



JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION (JSTE)



**A PUBLICATION OF THE
DEPARTMENT OF SCIENCE,
TECHNOLOGY AND MATHEMATICS
EDUCATION (STME),
NASARAWA STATE UNIVERSITY, KEFFI, NIGERIA**



VOLUME 10

ISSN: 2651-5539

EFFECTS OF FLIPPED CLASSROOM AND JIGSAW I LEARNING STRATEGIES ON STUDENTS' ACHIEVEMENT IN HABITAT IN ABUJA MUNICIPAL AREA COUNCIL, ABUJA, NIGERIA

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Citation: Akor K. H., Agu P. A. & Aku P. E. (2026). Effects of flipped classroom and jigsaw I learning strategies on students' achievement in habitat in Abuja Municipal Area Council, Abuja, Nigeria. *Journal of Science, Technology, and Education (JSTE)*; www.nsukjste.com/. 10(21), 270-285.

Abstract

This study investigated the effects of the Flipped Classroom and Jigsaw I Learning Strategy on students' achievement in Habitat in Abuja Municipal Area Council. Three research questions guided the study and three hypotheses were tested at the 0.05 level of significance. A quasi-experimental design, specifically a non-randomized control group pretest–posttest design, was adopted. The population comprised 48,921 public Upper Basic II students in AMAC during the 2023/2024 academic session, from which three co-educational schools were selected using simple random sampling. The instrument used for data collection was the Habitat Achievement Test (HAT), which was validated by experts. Its reliability was established using the Kuder–Richardson Formula 21, yielding a coefficient of 0.81. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was

employed to test the hypotheses at the 0.05 level of significance. The findings revealed that gender did not have a significant effect on students' achievement when taught using the Flipped Classroom and Jigsaw I strategies. However, a significant difference existed in students' achievement across the three instructional methods: Flipped Classroom, Jigsaw I, and the conventional method. There was no significant interaction effect between teaching methods and gender on students' achievement. Based on the findings, it was recommended that Basic Science teachers adopt activity-based strategies such as the Flipped Classroom and Jigsaw I to improve students' achievement in Habitat, promote active learning, and reduce reliance on conventional teaching methods.

Keywords: Flipped Classroom, Jigsaw I Learning Strategy, Basic Science, Academic Achievement, Habitat and Student-Centered Learning.

Introduction

Science as a knowledge is the bedrock of national development. This implies that any nation seeking national development must

prioritize science education (Ebuka, 2017). In pursuit of the goals of "Science for all," current reforms in science education emphasize scientific literacy and the need to

achieve equity and excellence in science classrooms (Okeke, 2018). According to the Federal Republic of Nigeria (FRN, 2014), various modalities and strategies have been put in place to implement educational policies at different levels of science education, including the provision of instructional resources, health schemes, counseling services, resource centers, and specialist teachers. It also emphasized that teaching should be practical, exploratory, and experimental in nature (Okpala, 2017). However, these efforts have had relatively little impact on students' achievement in science subjects.

Several research reports (Ogbu, 2018; Thornton, 2018; Umar, 2017; Olorundare, 2019) indicated that students' achievement in science has been poor and unsatisfactory over the years, largely attributed to teaching methods (Ugama, 2016). Basic Science is the gateway science taught at the basic level to prepare students for core science subjects such as Chemistry, Physics, and Biology. It provides foundational scientific skills required for human survival, sustainable development, and societal transformation (Samuel, 2019). Despite its importance and emphasis in the curriculum (FRN, 2014), Basic Science education in Nigeria faces major challenges, as it often falls below expectations. According to Jacob (2020), science learning experiences are not consistent with societal demands, while

Lynch (2016) noted broader challenges affecting the delivery of science education in schools.

Adequate and qualitative education can only be achieved through effective teaching and learning, including the use of innovative instructional approaches. Nigeria aims to achieve quality education as stated in the National Policy on Education (FRN, 2014). Basic Science objectives aim to improve the production of scientists and national development; however, students' achievement remains low (Agu & Samuel, 2018). This persistent underachievement may jeopardize students' chances of placement in tertiary institutions and hinder national progress in science and technology (Salisu & Samuel, 2022). Despite efforts to improve learning outcomes, students' academic achievement in Basic Science in the Abuja Municipal Area Council (AMAC) in the Basic Education Certificate Examination (BECE) remains a concern.

The academic achievement of students in Abuja Municipal Area Council (AMAC) in the Basic Education Certificate Examination (BECE) is presented in Table 1.1. Table 1.1 reveals that the percentage of students achieving credit passes or higher in Basic Science has remained below 50% over the past seven years. Although grades D7 and E8 are considered passing, they are insufficient for students to pursue science-oriented subjects at the Senior Secondary School

level. The varied academic outcomes in Basic Science are likely influenced by factors related to teachers, students, and learning environments (Ezeoguine & Amaechi-Udogu, 2019).

The academic achievement of students in Abuja Municipal Area Council (AMAC) in the Basic Education Certificate Examination (BECE) is presented in Table 1.

Table 1: Statistics of Basic Science Students' Academic Achievement in Basic Education Certificate Examination (BECE) (2020-2025) in Abuja, Nigeria

Year	Number Registered	Number Sat	Distinction (A1–B1)	Credit (C6)	Pass (D7–E8)	Failure (F9)
2020	47,113	41,092	6,052	16,718	14,699	3,624
2021	48,148	47,988	7,613	20,115	16,608	3,652
2022	48,086	48,056	8,955	19,436	18,336	1,329
2023	49,231	48,921	4,562	18,634	20,819	4,906
2024	50,269	49,897	6,487	18,008	22,204	3,198
2025	51,214	50,873	6,359	17,398	23,403	3,714

Source: Department of Statistics, Education Resource Center, Abuja (2025)

Table 1 reveals that the percentage of students achieving credit passes or higher in Basic Science has remained below 50% over the past seven years. Although grades D7 and E8 are considered passing, they are insufficient for students to pursue science-oriented subjects at the Senior Secondary School level. The varied academic outcomes in Basic Science are likely influenced by factors related to teachers, students, and parents (Ezeoguine & Amaechi-Udogu, 2019). However, the conventional 'chalk and talk' method still predominates in many classrooms, where students remain passive and rote learning becomes the norm, which is detrimental to their academic development. Consequently, there has been a gradual shift

towards active, participatory learning strategies, such as the Flipped Classroom and Jigsaw I.

Although there is no universally accepted definition of a flipped classroom, its core idea is to shift learning by transmitting information before class through instructional videos and other resources (Goedhart, Westrhenen, Moser & Zweekhorst, 2019). It involves inverting the classroom, where activities traditionally done in class are done at home and vice versa (Lage, Platt, & Treglia, 2016). For this study, the definition by Bergmann and Sams (2022) is adopted, which explains that what is usually done in class is done at home, while class time is used for active learning

activities. The flipped classroom strategy involves out-of-class learning and in-class instructional activities (Kara, 2016), in which students learn content through videos (Hew & Lo, 2018).

The flipped classroom is a blended learning approach that inverts traditional teaching by delivering theoretical knowledge through videos outside the classroom, while class time is used for interactive activities (Onah, Momohjimo, & Ebubechukwu, 2021; Demiralay, 2018). This allows students to learn at their own pace before class, while teachers prepare digital materials and provide guidance. Students identify difficult concepts beforehand and engage more effectively during class activities (Abeysekera & Dawson, 2019; Kim, Park & Joo, 2018). The strategy emphasizes student-centered learning, active participation, increased class time for meaningful engagement, and flexible learning supported by technology. In this strategy, teachers provide guidance (Clark, 2017), while the flipped classroom allows class time to focus on higher-order thinking and meaningful learning activities (Strayer, 2017). The teacher acts as a facilitator, creating productive learning environments that help students develop essential skills (Abeysekera & Dawson, 2019).

Jigsaw I is a cooperative learning strategy that enables each student in a "home" group to specialize in one aspect of a topic, meet

with members of other groups assigned the same aspect, and then return to teach their group. In this way, each student serves as a piece of the topic's puzzle, and together they form the complete Jigsaw. The technique makes students dependent on one another to succeed and was designed by Aronson (1978) to promote interdependence in learning. Jigsaw I requires that each student understands the material well enough to teach it to others (individual accountability) and contribute meaningfully to group tasks (Zakiah, 2019). Students are divided into groups of 5–6, and each group is given a topic divided into sub-sections so that each student is assigned a section. After learning their sections, they regroup, teach one another, exchange questions, and ensure the subject is well understood (Eriba & Samuel, 2018; Agu & Samuel, 2018). This integration enhances understanding and promotes academic achievement, as each student becomes both a learner and a teacher (Samuel, 2019), unlike the conventional approach, which treats students as passive learners.

The conventional method of teaching remains the dominant approach adopted by many science teachers in Nigeria and is largely teacher-centered (Atadoga, Mari & Danjuma, 2016). In this approach, teachers write on the board while students listen and take notes of important ideas. Adegoke (2017) observed that students are not actively involved in developing knowledge and

generally remain passive throughout the lesson. This lack of active engagement contributes significantly to students' low academic achievement in Basic Science. Consequently, researchers such as Jegede and Adebayo (2022), Lynch (2016), and Eyimoga (2022) have continued their efforts to improve students' academic achievement in science subjects.

Academic achievement is a measure of educational output and reflects the extent to which a learner performs a given task (Adeyemi, 2018). It can be viewed as how well or poorly a learner performs academic activities during the learning process. Poor academic achievement is regarded as performance below the expected standard (Samuel, 2019) and is often associated with ineffective teaching strategies and low student participation. Academic achievement in Basic Science is essential because it determines students' readiness for advanced science subjects and influences their future academic pursuits.

Gender, defined as the socially and culturally constructed roles assigned to males and females (Ugwu & Nwagbo, 2019), has shown inconsistent influence on students' academic achievement in Basic Science. Studies have reported varying findings: some indicate female superiority (Alamri, 2018; Amedu, 2024), others male superiority (Obiekwe, 2017), and others no significant difference (Timayi, 2016). These inconsistencies

suggest that the influence of gender on academic achievement remains inconclusive and requires further investigation. It is against this background that this study investigates the effects of Flipped Classroom and Jigsaw I Learning Strategies on students' academic achievement in Habitat in Abuja Municipal Area Council, Abuja, Nigeria.

Statement of the Problem

Students' poor achievement in the topic of Habitat in Biology in the Abuja Municipal Area Council (AMAC), Abuja, Nigeria, can be linked to several learning difficulties and teaching challenges. Many students struggle to clearly understand the meaning of Habitat and how it differs from related terms such as ecosystem, environment, and niche, leading to misconceptions and incorrect answers. In addition, the topic is often taught abstractly, with insufficient practical examples, making it harder for students to grasp the concept fully. Basic Science is a critical subject for individuals pursuing science-oriented disciplines, as it provides the foundation for advanced studies. However, students' academic performance in Basic Science in the Abuja Municipal Area Council (AMAC), Abuja, Nigeria, remains persistently poor, as evidenced in Basic Education Certificate Examination (BECE) records. This trend is a major concern for educational stakeholders, as it threatens the development of science and technology in Nigeria.

One major factor contributing to this problem is the continued use of conventional teaching methods, which often fail to engage students and result in low achievement. Therefore, there is a need for more student-centered approaches. Strategies such as the flipped classroom and Jigsaw I learning methods have shown potential to improve student engagement and achievement. Consequently, this study investigates the effects of flipped classroom and Jigsaw I learning strategies on students' achievement in Habitat in the Abuja Municipal Area Council (AMAC), Abuja, Nigeria.

Objectives of the Study

The purpose of this study was to investigate the Effect of flipped classroom and jigsaw I learning strategies on students' achievement in Habitat in Abuja Municipal Area Council, Abuja, Nigeria. Specifically, this study:

1. ascertain the achievement of students taught Habitat using flipped classroom and Jigsaw I learning strategies and those taught using conventional teaching method.
2. determine the achievement of male and female students taught Habitat using flipped classroom learning strategy.
3. ascertain the achievement of male and female students taught Habitat using Jigsaw I learning strategy.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught Habitat using flipped classroom and Jigsaw I learning strategies and those taught using conventional teaching method?
2. What are the mean achievement scores of male and female students taught Habitat using flipped classroom learning strategy?
3. What are the mean achievement scores of male and female Students taught Habitat using Jigsaw I learning strategy?

Statement of hypotheses

The following research hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

H₀₁: There is no significant difference in the mean achievement scores of students taught Habitat using flipped classroom and Jigsaw I learning strategies and students taught using conventional method of teaching.

H₀₂: There is no significant difference in the mean achievement scores of male and female students taught Habitat using flipped classroom learning strategy.

H₀₃: There is no significant difference in the mean achievement scores of male

and female students taught Habitat using Jigsaw I learning strategy.

Methodology

The study adopted a quasi-experimental design with a non-randomized control group and a pretest-posttest/posttest design. This design was considered appropriate because complete randomization of participants was not possible without disrupting the normal classroom setting (Emaikwu, 2015), and the use of intact classes helped control interaction effects. The population comprised 48,921 students and 175 Junior secondary schools in AMAC, FCT, Abuja. A sample of 238 students was selected using simple random sampling, with 84 students in the flipped classroom group, 75 in the Jigsaw I group, and 79 in the control group. Three coeducational schools were randomly selected and assigned to experimental and control groups to control for gender.

The instrument used was the Habitat Achievement Test (HAT), comprising 30 multiple-choice items adapted from the BECE (2015–2023) and covering key habitat topics aligned with the Upper Basic II curriculum. The instrument was used for pretest and posttest to measure students' academic achievement. Validity was established through expert review by three lecturers, resulting in necessary corrections and an average validity index of 0.80. Reliability was determined through a trial test with 30 students, yielding a coefficient of 0.81 using the Kuder-Richardson 21 (KR-21) formula. Data were analyzed using mean and standard deviation to answer research questions, and Analysis of Covariance (ANCOVA) was used to test hypotheses at the 0.05 level of significance. Bonferroni Multiple Comparisons was further used to determine the direction of differences among the groups.

Result

Research Question One

What are the mean achievement scores of students taught Habitats using flipped classroom and Jigsaw I learning strategies and those taught using conventional teaching method?

Table 1: Mean Achievement Scores of Students Taught Habitats Using Flipped Classroom, Jigsaw I Learning Strategies and Those Taught Using Conventional Teaching Method

Group		Pretest	Posttest
FlipC	Mean	9.99	24.99
	N	80	80
	Std. Deviation	3.063	3.810
JigsI	Mean	9.80	19.40
	N	75	75
	Std. Deviation	2.584	4.027
CM	Mean	9.86	16.04
	N	79	79
	Std. Deviation	2.990	4.570

Table 1 shows that pretest mean scores of students taught using Flip classroom has a mean score of 9.99 with a standard deviation of 3.063 and a post test score of 24.99 with a standard deviation of 3.81, the group taught using Jigsaw I had a pretest mean score of 9.80 with a standard of deviation of 2.58, a

post test mean score of 19.40 and a standard deviation of 4.027, while the conventional group had a pretest mean score of 9.89 with a standard deviation of 2.990, with a posttest mean score of 14.04 and a standard deviation of 4.77.

Hypothesis One

There is no significant difference in the mean achievement scores of students taught Habitats using flipped classroom and Jigsaw I learning strategies and students taught using conventional method of teaching.

Table 2: ANCOVA Result of the Mean Achievement Scores of Students Taught Habitats Using Flipped Classroom, Jigsaw I Learning Strategies and Students Taught Using Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3253.124 ^a	3	1084.375	62.780	0.000	0.450
Intercept	7108.986	1	7108.986	411.576	0.000	0.642
Pretest	3.181	1	3.181	.184	0.668	0.001
Group	3244.286	2	1622.143	93.914	0.000	0.450
Error	3972.692	230	17.273			
Total	102473.000	234				
Corrected Total	7225.816	233				

a. R Squared = .450 (Adjusted R Squared = .443)

Table 2 ANCOVA result of the mean achievement scores of students taught habitats using flipped classroom and jigsaw I learning strategies and students taught using conventional method of teaching, since the F (1,93.914) with associated probability, $P=0.000$, $< \alpha = 0.05$, thus the hypothesis was rejected, implying that there was significant difference in the mean achievement scores of students taught habitats using flipped

classroom and jigsaw I learning strategies and students taught using conventional method of teaching. This is because the P-value is less than the alpha level of 0.05; therefore, the null hypothesis is rejected.

Based on the established difference in the achievement scores of the groups, Bonferroni Multiple Comparisons was used to determine the direction of the difference. The results of the analysis is presented in Table 3.

Table 3: Bonferroni Multiple Comparisons Results of Mean Achievement Scores of Students Taught Habitats Using Flipped Classroom and Jigsaw I Learning Strategies and Students Taught Using Conventional Method of Teaching

Pairwise Comparisons

Dependent Variable: Posttest

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
FlipC	JigsI	5.580*	0.668	0.000	3.968	7.191
	CM	8.944*	0.659	0.000	7.354	10.534
JigsI	FlipC	-5.580*	0.668	0.000	-7.191	-3.968
	CM	3.364*	0.670	0.000	1.749	4.980
CM	FlipC	-8.944*	0.659	0.000	-10.534	-7.354
	JigsI	-3.364*	0.670	0.000	-4.980	-1.749

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 3 shows the Bonferroni multiple-comparison results for the mean achievement scores of students taught habitats using the Flipped Classroom (FlipC), Jigsaw I (JigsI), and Conventional Method (CM). The results indicate a significant difference among the three instructional strategies.

The comparison between Flipped Classroom and Jigsaw I shows a mean difference of 5.580 with a p-value of 0.000. Since the p-value is less than the 0.05 significance

threshold, the null hypothesis was rejected. This implies that students taught with Flipped Classroom strategy achieved significantly higher mean scores than those taught with Jigsaw I.

When the Flipped Classroom and Conventional Method were compared, the mean difference was 8.944 with a p-value of 0.000. The null hypothesis was also rejected, indicating a significant difference in favour of Flipped Classroom. This suggests that

students exposed to Flipped Classroom strategy performed significantly better than those taught with the Conventional Method. The comparison between Jigsaw I and the Conventional Method showed a mean difference of 3.364 with a p-value of 0.000. Since this is significant, the null hypothesis was rejected, implying that students taught using Jigsaw I strategy also performed significantly better than those taught with the Conventional Method. The Bonferroni post-

hoc analysis revealed that the Flipped Classroom strategy produced the highest achievement scores, followed by Jigsaw I strategy, while the Conventional Method recorded the lowest mean scores. This result suggests that innovative, student-centered approaches such as the Flipped Classroom and Jigsaw I are more effective at improving students' achievement in habitats than the traditional, teacher-centered method.

Research Question Two

What are the mean achievement scores of male and female students taught Habitats using flipped classroom learning strategy?

Table 4: Mean Achievement Scores of Male and Female Students Taught Habitats Using Flipped Classroom Learning Strategy

GenderFC		Pretest	Posttest
Male	Mean	9.61	24.83
	N	36	36
	Std. Deviation	3.036	3.692
Female	Mean	10.30	25.11
	N	44	44
	Std. Deviation	3.085	3.943

Table 4 shows the mean achievement scores and standard deviation of male and female students in the Flipped Classroom (FC) group. For male students, the pretest mean score is 9.61 (SD = 3.036), while the

posttest mean score is 24.83 (SD = 3.692). For the female students, the pretest mean score is 10.30 (SD = 3.085), and the posttest mean score is 25.11 (SD = 3.943).

Hypothesis Two

H₀₂: There is no significant difference in the mean achievement scores of male and female students taught Habitats using flipped classroom learning strategy

The data used to test this hypothesis is presented in Table 4.5.

Table 5: ANCOVA Result of Mean Achievement Scores of Male and Female Students Taught Habitats Using Flipped Classroom Learning Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	31.414 ^a	2	15.707	1.084	0.343	0.027
Intercept	4919.292	1	4919.292	339.543	0.000	0.815
Pretest	29.859	1	29.859	2.061	0.155	0.026
GenderFC	3.425	1	3.425	0.236	0.628	0.003
Error	1115.573	77	14.488			
Total	51097.000	80				
Corrected Total	1146.987	79				

a. R Squared = .027 (Adjusted R Squared = .002)

Table 5 shows the ANCOVA result of the mean achievement scores of male and female students taught habitats using the Flipped Classroom (FC) strategy. The table shows that $F(1, 77) = 0.236$ with an exact probability value of 0.628 ($F(1, 77) = 0.236$; $p = 0.628 > \alpha = 0.05$). Since the associated

probability (0.628) is greater than the 0.05 level of significance, the null hypothesis was retained. This implies that there was no significant difference in the mean achievement scores of male and female students taught habitats using the Flipped Classroom strategy.

Research Question Three

What are the mean achievement scores of male and female students taught Habitats using flipped classroom learning strategy?

Table 6: Mean Achievement Scores of Male and Female Students Taught Habitats Using Flipped Classroom Learning Strategy

GenderFC		Pretest	Posttest
Male	Mean	9.61	24.83
	N	36	36
	Std. Deviation	3.036	3.692
Female	Mean	10.30	25.11
	N	44	44
	Std. Deviation	3.085	3.943

Table 6 shows the mean achievement scores and standard deviation of male and female students in the Flipped Classroom (FC) group. For male students, the pretest mean score is 9.61 (SD = 3.036), while the posttest

mean score is 24.83 (SD = 3.692). For the female students, the pretest mean score is 10.30 (SD = 3.085), and the posttest mean score is 25.11 (SD = 3.943).

Hypothesis Three

H₀₃: There is no significant difference in the mean achievement scores of male and female students taught Habitats using Jigsaw I learning strategy.

The data used to test this hypothesis is presented in Table 7.

Table 7: ANCOVA Result of Mean Achievement Scores of Male and Female Students Taught Habitats Using Jigsaw I Learning Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	337.266 ^a	2	168.633	14.073	0.000	0.281
Intercept	598.373	1	598.373	49.938	0.000	0.410
Pretest	335.708	1	335.708	28.017	0.000	0.280
GenderJI	1.944	1	1.944	0.162	0.688	0.002
Error	862.734	72	11.982			
Total	29427.000	75				
Corrected Total	1200.000	74				

a. R Squared = .281 (Adjusted R Squared = .261)

Table 7 presents the ANCOVA result of the mean achievement scores of male and female students taught habitats using the Jigsaw I learning strategy. The result shows that $F(1, 72) = 0.162$ with an exact probability value of 0.688 ($F(1, 72) = 0.162$; $p = 0.688 > \alpha = 0.05$). Since the associated probability

(0.688) is greater than the 0.05 level of significance, the null hypothesis was retained. This implies that there was no significant difference in the mean achievement scores of male and female students taught habitats using the Jigsaw I learning strategy.

Discussions of Findings

The study investigated the effects of flipped classroom and jigsaw I learning strategies on students' achievement in habitats in Abuja Municipal Area Council, Abuja, Nigeria. The findings revealed that;

There was a significant difference in the mean achievement scores of students taught using flipped classroom and jigsaw I learning strategies compared with those taught using the conventional teaching method. This finding is consistent with the work of Udo and Akpan (2020), Yusuf and Afolabi

(2019), and Olatoye (2018), who found that active, student-centered approaches such as the flipped classroom and cooperative learning strategies improve students' academic performance more than the conventional lecture method. Similarly, Orji and Ogar (2020) reported that jigsaw learning fosters collaborative interaction and peer teaching, thereby promoting a deeper understanding of the subject matter. On the contrary, however, Musa and Ibrahim (2017) and Okoli (2016) found that in some contexts, conventional methods produced

higher achievement, attributing this to students' familiarity with traditional instructional practices. This could be that flipped classroom and jigsaw strategies provide students with opportunities for active participation, peer-to-peer learning, and self-paced study, thereby improving comprehension and achievement. The flipped classroom allows learners to preview content before class and engage in interactive activities during lessons, promoting critical thinking and problem-solving. Similarly, the jigsaw I strategy compels students to become "experts" on subtopics and teach their peers, thereby reinforcing their own understanding. These approaches not only enhance achievement but also build confidence, responsibility, and communication skills, making them effective alternatives to conventional teaching methods.

The analysis revealed no significant difference in the mean achievement scores of male and female students taught habitats using the flipped classroom strategy. This suggests that the flipped classroom approach was equally effective at enhancing achievement, regardless of gender. In other words, both male and female students benefited similarly from the opportunities for pre-class engagement, active participation, and collaborative learning activities provided by the strategy. This finding aligns with the reports of Okonkwo (2019), Adebayo and Musa (2020), and Ijeoma (2021), who found

no significant gender difference in academic achievement when innovative, student-centered strategies were employed in science classrooms. These authors emphasized that active learning strategies tend to neutralize gender-based differences that often emerge in conventional teaching settings. Similarly, Ajayi and Bello (2022) concluded that flipped classrooms create inclusive environments in which all learners, regardless of gender, can engage meaningfully with the content. Conversely, the result contrasts with the findings of Usman (2017) and Olayinka (2018), who observed that male students sometimes outperform females in science-related subjects, attributing this to societal stereotypes, self-concept, and differential encouragement. The present finding, therefore, provides evidence that when instructional strategies are properly designed to engage all learners, gender disparities in achievement can be minimized.

The analysis showed that there was no significant difference in the mean achievement scores of male and female students taught habitats using the Jigsaw I learning strategy. This indicates that the Jigsaw I strategy provided equal learning opportunities and benefits to both male and female students. The cooperative and interdependent nature of the Jigsaw method ensured that all learners, regardless of gender, actively participated in group tasks

and contributed meaningfully to the learning process, thereby leveling performance outcomes. This finding is consistent with those of Okonkwo (2019), Adebayo and Musa (2020), and Ijeoma (2021), who reported that innovative, cooperative instructional approaches tend to minimize gender disparities in science classrooms. These studies found that when learners collaborate in structured group activities, both male and female students achieve comparable levels. Similarly, Ajayi and Bello (2022) observed that cooperative strategies such as the Jigsaw method promote inclusivity and equal participation, thereby fostering balanced academic achievement across genders. However, this result contrasts with the findings of Usman (2017) and Olayinka (2018), who argued that male students sometimes perform better in science-related subjects due to socio-cultural factors, self-confidence, and gender stereotypes. The current study provides evidence that such disparities can be mitigated when gender-friendly instructional strategies, such as Jigsaw I, are adopted. This could be that since Jigsaw I learning strategy fosters equity in learning outcomes by allowing both male and female students to contribute and benefit equally from group-based tasks. It therefore reinforces the potential of cooperative learning approaches to reduce gender gaps in science education

and to promote fairness and inclusivity in the classroom.

Conclusion

The results show that students taught with the Flipped Classroom and Jigsaw I learning strategies achieved significantly higher scores in Habitat than the control group. The study suggests that Flipped Classroom and Jigsaw I learning strategies are effective for enhancing secondary school students' achievement in Habitat.

Recommendations

In light of the findings of this study, it was recommended that:

1. Basic science teachers should adopt activity-based methods such as the flipped classroom and jigsaw I learning strategies, as these encourage and motivate students in the learning process, promote learning by doing, allow students to discover facts for themselves, and aid their achievement in Habitat.
2. Basic science teachers should be dissuaded from using conventional teaching methods that promote rote learning and make learners passive in basic science classrooms.
3. Pre-service teachers should be trained in the use of activity-based methods, such as the flipped classroom and jigsaw I learning strategies, in teaching science concepts.

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