with lecture method.

Ho₂: There is no significant difference between the mean achievement scores of Male and Female Students taught Chemistry using Think-pair-share.

Ho₃: There is no significant difference between the mean achievement scores of Male and Female Students taught Chemistry with lecture method.

2. Method

The design of the study is quasi experimental pretest-posttest control group research design. The area of the study is Awka education zone which is the capital of Anambra state. The population of this study is all Chemistry students in public secondary schools in Awka Education zone of 2023/2024 academic session. They are one thousand, two hundred and ninety-eight (1,298). Purposive sampling and simple random sampling were variously used for the selection of the participants of this study. The sample consisted of 60 female and 60 male students, selected to ensure gender balance and to provide a comprehensive understanding of the Think-Pair-Share strategy's impact across both sexes. The wide age range of participants, from 14 to 18 years, was chosen to capture diverse perspectives and developmental stages, enhancing the generalizability of the findings. The experimental group comprises sixty (60) students. Similarly, the control group comprises sixty (60) students.

The instrument for data collection was a validated Chemistry achievement test titled, Achievement Test in Chemistry (ATC) was used for the pretest and posttest. The instrument comprises two sections. Section A was designed for the collection of demographic data from the sample of the study. Section B comprises ten (10) multiple choice objective test questions. Each item comprises four plausible answer options. There were extracted, Senior School Certificate Examination, (SSCE) questions, from the following topics: oxidation, reduction and rate of chemical reactions. For scoring of the test, each correct answer ticked attracts 10%. The total score for the ten items that compose the test was 100%. Though the items that compose the Achievement Test in Chemistry (ATC) were extracted from SSCE examination questions which are already validated by SSCE examination body, they were also subjected to further validation, because the questions were extracted from examination questions used in different academic sessions.

The content validity of the ATC was confirmed by two experts in Chemistry Education who are lecturers at Nnamdi Azikwe University, Awka. Pearson's Product-Moment correlation formula was used to compute the extent of reliability of the instrument and the reliability index of 0.83 was obtained. A total of five lessons were given to, the experimental group. Similarly, five lessons were taught to the control group. Participant consent was obtained through a structured process. Initially, participants received an information sheet detailing the study's purpose, procedures, risks, and benefits. They were then given a consent form reiterating key points and affirming voluntary participation, confidentiality, and the right to withdraw without repercussions. Participants, or their guardians if under 18, were asked to sign and return the consent form before participating. This ensured all participants were fully informed and had agreed to the study's conditions before any data collection began.

On that day of his first visit, with the assistant of the Chemistry teacher assigned to help her, he gave all SS2

Chemistry students, research attendance numbers and then gave them the pretest. After the pretest which lasted only twenty (20) minutes, she taught them oxidation and Reduction. These same activities were duplicated on the day of her first visit to each school. These took place during the first week of her study. Oxidation and reduction were taught during the first two weeks. She taught them rate of chemical reaction during the third and fourth weeks. Revision was done during the fifth week. Students were given the post-test immediately after revision. The experimental group were taught with Think-Pair-Share method while the control group were taught with lecture method.

The Think-Pair-Share (TPS) strategy differs significantly from the traditional lecture method in its approach to student engagement and learning. TPS encourages active participation by having students first think individually about a question, then pair up to discuss their thoughts, and finally share their ideas with the larger group. This collaborative learning method promotes deeper understanding, critical thinking, and communication skills. In contrast, the conventional lecture method is primarily teacher-centered, with students passively receiving information. The students whose scripts were selected for marking after the pretest were identified through their research attendance numbers. The post-test scripts of those same students were identified and selected for marking. Mean achievement scores were used to answer the research questions while t-test for independent variables were used to test the hypotheses at 0.05 level of significance. All analysis were conducted in SPSS software.

3. Results

Table 1. Difference between the mean achievement scores of students taught chemistry using think-pair-share and those taught with lecture method

Teaching Method	n	ΣX	x (mean)
Think-pair-share	60	2,300	38.0
Lecture method	60	1,540	26.0

Table 1 compares the mean achievement scores of students taught Chemistry using Think-pair-share (TPS) versus the Lecture method. TPS resulted in a higher mean score of 38.0 compared to 26.0 for the Lecture method. With a sample size of 60 for each method, TPS achieved a total score (ΣX) of 2,300, indicating consistent performance across the group. Conversely, the Lecture method achieved a total score of 1,540. The difference in mean scores suggests that students taught with TPS may have performed significantly better academically compared to those taught through traditional lectures, highlighting the potential efficacy of TPS in enhancing student achievement in Chemistry.

Table 2. Difference between the mean achievement scores of male and female students taught chemistry using think-pair-share method

Gender	n	ΣX	x (mean)
Male	30	1,350	45
Female	30	950	32

Table 2 illustrates the difference in mean achievement scores between Male and Female Students taught Chemistry using the Think-pair-share (TPS) method. Among male students ($n = 30$), the mean score was 45 with a total score (ΣX) of 1,350, indicating strong performance. Female students ($n = 30$) had a mean score of 32 with a total score of 950. This disparity suggests that male students performed notably better in Chemistry when taught using TPS compared to their female counterparts. The findings underscore potential gender differences in academic outcomes related to instructional methods like TPS, warranting further investigation into effective strategies for both genders.

Table 3. Difference between the mean achievement scores of male and female students taught chemistry with lecture method

Gender	n	ΣX	x (mean)
Male	30	850	28
Female	30	690	23

Table 3 compares the mean achievement scores of Male and Female Students taught Chemistry using the Lecture method. Male students (n = 30) achieved a mean score of 28 with a total score (ΣX) of 850, while female students (n = 30) had a mean score of 23 with a total score of 690. The data indicates a performance difference favoring male students in this instructional approach, albeit to a lesser extent than with the Think-pair-share method. These findings suggest varying impacts of instructional methods on gender-specific academic achievement in Chemistry, highlighting the need for tailored approaches to address potential disparities and optimize learning outcomes for all students.

Table 4. Test of significant difference between the mean achievement scores of all students taught chemistry using think-pair-share and mean achievement scores of those taught with lecture method

Teaching									
Method	n	ΣX	x	SD	Df	L.S.	t-cal	t-tab	Decision
TPS	60	2,300	38	12.8					
Lecture	60	1,540	26	11.3	118	0.05	3.9	2.00	p > 0.05

H₀ rejected

ΣX = sum of scores, x = mean, SD = Standard deviation, Df = Degree of freedom, L.S. = level of significance, t-cal = value of 't-test' calculated, t-tab = critical value of 't' at t-table, n = Sample size

Table 4 unveils analysis of data obtained for hypothesis 1. Since the calculated 't' value which is 3.9 is greater than the critical table value which is 1.98, the null hypothesis which states that there is no significant difference between the mean achievement scores of students taught Chemistry using Think-pair-share and the mean achievement scores of students taught Chemistry with lecture method is rejected.

Table 5. Test of significant difference between the mean achievement scores of male and female students taught chemistry using think-pair-share

Sex	n	ΣX	x	SD	Df	L.S.	t-cal	t-tab	Decision
Male	30	1,350	45	9.5					
Female	30	950	32	12.1	58	0.05	4.6	2.021	p > 0.05

H₀ is rejected

ΣX = sum of scores, x = mean, SD = Standard deviation, Df = Degree of freedom, L.S. = level of significance, t-cal = value of 't-test' calculated, t-tab = critical value of 't' at t-table, n = sample size

Table 5 presents analysis of data elicited for hypothesis 2 This critical t-table value is less than the computed than the calculated t-value which is 4.6. Based on this, the null hypothesis which states that there is no significant difference between the mean achievement scores of male and female Chemistry students taught using Think-pair-share is rejected

and the alternate hypothesis which states that there is a significant difference between the mean achievement scores of male and female Chemistry students taught using Think-pair-share is accepted.

Table 6. Test of significant difference between mean achievement scores of male and female students taught chemistry using lecture method

Sex	n	ΣX	\bar{x}	SD	Df	L.S.	t-cal	t-tab	Decision
Male	30	850	28	12					
Female	30	690	23	9	58	0.05	1.1	2.021	$p < 0.05$

H_0 is accepted

ΣX = sum of scores, \bar{x} = mean, SD = Standard deviation, Df = Degree of freedom, L.S. = level of significance, t-cal = value of 't-test' calculated, t-tab = critical value of 't' at t-table, n = sample size

Table 6 presents data analysis for hypothesis 3. This critical t-table value is more than the computed the calculated t-value which is 1.1. Following this, the null hypothesis which states that there is no significant difference between the mean achievement scores of Male and Female Students taught Chemistry using Think-pair-share method is accepted and the alternate hypothesis which states that there is a significant difference between the mean achievement scores of Male and Female Students taught Chemistry using lecture method is rejected

4. Discussion

Data analyzed for hypothesis 1 in this study indicates a significant difference between the mean achievement scores of students taught Chemistry using Think-pair-share and the mean achievement scores of students taught Chemistry with lecture method. This result tallies with the findings of Usang and Okoli (2021) and Edem et al. (2023) who found a significant difference between the mean achievement scores of students who were taught Chemistry with Think-pair-share method and students who were taught Chemistry with lecture method and also noted that students taught Chemistry with Think-pair-share obtained significantly higher mean achievement scores than students taught Chemistry with lecture method. The results of the studies by Uzoma and Okoli (2019) and Ogbaga and Osuafor (2022) also found that students who were taught Biology with Think-pair-share strategies had higher scores than student who were taught Biology with lecture method.

The findings of research question 2 align with Suci and Zainul (2023). Both studies indicate that male students taught Chemistry using the TPS method achieved significantly higher mean scores compared to female peers using the Think-Pair-Share method. Similarly, the results of research question 3 corroborate Fitriyana et al. (2024) findings, showing a slight advantage in mean achievement scores for male students taught Chemistry via the lecture method over their female counterparts. The result of hypothesis 2 of this study which found that there is a significant difference between the mean achievement scores of Male and Female Students taught Chemistry using Think-pair-share method contradicts the findings of Usang and Okoli (2021) and Ogbaga and Osuafor (2022) who respectively found no significant difference in mean achievement scores of Male and Female Students taught Chemistry and Biology, using Think-pair-share method. The result of hypothesis 3 which found no significant difference between the mean achievement scores of Male and Female Students taught Chemistry with lecture method and which also revealed neither male nor female students had a mean that was up to 30%, confirms the findings of Usang and Okoli (2021), Edem et al. (2023), Uzoma and Okoli (2019) and Ogbaga and Osuafor (2022) who found that students who were taught with lecture method had poor mean achievement scores.

This study makes several unique contributions to the existing literature on teaching methods and academic achievement in Chemistry. Firstly, by comparing the Think-pair-share and Lecture methods, it provides empirical evidence of their effectiveness in enhancing students' mean achievement scores. This direct comparison adds clarity to educators and policymakers seeking evidence-based instructional strategies. Moreover, the study extends beyond

method effectiveness by analyzing gender-specific outcomes within each teaching approach. It highlights how male and female students perform differently under the Lecture method, revealing nuanced gender dynamics in educational settings that can influence pedagogical strategies. Furthermore, the findings underscore the importance of considering both instructional methods and gender when designing educational interventions. This holistic approach contributes to a deeper understanding of factors impacting student achievement in Chemistry, potentially informing curriculum development and teaching practices.

5. Limitations of the study

One limitation of the study is its focus on a specific subject (Chemistry) and teaching methods (Think-pair-share and Lecture). This narrow scope restricts the generalizability of findings to other subjects or instructional approaches. Additionally, the sample size of 60 students per group may limit the statistical power and representativeness of the results. Future research could expand the scope by including multiple subjects beyond Chemistry and exploring various teaching methods beyond Think-pair-share and Lecture. Increasing the sample size and diversity of participants would enhance generalizability.

Additionally, examining additional demographic factors such as socioeconomic status, prior academic achievement, and learning styles could provide a more comprehensive understanding of their impact on educational outcomes. Longitudinal studies could also be valuable to track academic progress over time and assess the sustained effects of different teaching strategies. Such approaches would contribute to a more nuanced understanding of effective educational practices across diverse student populations.

6. Conclusions

Chemistry students who learn the subject using Think-Pair-Share techniques score higher than those who learn the subject through lectures. When taught Chemistry using the Think-Pair-Share approach, male students scored higher than female students when taught Chemistry using the TPS method. A small percentage of male students who get Chemistry instruction via lecture surpasses the scores of female students who receive the same instruction.

The mean achievement scores of students taught Chemistry using the TPS technique and those taught Chemistry using the lecture approach differ significantly. Those taught Chemistry using the TPS technique, male and female SS2 students, respectively, get greater achievement scores than those taught Chemistry using the lecture approach. The mean achievement scores of male and female SS2 Chemistry students taught using the lecture approach do not differ significantly. When taught using a lecture style, students of all genders do badly.

This study's findings have significant implications for educational practice. They suggest that implementing the Think-pair-share method in Chemistry instruction can potentially lead to higher achievement scores compared to traditional lecture methods. This highlights the importance of active student engagement and collaborative learning in enhancing learning outcomes. Educators may consider integrating collaborative strategies like Think-pair-share into their teaching practices to promote deeper understanding and retention of subject matter.

This study underscores the transformative potential of adopting collaborative learning methods like Think-pair-share in Chemistry education. By demonstrating its positive impact on student achievement compared to traditional lecture methods, it advocates for pedagogical shifts towards more interactive and engaging instructional approaches. Emphasizing active student participation and knowledge construction, these findings urge educators to reconsider how they facilitate learning to foster deeper comprehension and retention among students. Integrating such strategies not only enhances academic performance but also cultivates critical thinking and problem-solving skills essential for students' future success in science and beyond, thereby promoting a more effective and enriching educational experience.

7. Recommendations

School authorities, such as Secondary School Principals, should regularly organize seminars on the application of

the TPS method in teaching Chemistry. Resource persons skilled in TPS strategies should be invited to train teachers on effective implementation.

School Principals and academic advisers should encourage teachers to include the TPS method among their teaching strategies for Chemistry.

Proprietors of schools, including Ministry of Education authorities and private school owners, should construct spacious classrooms conducive to TPS activities. They should provide sufficient and adequate chairs and tables for paired partners to comfortably collaborate.

Future research should explore the long-term impact of TPS on student performance, consider additional demographic factors such as socioeconomic status, and expand to include multiple subjects beyond Chemistry.

Conflict of interest

The author declares there is no conflict of interest at any point with reference to research findings.

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