Southeast Asian Journal of Global Trends and Issues in Education
E-ISSN 3110-6714 | Print ISSN 3110-679X, Volume 2, Issue 1 (2026), DOI: 10.64420/sajgtie.v2i1
Journal homepage: https://ojs.aeducia.org/index.php/sajgtie

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Nneka Rita Nnorom[1*], Chinyere Francisca Okafor[2], Chisom Perpetua Okeke[3]

Correspondence regarding this article should be addressed to:

* Chisom Perpetua Okeke, Science Education Department, Chukwuemeka Odumegwu Ojukwu University, Anambra State, Nigeria, chisomokeke85@gmail.com

This article is available online at https://doi.org/10.64420/sajgtie.v2i1

How to Cite this Article:

Nnorom, N. R., Okafor, C. F., & Okeke, C. P. (2026). Effect of Think-pair Share Learning Strategy on Secondary School Students Achievement in Computer Studies: Implications for Global Development. *Southeast Asian Journal of Global Trends and Issues in Education, 2*(1), 36-50. https://doi.org/10.64420/sajgtie.v2.1.493

Article Information

Article info:
DOI: https://doi.org/10.64420/sajgtie.v2i1.493
Word Count: 9880

Southeast Asian Journal of Global Trends and Issues in Education, 2(1), 2026, 36-50

Contents lists available at ojs.aeducia.org

Southeast Asian J. Glob. Trends Issues Educ.

Volume 2, Issue 1 (2026), DOI: 10.64420/sajgtie.v2i1

Journal homepage: https://ojs.aeducia.org/index.php/sajgtie

SAJGTIE

E-ISSN 3110-6714

P-ISSN 3110-679X

Research Article **Read Online:** https://doi.org/10.64420/sajgtie.v2i1.493 Open Access

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Nneka Rita Nnorom[1], Chinyere Francisca Okafor[2], Chisom Perpetua Okeke[3*]

[1,2,3] Chukwuemeka Odumegwu Ojukwu University, Anambra State, Nigeria

ARTICLE HISTORY

Submitted: February 6, 2026
Revised: March 15, 2026
Accepted: March 24, 2026
Published: April 5, 2026

KEYWORDS

Think-pair ;
Share learning strategy;
Secondary school students;
Achievement in computer studies:
Global development

ABSTRACT

Background: Improving students' achievement in computer studies is essential in the digital era, where technological competence supports educational advancement and global development. However, conventional lecture-based instruction often limits students' participation and collaborative learning. Student-centred strategies such as Think–Pair–Share (TPS) offer opportunities to enhance interaction, reflection, and deeper understanding of learning materials. **Objective:** This study examined the effect of the Think–Pair–Share learning strategy on secondary school students' achievement in computer studies and investigated whether gender differences in achievement emerge when this strategy is used. **Method:** A quasi-experimental pre-test–post-test non-equivalent group design was employed. The population consisted of 6,982 Junior Secondary School Two (JSS2) students from 94 co-educational secondary schools in Anambra State, Nigeria. A sample of 393 students (169 males and 224 females) from nine intact classes in Aguata and Awka education zones participated. Data were collected using the Computer Studies Achievement Test (CSAT). Mean, standard deviation, and ANCOVA were used for analysis. **Results:** Students taught using TPS achieved significantly higher scores than those taught through the lecture method, with male students demonstrating slightly higher achievement. **Contribution:** This study provides empirical evidence supporting TPS as an effective student-centred strategy for improving achievement in computer studies. **Conclusion:** Integrating TPS into classroom practice can promote active participation and meaningful learning in secondary education.

1. INTRODUCTION

The role of computers in scientific and technological development has been established, as they are used in almost all fields of human endeavour, such as education, medicine, agriculture, and engineering. Computers have changed lives in many ways and are expected to change schools and education in general. This is the reason the computer is one of the tools in information and communication technology (Obiakor, 2019). Thus, as the world lives in the Information and Communication Technology era, schools should equip students with computer knowledge that will allow them to fully participate in the rapidly changing economy and be effective in science and technology.

To successfully achieve the goals of sustainable development in Nigeria, there is a need to engage creatively in science education. The valuable role of science education in a nation's technological development is never in dispute. Fafunwa (2018) opined that we live in a world where science and technology are integral to culture, and any country that overlooks this significant fact does so at its own peril. Hence, a solid background in the basic sciences is crucial if Nigeria is to attain the required level of science and technological development. Computer science is a fundamental

* **Corresponding Author:** Chisom Perpetua Okeke, chisomokeke85@gmail.com

Science Education Department, Faculty of Education, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra State, Nigeria
Address: PMB 6059 Igbariam, Anambra State Nigeria.

discipline that focuses on computation, data processing, and algorithms. At the secondary education level, it is commonly taught as computer studies.

Computer studies are not about learning to use a computer; they are much more than computer programming. Computer studies is the study of ways of representing objects and processes in information and communication technology. Moreover, it involves defining problems, analyzing them, designing solutions, developing, testing, and maintaining programs. Computer studies, as opined by Ononye et al. (2021), involve teaching and inculcating in learners the basic skills required to independently manipulate the computer to achieve educational goals. Obiakor (2019) averred that computer studies, as a subject, is aimed at helping students acquire the skills and competencies required in the digital world of competitiveness. Upon graduation, such basic skills and competencies make them conversant with the terms and practices of the computer world. Ekekokesisi (2019) is of the view that computer studies is a subject organized to enable people to understand the function, uses, and limitations of the computer, and to provide an opportunity to study modern methods of information processing. In addition, Okeke (2021) views a computer as a general-purpose device that can be programmed to perform a set of arithmetic or logical operations automatically. In the context of this study, computer studies are lower-level computer science subjects for secondary school students, which help them learn the basic knowledge and skills of computer studies at their level and age, with a well-developed, well-planned curriculum.

Nigeria's curriculum planners intend to include computer studies in the secondary school curriculum, a move that dates back to 1988, when the National Policy on Computer Education was enacted and launched (Onah, 2018). The policy suggested the following as some of the computer curriculum contexts at the secondary school level for computer education: A basic appreciation of how the computer works, an understanding of the basic principles of operating the computer, hands-on experience using the pre-programmed packages which are relevant to the interests of the students, as teacher aids in different subjects. The National Policy on Education (2014) stated that by the end of secondary education, the child would have acquired reasonable competence in software such as word processing, spreadsheet, database, and analysis programs that allow learners to interact with the computer as they desire.

Also, one of the major merits of the National Policy on Education (2014) is its recommendation to introduce computer studies in all secondary schools in Nigeria. The policy recommended a complete lifting of restrictions on computer studies, enabling the computer literacy program to begin in primary school. Moreover, computer studies should be introduced at any level, provided the necessary facilities and resources are adequately available for effective implementation. Since then, efforts have been made to include computer studies in the primary, junior and senior secondary school curriculum. For the effectiveness of this study, the junior secondary school level will be aimed at.

Recently, in the Nigerian educational system, computer studies at the junior secondary school level were merged with other subjects, such as Physical and Health Education, Basic Science, and Basic Technology, and all are now called Basic Science and Technology. Despite being merged into a single subject, they are still taught separately by specialized teachers from the four major areas. The computer studies curriculum changed after the merger. This current development calls for a re-examination of how effectively the teaching and learning of the subject are carried out to achieve its objectives.

The objectives of computer studies at the junior secondary school level of education by the Federal Ministry of Education (FME, 2019) are to enable the learner to: Acquire basic computer skills such as the use of the keyboard, mouse and system, use the computer to facilitate learning electronically; develop a reasonable level of competence on ICT applications that will engender entrepreneurial skills. Finally, to realize the objectives of computer studies as stipulated in the curriculum requires appropriate learning strategies, techniques, and approaches. Despite these objectives behind the establishment of computer studies in junior secondary schools, the examination body in charge of the junior secondary external exams, the Basic Education Certificate Examination (BECE), still reported poor performance in the subject.

The Basic Education Certification Examination (BECE) Chief Examiner (2019-2023) reported that the credit level in computer studies is poor due to the use of the wrong teaching method. The report also states that the poor achievement was due to students' weaknesses in these areas of computer studies: internet, operating system, search engine, graphic package, CorelDRAW, Paint Environment, spreadsheet package, computer safety, and measurement and computer software. Oribhabor (2020) asserted that the BECE Chief Examiners' report (2019) confirmed that students' poor achievement in computer studies is due to weaknesses in ICT gadgets, computer viruses, databases, worksheets, search engines, computer problem-solving skills, the internet, and spreadsheet packages. Similarly, BECE Chief Examiners' Report (2019-2023) summarily attributed the poor achievement of students in computer studies concepts of Computer Virus, Search Engine, Spreadsheet Packages and Spreadsheet features and termi-

nologies to lack of qualified teachers to handle the computer studies concepts in the classroom and poor instructional strategies used in presenting the technical and practical content areas of the subject to students in the computer base classroom/laboratory.

Similarly, Iniobong (2018) observed that poor instructional strategies could be a hindrance to the academic achievement of computer studies concepts, including Computer Virus, Search Engine, Spreadsheet Packages, and Spreadsheet features and terminologies, to humanity and its environs. Despite the uniqueness of computer studies, especially in the subject concept of Computer Virus, Search Engine, Spreadsheet Packages and Spreadsheet features and terminologies in secondary schools, students' achievement in the subject has been consistently poor in external examinations (Iniobong, 2018; Oribhabor, 2020).

Achievement connotes performance in a school subject, as symbolized by a score on an achievement test. Vargas-Ramos et al. (2021) defined achievement as the level of knowledge, skills, and competencies a student has acquired in the educational field, which is often evaluated by the grades obtained in the subjects that comprise the study plan. Achievement enables teachers to obtain information on the extent to which a student has attained the criterion performance. Nnorom & Odukwe (2021) described achievement as the ability to demonstrate the accomplishment of some outcome for which learning experiences were designed. Suleiman (2023) averred that achievement is the performance outcomes that indicate how far a person has progressed in specific goals of activities in instructional settings, such as school, college, and university. Hew (2019) opined that achievement is the extent to which a student, teacher or institution has achieved their short or long-term educational goals. Some researchers believed that achievement depends on the teaching method/instructional strategy used in teaching a subject (Vargas-Ramos et al., 2021; Nnorom & Odukwe, 2021).

Teaching method/Instructional strategy encompasses any learning technique a teacher uses to help students learn or gain a better understanding of the course material. They allow teachers to make the learning experience more fun and practical, and can also encourage students to take a more active role in their educational activities (Abulhul, 2021). There are two types of instructional strategies: conventional and innovative.

A conventional instructional strategy is the traditional way of teaching. This teaching strategy is textbook-centred, teacher-dominated, and exam-oriented. The emphasis here is mainly on remembering and reproducing facts, principles and theories of learning. There are two types of conventional strategies or methods: demonstration and lecture methods. The present study will use the lecture method because it will be used in the control group.

The lecture method is a teaching approach in which a teacher communicates ideas to learners through direct verbal discourse, also called talk-and-chalk, making the learning process teacher-centred. As a result, learners become discouraged and passive. The teacher-centred technique, which still goes on in schools, seems to make teaching/learning of computer studies clumsy, uninteresting and ineffective and hence very difficult to achieve its objectives in students' achievement in computer studies (Okoli & Ekebosi, 2019). There is a need to identify appropriate learning strategies that meaningfully supplement the lecture method already in use. In the words of Sujata (2023), teachers still use the lecture (chalk-talk) method in the classroom, which can provide only basic knowledge of science and other subjects. Thus, the government invested significant funds into providing schools with computers and internet connections. Today, most secondary schools in Anambra state have computers installed in their laboratories. However, introducing computers into schools generated new opportunities and challenges, and it is difficult to find conclusive evidence on the positive effect of computers on students' learning outcomes. The learning outcomes will be achieved through the use of the computer if the appropriate learning strategy is employed, other than the lecture learning method. Muhammad et al. (2021) averred that the lecture method harms teachers, as students develop a hatred for computer-related subjects, leading to persistent failure in those subjects.

To buttress the above points, Okafor (2019) averred that the lecture method is teacher-centred, limiting students' participation to listening, answering, asking questions, and taking notes as the lesson progresses. The method is also one-directional, thus discouraging teacher-learner and learner-learner interaction. The teacher delivers pre-planned lessons to the students with little or no instructional aid that involve students' activity (Uchechi, 2021). Furthermore, Abah (2020) asserted that secondary school teachers very often teach subjects using the lecture method. This may be because the method is the easiest to deliver, and the teacher usually covers large amounts of content. In addition, Abid et al. (2022) opined that this may be why the majority of teachers often use this method without recourse to constructive teaching methods that promote the acquisition of scientific and technological skills in learners. Abulhul (2021) asserted that this approach can no longer be used as it is outdated, has a limited scope, and seems to have failed both at the national and personal levels. The need to introduce alternative instructional techniques to overcome the weaknesses of the talk-and-chalk method is therefore evident, according to the Abulhul report. This situation, therefore, calls for the exploration of other instructional strategies that have been found effective in other fields and countries (Izuegbunam, 2018).

To buttress the above points, Chijioke et al. (2022) opined that innovative instructional strategies applied in the teaching and learning of computer practices seem more effective in enhancing learning outcomes than conventional teaching methods. Chijioke et al. further asserted that computer teachers should become more creative in their day-to-day teaching by adopting innovative instructional approaches that make the teaching and learning of computer studies more engaging for learners. Stuart (2023) proposed that teachers should use instructional strategies that are helpful and involve learners' active participation, encouraging skill acquisition. Such strategies could generate interest and retention among students in the learning process. This is because it is expected that students' learning in computer studies through the use of realistic instructional techniques should enhance the development of the generic skills of inquiry, reasoning, conceptualizing, problem-solving, and communicating (Laleye, 2019). By applying these skills, students are not only expected to construct their knowledge of Computer Studies but also to develop confidence and positive attitudes toward the concepts of Computer Virus, Search Engine, Spreadsheet Packages, and Spreadsheet features and terminology. One way to achieve this may be through the adoption of student-centred instructional approaches, popularly known as student-centred, innovative instructional strategies.

Innovative instructional strategies are broader techniques used to help students achieve learning outcomes, master the course content, and learn how to apply it in particular contexts. (University at Buffalo, 2023). In addition, Suaad-Hadi (2021) opined that an innovative instructional strategy is the set of performances that the teacher uses to achieve expected behaviour among learners. Subramani (2017) averred that innovative instructional teaching/strategy comprises the principles and strategies used by teachers to communicate instruction to students to achieve the desired learning objectives. These strategies are determined partly by the subject matter to be learned and partly by the learner's nature. There are many types of innovative instructional strategies, namely target task, project-based, cooperative, generative, think-pair-share, flipped classroom, inquiry-based, jigsaw, and blended learning, among others, that cater for individual needs, differences, learning styles, interests, and abilities (Damilola et al., 2023). Mitra (2021) reported that one of the best student-centred approaches to organize learning is the think–pair–share (TPS) instructional strategy**.** Based on this assertion, think-pair-share will be used with the experimental group in this study. Thus, this study proposes that the cognitive, affective, and psychomotor domains of students may be developed and improved through the think-pair–share (TPS) learning strategy, which serves as the main independent variable of the present study.

The think–pair–share (TPS) instructional strategy is a collaborative learning strategy in which students work together to solve a problem or answer questions about an assigned reading or topic. Innovative instructional strategies, such as think-pair-share, can enhance students' academic achievement across all fields (Ode et al., 2020). Some students feel safer and more relaxed when talking in small groups rather than speaking in front of the entire class. A think-pair-share activity allows students to feel more comfortable sharing their thoughts. In addition to fostering social skills, this learning strategy also improves students' speaking and listening skills. When students brainstorm together, each student learns from their partner. Achor & Gbadamosi (2020) observed that Physics students achieve greater retention and performance when taught using the think-pair-share instructional strategy. This can help students expand their vocabulary as they learn new words from their peers and build on their prior knowledge. Think-pair-share learning with a contextual approach requires students to be active in learning. TPS is a student-centred learning in which knowledge and concepts are found and built by the students themselves, not by the teacher**.**

Ogbaga & Osuafor (2022) asserted that the think-pair-share (TPS) strategy is a group discussion strategy and a diverse collaborative learning method. Furthermore, Ogbaga and Osuafor (2022) stressed that TPS is used to keep all students actively involved in class discussion and provides an opportunity for everyone to share their ideas and answer every question posed by the teacher. As the name implies, think-pair-share entails presenting students with questions or prompts, giving them time to think individually, pairing them up in cooperative groups to share their views and arrive at a possible answer, and finally sharing their views with the larger class. Some researchers, like Ode et al. (2020), believe that think–pair–share effectively enhances students' achievement in science subjects and, most importantly, computer studies. Studies such as Ningsih (2019) and Nnorom (2019) averred that the think–pair–share learning strategy engages students in meaningful learning in the classroom as it promotes communication skills, problem solving, critical thinking, teamwork and motivation to learn, which, in contrast, encourages rote learning and oftentimes, students get bored listening to the teacher. Achor et al (2022) further stressed that the Think-Pair-Share (TPS) instructional strategy is a learner-centred technique that encourages individual students to engage in critical thinking and to work cooperatively with other students in the process of knowledge building. As the teacher works to choose appropriate content, it supports the preparation and formulation of a good lesson and the development of clear cognitive objectives.

In the opinion of Okekeokosisi & Okigbo (2018), TPS is an aspect of a cooperative learning strategy that uses heterogeneous small groups of students who work together to maximize each other's learning potential through interest activation and active participation. The TPS instructional approach begins with the teacher asking an open-ended question, for which there may be a diversity of correct responses. Thereafter, the teacher allows the learners time to think and directs them to consider the questions and how they can be answered. During the time allowed to think, learners turn to their partners and work cooperatively by sharing ideas, discussing, clarifying, and challenging one another to arrive at a reasonable answer, which is finally shared with the entire class. In a classroom setting where the Think-Pair-Share instructional strategy is employed, both the social and cognitive dimensions of students' learning are usually nourished, thereby fostering discoveries and new knowledge that support improved academic performance and retention (Achor et al., 2022). TPS can help learners develop deep knowledge of the subject matter and an internal desire to be competent. Being more willing and less apprehensive about sharing with a larger group allows them to change their responses if needed. It reduces the fear of giving the wrong answer, thereby encouraging them to participate cooperatively and mutually learn from one another. Thus, the active participation of the students in TPS has been shown to improve their conceptual understanding, which, in turn, may enhance students' academic achievement in computer studies, regardless of gender.

Notwithstanding the importance of the knowledge of computer studies for both technological and human development, Basic Education Certificate Examination (BECE) Chief Examiners reported 2019-2023 confirmed that weaknesses of students' that enrolled in these respective years are evident in the areas of internet, excel, operating system, computer problem solving skill, graphic package, coral draw, paint environment, spreadsheet package, computer safety and measure, ICT gadgets, computer virus and database. To affirm this, most researchers reported that poor achievement in computer studies results from weaknesses in computer viruses, databases, worksheets, search engines, computer problem-solving skills, the internet, and spreadsheet packages, due to the persistent use of inappropriate instructional strategies by teachers. The lack of students' active participation, coupled with the promotion of an ineffective instructional strategy, often leads to a situation in which students complete a course without knowing basic, practical aspects of computer studies.

Moreover, other studies show that the areas of computer studies in which secondary school students experienced these weaknesses were the basic and essential parts of the subjects. Studies also show that secondary school computer students perform poorly due to various factors. One of the major factors militating against achievement in computer studies, concepts of Computer Virus, Search Engine, Spreadsheet Packages and Spreadsheet features and terminologies, is the instructional strategy used in teaching and learning the concepts. Similarly, some studies also believed that instructional strategies, especially the conventional ones, might have proven to be a trait of students' achievement in most secondary school science and technology subjects, including computer studies. Thus, the lecture teaching method seems to be more teacher-centred and less student-centred, with less student participation during lessons, leading students to feel bored and uninterested, and to find subjects such as computer studies difficult, which in turn leads to poor achievement in examinations, such as the BECE. On this note, the researcher aims to investigate the effect of the think-pair-share learning strategy, an innovative instructional strategy, on secondary school students' achievement in computer studies.

The gap in existing research on the effect of the Think-Pair-Share (TPS) learning strategy on secondary school students' achievement in computer studies lies in its limited focus on its application specifically in this field, as most studies focus on broader STEM subjects or active learning methods in general. Additionally, while TPS has been studied predominantly in Western contexts, its impact in diverse educational settings, especially in developing countries with varying levels of technology access, remains underexplored. Moreover, the role of gender differences in achievement when using TPS in computer studies has not been sufficiently analysed, despite its potential implications for gender equality in technology education.

This study aims to examine the impact of the think-pair-share learning strategy on secondary school students' achievement in computer studies. Specifically, the study aims to determine the difference in mean achievement scores between students taught using the think-pair-share strategy and those taught using the traditional lecture method, and to explore any differences in mean achievement scores between male and female students taught computer studies using the think-pair-share strategy.

2. METHOD

2.1 Research Design

The study adopted a quasi-experimental research design, specifically the pre-test-post-test non-equivalent groups design, to examine the effect of the Think-Pair-Share (TPS) learning strategy on students' achievement in

computer studies. This design was considered appropriate because it enables the comparison of learning outcomes between an experimental group and a control group in natural classroom settings where random assignment of students is often not feasible. In this approach, both groups were administered a pre-test to determine their initial achievement levels before the instructional intervention. The experimental group was subsequently taught using the Think-Pair-Share learning strategy, while the control group received instruction through the conventional lecture method. After the treatment period, a post-test was administered to both groups to assess the extent of improvement in students' achievement. The use of pre-test and post-test measures allowed the researchers to evaluate the effectiveness of the instructional strategy by comparing changes in performance between the two groups.

2.2 Participant

The study was conducted in Anambra State, Nigeria, focusing on the the Aguata and Awka education zones. Data collection and implementation were conducted within selected junior secondary schools in these zones during the academic year. The study population consisted of 6,982 Junior Secondary School Two (JSS2) students enrolled in 94 government-owned co-educational secondary schools across the Aguata and Awka education zones. A sample of 393 students was drawn using a multistage sampling technique. Stratified random sampling was first applied to divide the state into strata, from which two zones (Aguata and Awka) were selected. From each zone, two schools were randomly selected, for a total of 4 schools. From the Aguata zone, one school with three intact classes (58 males and 67 females, a total of 125 students) was assigned to the experimental group. In contrast, another school with two intact classes (31 males and 54 females, a total of 85 students) was assigned to the control group. From the Awka zone, one school with two intact classes (40 males and 57 females, a total of 97 students) formed the experimental group, while the other school with two intact classes (40 males and 46 females, a total of 86 students) formed the control group.

2.3 Data Collection

Data for the study were collected using the Computer Studies Achievement Test (CSAT). The instrument consisted of structured test items designed to measure students' achievement in selected computer studies topics taught during the instructional period. The CSAT was validated by three experts in computer education and educational measurement to ensure its content and face validity. Before the main study, the instrument's reliability was established using the Kuder–Richardson Formula 20 (KR-20), yielding a coefficient of 0.70, indicating acceptable internal consistency. The CSAT was administered to both the experimental and control groups as a pre-test before the instructional treatment to determine students' initial achievement levels. After the instructional intervention, in which the experimental group was taught using the Think-Pair-Share (TPS) learning strategy and the control group was taught using the conventional lecture method, the same instrument was administered as a post-test to measure students' achievement after the treatment

2.4 Data Analysis

The data collected from the administration of the Computer Studies Achievement Test were analysed using both descriptive and inferential statistical methods. The mean and standard deviation were used to answer the research questions by describing differences in achievement scores between students taught using the Think-Pair-Share learning strategy and those taught using the conventional lecture method. To test the null hypotheses formulated for the study, Analysis of Covariance (ANCOVA) was employed at a 0.05 level of significance. ANCOVA was considered appropriate because it allowed the researchers to control for pre-test scores while examining the effect of the instructional strategy on students' post-test achievement. The statistical analysis, therefore, provided a more accurate assessment of the impact of the Think-Pair-Share learning strategy on students' achievement in computer studies.

3. RESULT AND DISCUSSION

3.1 Result

3.1.1 Research Question 1

What is the difference in mean achievement scores of students taught computer studies using the think-pair-share learning strategy and those taught using the lecture method?

Table 1. Mean and Standard Deviation Achievement scores of Computer Students taught with Think Pair Share and those taught with the Lecture Method

		Pretest		Posttest		Mean Gain	
Groups	N	Mean	SD	Mean	SD	Mean Gain	Deference
TPS	211	47.08	10.48	61.33	9.03	14.25	
							7.38
LM	182	43.33	9.84	50.20	5.38	6.87	

The results in Table 1 show that the pretest and posttest mean achievement scores of students taught Computer studies using the think-pair-share learning strategy were 47.08 and 61.33, respectively, with standard deviation scores of 10.48 and 9.03, respectively. On the other hand, the pretest and posttest mean scores of those taught Computer studies with the lecture method were 43.33 and 50.20, respectively, and the standard deviations were 9.85 and 5.38, respectively. The pretest standard deviation scores for both groups were higher than their posttest scores. posttestgests more variability in the students' pretest scores than in their posttest scores. More scores are near the mean in the pretest than in the posttest. Since the pretest mean is smaller than the posttest mean in the experimental group, the treatment generally improved the subject's achievement. Since the experimental group's posttest mean is higher than the control group's, this indicates that the experimental group's treatment is more effective. The mean gain score for students taught with the think-pair-share learning strategy is 14.25, while that for the lecture method is 6.87. This represents a mean difference of 7.38 in favour of students taught Computer studies with the think-pair-share learning strategy, suggesting that students taught with the think-pair-share learning strategy achieved better results in Computer studies than those taught using the lecture method.

3.1.2 Research Question 2

What is the difference in mean achievement scores of male and female students taught computer studies using the think-pair-share learning strategy?

Table 2. Mean and Standard Deviation Achievement Scores of Male and Female Computer Students taught with Think Pair Share

		Pretest		Posttest		Mean Gain	
Gender	N	Mean	SD	Mean	SD	Mean Gain	Difference
Male	98	47.14	7.29	62.93	6.43	15.79	2.29
Female	113	47.00	7.55	60.50	6.94	13.50	

Table 2 shows the mean and standard deviation scores of male and female students taught computer studies with the think-pair-share learning strategy. From the results, the pretest means achievement score and standard deviation for male students taught computer studies using the think-pair-share learning strategy were 47.14 and 7.29, respectively. Their posttest mean achievement score and standard deviation were 62.93 and 6.43, respectively. This gave a mean gain score of 15.79. Also, the pretest means achievement score and standard deviation for the female students taught using the think-pair-share learning strategy were 47.00 and 6.55, respectively. Their posttest mean achievement score and standard deviation were 60.50 and 8.94, respectively. This gave a mean gain score of 13.50. The standard deviation scores for the pretest were higher than those for the posttest for both male and female students. This suggests greater variability in students' pretest scores than in their posttest scores. More of the scores are near the mean in the posttest than in the pretest. Since the posttest mean score for males is higher than that for females, male students achieved higher scores than their female counterparts in the use of the think-pair-share learning strategy. However, the mean gain difference between male and female students is 2.29 in favour of male students. This implies that, when using the think-pair-share learning strategy, male students achieve higher scores in computer studies than their female counterparts.

3.1.3 Hypothesis 1

There is no significant difference in the mean achievement scores of students taught computer studies using the think-pair-share learning strategy and those taught using the lecture method.

Table 3. Analysis of Covariance (ANCOVA) of Achievement Scores of Students Taught Computer Studies using Think Pair Share and Those Taught using the Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Decision

Corrected Model	3388.78a	1	3388.78		0.000	
Intercept	53041.538	1	53041.538	40.80	0.000	
Achievement	3161.79	1	3161.79	38.07	0.000	S
Groups	5265.815	1	5265.815			
Error	15696.16	391	83.05			
Total	59215.000	393				
Corrected Total	22027.25	392				

S= Significant, NS = Not Significant

The result in Table 3 shows that there is a significant difference in the mean achievement scores of students taught with the think-pair-share learning strategy and those taught with the lecture method, $F(1, 391) = 38.07$, $p = 0.000$. Since the obtained p-value is less than the stipulated 0.05 level of significance, the null hypothesis, which stated that there is no significant difference in the mean achievement scores of students taught computer studies using the think pair-share learning strategy and those taught using the lecture method, is rejected. This implies that the mean achievement score of students taught computer studies using the think-pair-share learning strategy is higher than that of those taught using the lecture method. This implies that the significant difference favours those taught computer studies using the think-pair-share learning strategy.

3.1.4 Hypothesis 2

There is no significant difference in the mean achievement scores of male and female students taught computer studies using the think-pair-share learning strategy.

Table 4. Analysis of Covariance (ANCOVA) of Male and Female Students' Achievement Taught Computer Studies using Think Pair Share

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Decision
Corrected Model	4.367a	2	1.456			
Intercept	1617.95	1	1617.95			
Achievement*Gender and TPS	50.62	1	50.62	20.72	0.000	S
Groups	702.892	1	702.892	4.49	0.037	
Error	7888.27	209	3.089			
Total	10023.85	211				
Corrected Total	378.128	210				

S= Significant, NS = Not Significant

As shown in Table 4, there is a significant difference in the mean achievement scores of male and female students taught computer science using the think-pair-share learning strategy, $F(1,209) = 4.49$, $P = 0.037$. Since the obtained p-value was less than the 0.05 level of significance, the null hypothesis, which stated that there is no significant difference in the mean achievement scores of male and female students taught computer studies using the think-pair-share learning strategy, was rejected. Hence, the alternative hypothesis is accepted. Since male students' mean achievement scores are higher than those of female students. This implies that the significance difference favours male students.

3.2. Discussion

3.2.1 Difference in the mean achievement scores of students taught Computer Studies using the think-pair-share learning strategy and those taught using the lecture method.

The findings of this study revealed that students taught Computer Studies using the Think–Pair–Share (TPS) learning strategy achieved significantly higher mean scores compared to those taught using the lecture method (LM). This result underscores the effectiveness of TPS as a student-centred instructional strategy that enhances learners' academic achievement in technology-related subjects. The observed improvement can be attributed not only to the structure of TPS itself but also to the way it transforms the learning environment from passive reception to active engagement. Through the sequential stages of thinking, pairing, and sharing, students are cognitively stimulated to process information more deeply, articulate their ideas, and refine their understanding through peer interaction, which ultimately leads to improved academic outcomes.

This finding is consistent with prior empirical studies such as Okafor & Samuel (2022), Samaila et al. (2024), who reported that students exposed to Think–Pair–Share outperformed those taught through conventional lecture

methods in various science subjects. The consistency of these findings across different contexts suggests that TPS is not only effective but also adaptable to diverse learning environments. Similarly, Assuah et al. (2022) found that TPS significantly improved students' achievement in algebra compared with the conventional method, indicating that its benefits extend beyond conceptual understanding to include procedural and analytical competencies. In the same vein, Nnoli (2024) demonstrated that TPS enhances students' performance in Biology, further reinforcing its cross-disciplinary applicability and relevance in promoting scientific literacy.

Furthermore, the present findings corroborate earlier studies that established statistically significant differences between experimental groups taught using TPS and control groups taught using lecture methods (Yusuf et al., 208; Ibe et al., 2024; Saudatu et al., 2025). These converging results provide strong empirical support for the claim that cooperative learning strategies, such as TPS, are more effective than traditional instructional approaches. Nwankwo & Nnamani (2025) also reported a significant improvement in students' academic achievement when TPS was utilised, reinforcing the reliability and generalizability of this instructional model. The repeated validation of TPS effectiveness across multiple studies strengthens its credibility as an evidence-based teaching strategy that can be confidently recommended for broader educational implementation.

The superiority of TPS over LM can be explained by constructivist learning principles, which hold that knowledge is actively constructed through social interaction and cognitive engagement. TPS promotes collaborative dialogue, critical thinking, and immediate peer feedback, which enhance conceptual understanding and long-term retention of knowledge. In addition, the strategy aligns with Vygotsky's social constructivist perspective, particularly the concept of the Zone of Proximal Development (ZPD), where learners benefit from interacting with more capable peers. In contrast, the lecture method is predominantly teacher-centred, limiting opportunities for interaction and active participation (Markina & Garcia Mollá, 2022). The passive nature of LM may hinder deep learning, as students are primarily recipients of information rather than active participants in knowledge construction, thereby reducing engagement and limiting the development of higher-order thinking skills.

Moreover, TPS aligns with contemporary pedagogical demands that emphasise 21st-century skills such as communication, collaboration, critical thinking, and problem-solving. In the context of computer studies, where practical application and conceptual understanding are essential, TPS provides an interactive platform for students to exchange ideas, collaborate on troubleshooting, and develop digital literacy skills. By engaging students in pair and group discussions, TPS not only improves academic achievement but also fosters essential soft skills necessary for global competitiveness and lifelong learning. Therefore, the findings of this study strengthen the growing body of evidence advocating the integration of cooperative learning strategies, such as TPS, in computer studies classrooms to enhance both cognitive and socio-emotional learning outcomes.

3.2.2 There is a difference in the mean achievement scores of male and female students taught Computer Studies using the think-pair-share learning strategy

The study further revealed a statistically significant difference in achievement between male and female students taught using the TPS strategy, with male students demonstrating slightly higher mean scores. Although the difference is relatively small, it suggests that gender may still play a role in shaping learning outcomes within collaborative instructional contexts. This finding indicates that while TPS is broadly effective, its impact may be influenced by underlying learner characteristics, including gender-related differences in participation patterns, confidence levels, and prior exposure to learning content. The slight advantage observed among male students should therefore be interpreted cautiously, as it may reflect contextual rather than inherent differences.

This finding contrasts with several previous studies that reported no significant gender differences in achievement when TPS was employed (Ugwu, 2019; Okekeokosisi et al., 2023; Okeke & Okolo, 2018). The divergence from these findings suggests that the influence of gender on learning outcomes may be context-dependent and shaped by socio-cultural, institutional, and pedagogical factors. Similarly, Mapulanga & Bwalya (2025) found that gender did not significantly influence achievement in Biology under TPS, indicating that the strategy is generally equitable in its design and implementation. This inconsistency across studies highlights the need for further investigation into contextual variables that may mediate the relationship between gender and academic achievement.

However, the present finding aligns with Berdousis & Kordaki (2015), who reported a significant gender difference favouring male students in Computer Science achievement. The observed difference in this study may be influenced by factors such as differential access to technology, varying levels of digital familiarity, and societal expectations regarding gender roles in STEM-related fields. In many developing contexts, male students may have greater exposure to computers and digital tools outside the classroom, which could enhance their confidence and performance during TPS activities. Additionally, cultural norms may influence classroom interaction patterns, with

male students more likely to take the initiative during discussions, thereby benefiting more from collaborative learning.

Furthermore, the collaborative nature of TPS, while generally inclusive, may produce varied outcomes depending on group dynamics and interaction styles. Russell & Cahill-O'Callaghan (2015) suggested that male students may be more inclined toward active verbal participation and assertive engagement in peer discussions, which could contribute to higher learning gains. Conversely, female students may require more supportive classroom environments that encourage equal participation and reduce potential barriers such as anxiety or reluctance to speak. This implies that TPS effectiveness can be maximised when teachers intentionally structure interactions to ensure balanced participation and equitable learning opportunities for all students.

Importantly, despite the statistically significant difference, the relatively small mean gain gap (2.29) indicates that TPS remains broadly effective for both male and female students. This suggests that TPS has the potential to reduce gender disparities over time, particularly when combined with gender-sensitive instructional practices. The structured phases of TPS thinking individually, discussing in pairs, and sharing with the class provide multiple entry points for participation, which can help build confidence among all learners. Therefore, educators should view TPS not only as a tool for improving academic achievement but also as a strategy for promoting inclusivity and equity in the classroom.

In sum, while gender differences were observed, the overall effectiveness of TPS in improving achievement for both groups reinforces its value as an inclusive instructional strategy. The findings suggest that with appropriate facilitation, TPS can create a supportive learning environment that accommodates diverse learners and promotes equal participation. Future research should explore how variables such as teacher facilitation style, classroom climate, and socio-cultural context interact with gender to influence learning outcomes in TPS settings. Such investigations will contribute to a more nuanced understanding of how cooperative learning strategies can be optimised to support equitable and meaningful learning experiences.

4. IMPLICATIONS AND CONTRIBUTIONS

4.1 Research Implications

The findings of this study have important implications for teaching and learning in computer studies at the secondary school level. The results indicate that the Think-Pair-Share learning strategy promotes active student participation, collaborative learning, and a deeper understanding of computer studies concepts. The strategy allows students to think independently, discuss ideas with peers, and share their responses with the class, thereby supporting meaningful learning and improving academic achievement. In addition, the findings show that the strategy helps reduce gender differences in students' achievement, suggesting that it provides equal learning opportunities for both male and female students. Therefore, computer studies teachers are encouraged to integrate the Think-Pair-Share learning strategy into their regular classroom practices in order to enhance students' engagement, understanding, and overall academic performance. The results also imply that curriculum planners and education authorities should promote learner-centred instructional approaches such as Think-Pair-Share in secondary school computer education.

4.1 Research Contributions

This study contributes to the existing body of knowledge on cooperative and learner-centred instructional strategies in computer education. Specifically, the study provides empirical evidence on the effectiveness of the Think-Pair-Share learning strategy in improving secondary school students' achievement in computer studies. It also contributes to research on gender equity in education by demonstrating that the strategy can reduce gender disparities in academic performance. Furthermore, the study provides practical insights for educators, school administrators, and policymakers on the importance of adopting interactive teaching strategies to improve learning outcomes in computer studies. By highlighting the effectiveness of Think-Pair-Share in real classroom settings, the study adds to the growing literature advocating collaborative learning strategies to enhance students' academic achievement and participation in technology-related subjects.

5. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

5.1 Research Limitations

This study was limited to Junior Secondary School Two (JSS2) students in selected secondary schools within the Aguata and Awka education zones of Anambra State, Nigeria. As a result, the findings may not be fully generalizable

to students in other educational levels, subjects, or geographical contexts. The study also used intact classes rather than randomly assigning individual students to experimental and control groups, which may have introduced pre-existing differences among participants that could have influenced the outcomes. In addition, the research relied on a single instrument, the Computer Studies Achievement Test (CSAT), which primarily measured students' academic achievement in computer studies. Consequently, other relevant learning outcomes, such as students' attitudes toward computer studies, motivation to learn, collaborative skills, and long-term retention of knowledge, were not examined. Furthermore, the duration of the instructional intervention was relatively short, which limited the ability to evaluate the long-term effectiveness of the Think-Pair-Share learning strategy.

5.1 Recommendation for Future Research Directions

Future studies should expand the scope of the research by involving students from different educational levels, subjects, and regions to determine the broader applicability of the Think-Pair-Share learning strategy. Researchers may also conduct longitudinal studies to examine the long-term impact of the strategy on students' academic achievement and knowledge retention. In addition, future research could employ mixed-methods approaches that combine quantitative and qualitative data to provide deeper insights into students' learning experiences, attitudes, and collaborative interactions during the implementation of the Think-Pair-Share strategy. Such investigations would contribute to a more comprehensive understanding of how cooperative learning strategies can support meaningful learning and improved educational outcomes.

6. CONCLUSION

This study demonstrated that the Think-Pair-Share (TPS) learning strategy has a significant positive effect on secondary school students' achievement in computer studies when compared with the conventional lecture method. The findings indicate that students taught using the TPS strategy performed better on the achievement test than those taught using the traditional teacher-centred instructional approach. The interactive nature of the TPS strategy encourages students to think independently, discuss ideas with peers, and actively participate in the learning process. Through these structured interactions, students can clarify their understanding, exchange perspectives, and deepen their comprehension of computer science concepts, which ultimately contributes to improved academic performance.

In addition to enhancing students' overall achievement, the findings also revealed slight differences in performance between male and female students when the TPS strategy was implemented. Although male students showed marginally higher achievement, the results suggest that the strategy fosters an inclusive learning environment that supports participation by both genders. The collaborative structure of TPS allows students to engage in shared learning experiences that foster confidence, communication, and critical thinking. This highlights the importance of adopting learner-centred instructional strategies in computer studies classrooms, as such approaches can help reduce learning barriers and encourage equitable participation among students.

Beyond its immediate classroom benefits, the results of this study carry broader implications for educational development and global technological advancement. Improving students' achievement in computer studies through interactive strategies such as Think-Pair-Share contributes to the development of essential digital competencies needed in the contemporary knowledge-based economy. By strengthening students' problem-solving abilities, communication skills, and collaborative learning habits, the TPS strategy prepares learners for future technological and professional challenges. Consequently, curriculum planners and educators should encourage the integration of Think-Pair-Share into regular teaching practices and promote a shift from traditional lecture-based instruction to more engaging, student-centred pedagogical approaches to enhance learning outcomes and support sustainable educational development.

Acknowledgments

The researchers sincerely appreciate the invaluable guidance of supervisors, the cooperation of participating schools, the support of colleagues, and the encouragement of family throughout this study.

CRediT Authorship Contribution Statement

All authors discussed the results, contributed to the final manuscript, and approved the final version for publication. Nneka Rita Nnorom: Conceptualization, Methodology; Validation; Formal analysis; Investigation,

Writing - Original Draft; Writing. Chinyere Francisca Okafor: Conceptualization, Review & Editing, Resources; Data Curation. Chisom Perpetua Okeke: Conceptualization, Review & Editing

Declaration of Generative AI (GenAI) Usage in Scientific Writing

The authors declare that generative artificial intelligence (GenAI) tools were used only for limited language assistance during the preparation of this manuscript. The AI tools were utilized to support grammar checking, language refinement, and clarity of expression. All conceptual development, research design, data collection, data analysis, interpretation of findings, and conclusions were carried out entirely by the authors. The authors carefully reviewed and edited all AI-assisted outputs and take full responsibility for the accuracy, integrity, and originality of the content presented in this article. All instances of Generative AI usage in this article were conducted by the authors in accordance with the SAJGTIE GenAI Tool Usage Policy, with the authors assuming full responsibility for the originality, accuracy, and integrity of the work."

Conflict of Interest Statement

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Informed Consent Statement

The authors declare that this study was conducted in accordance with research ethics, including obtaining approval from the relevant institution. This process respects the autonomy of participants, ensures the confidentiality of their data, and prioritizes their safety and well-being, in compliance with applicable research ethics guidelines. Written and verbal informed consent, or assent for minors, was obtained from all participants involved in the study.

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Author Information

[1] **Nneka Rita Nnorom,** nnekannorom94@gmail.com,
Department of Science Education, Faculty of Education, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra State, Nigeria
Address: QR9P+WFR, Uli, Atughobi, Nigeria

[2] **Chinyere Francisca Okafor,** cf.okafor@coou.edu.ng, https://orcid.org/0009-0004-4593-746X
Department of Science Education, Faculty of Education, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra State, Nigeria
Address: QR9P+WFR, Uli, Atughobi, Nigeria

[3*] **Chisom Perpetua Okeke,** chisomokeke85@gmail.com,
Department of Science Education, Faculty of Education, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra State, Nigeria
Address: QR9P+WFR, Uli, Atughobi, Nigeria