

Jigsaw Cooperative Instructional Strategy and Students' Achievement in Civic Education: Implications for Sustainability Education

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Abstract

This study examined the effect of Jigsaw Cooperative Instructional Strategy (JCIS) on students' achievement in Civic Education, with particular attention to gender dimensions and implications for sustainability education. This research adopted a non-equivalent pretest-posttest control group quasi-experimental design. The study sampled 586 Senior Secondary II (SSII) students from government-owned schools using a multistage sampling procedure. A validated 50-item Civic Education Achievement Test (CEAT) with a reliability coefficient of 0.89 served as the research instrument. Data were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA) at a 0.05 significance level. The findings revealed that students taught Civic Education using JCIS achieved significantly higher mean scores than those exposed to conventional instructional strategies. Male students recorded substantially higher mean scores (69.01) than females (64.49), but there was no significant interaction effect between instructional strategy and gender on achievement. The study concluded, amongst others, that JCIS enhances students' academic outcomes in Civic Education. This research contributes to the existing literature by revealing that JCIS, as an effective instructional strategy, can be leveraged to advance equity, inclusivity, and transformative civic learning.

Keywords: academic achievement, civic education, gender, jigsaw cooperative learning, sustainability education

1. Introduction

All over the world, teaching serves as the medium through which knowledge is transmitted to people for the purpose of personal growth and development. The teaching-learning process involves several factors, ranging from personal factors such as teacher gender, qualification, marital status, socioeconomic status, and psychological traits, to school factors including facilities, classroom issues, school type, and instructional resources. Research has established that these factors impact the products of learning institutions across levels (Nkanu et al., 2025; Johnson et al., 2024; Nwafor et al., 2024a; Nwafor et al., 2024b; Adams et al., 2024; Ekpoto et al., 2022; Ekpoto & Bassey, 2018). One key factor

that significantly impacts students' learning in schools is the instructional strategy used to deliver content knowledge. The method or strategy employed by the teacher in the teaching-learning environment has been reported to have a tremendous effect on the academic achievement of learners (Nkanu et al., 2024 & 2025; Johnson et al., 2024).

Over the years, scholars have advocated for a shift from the teacher-centered instructional method to a learner-centered approach (Nkanu et al., 2025; Johnson et al., 2024; Johnson et al., 2025; Ekpoto & Adie, 2025; Zarnita et al., 2019; Suparwati, 2024; Shofa et al., 2024; Addo et al., 2025). Scholars who support learner-centered teaching and learning strategies hold the view that it is more student-friendly compared to the teacher-centered method (Igba & Nwafor, 2016; Zarnita et al., 2019). These researchers averred that a student-centered strategy not only easily engages students but also elicits their interest and boosts their academic achievement. Jigsaw Cooperative learning strategy, a well-known student-centered teaching method, has become one of the best ways to consider when seeking a holistic and innovative instructional strategy that yields desirable classroom teaching and learning outcomes. It emphasizes organized group work, where students collaborate to solve problems and build knowledge, which helps them better understand and retain ideas (Suparwati, 2024; Shofa et al., 2024).

Besides the Jigsaw technique, there are other examples of cooperative learning strategies like Think-Pair-Share, and Team-Assisted Individualization that have proven to encourage peer interaction, lower learning anxiety, and make all students feel belonged (Igba & Nwafor, 2016; Zarnita et al., 2019; Suparwati, 2024; Shofa et al., 2024). These teaching-learning strategies not only help students achieve better in school, but they also help students learn how to communicate and get along with others. Regardless of gender, these strategies, particularly the Jigsaw cooperative instructional strategy (JCIS), inculcate in students rare nation-building skills which are in very high demand in our world today (Igba & Nwafor, 2016). Recent studies have demonstrated that employing gender-sensitive cooperative teaching methods enhances both boys' and girls' engagement, confidence, and academic success (Suparwati, 2024; Shofa et al., 2024). These scholars' assertion validates the view that engaging cooperative tactics in Civic Education and other courses may enhance learning outcomes as well as elicit unbiased participation and achievement among school children, irrespective of their biological sex.

Although the world is moving towards more student-centered pedagogies in educational institutions, Civic Education in Nigeria continues to be presented mostly along the traditional, teacher-centered means, which restricts the involvement of learners and the critical thinking process. This position is not ideal, as Civic Education is core to equipping the young at heart with democratic citizenship, social responsibility, and sustainable development. Although international research evidence on cooperative learning techniques, such as the Jigsaw model, has demonstrated evidence-based approaches to promote collaboration, inclusiveness, and improved learning, research in Nigeria has been limited, scattered, and primarily focused on science and mathematics subjects. Little research has been conducted on a systematic study of the application of the Jigsaw Cooperative Instructional Strategy (JCIS) in Civic Education, with a specific focus on gender responsiveness and its overall impact on sustainability education. This loophole is critical since the Civic Education classrooms are a significant platform to foster values like equity, empathy, cooperation, and responsible citizenship (which are vital towards the attainment of Sustainable Development Goal (SDG) 4.7). To fill this gap, the current study investigates the impact of JCIS on students' achievements in Civic Education in Nigeria, with a particular focus on gender differences and implications for sustainability-oriented learning.

2. Research Questions

- 1) What is the effect of the Jigsaw co-operative instructional strategy on the mean achievement of male and female students in Civic Education?
- 2) What is the interaction effect of instructional strategies and gender on students' achievement in Civic Education?

3. Research Hypotheses

Two hypotheses guided the study at 0.05 level of significance.

- H0₁: The Jigsaw cooperative instructional strategy has no significant effect on the mean achievement of male and female students in Civic Education.
- H0₂: There is no significant interaction effect of instructional strategies and gender on students' mean achievement in Civic Education.

4. Literature Review

4.1 Theoretical Framework

The research is grounded in Social Interdependence Theory (Deutsch, 1949; Johnson & Johnson, 2005), which offers the theoretical basis for the success of cooperative learning techniques, such as the Jigsaw Cooperative Instructional Strategy (JCIS). Social Interdependence Theory posits that the interdependence pattern among group members determines how they interact with one another, which in turn influences their educational and social outcomes. Promotive interaction, mutual support, and collective responsibility are encouraged by positive interdependence, whereby learners feel that they cannot reach their learning objectives unless their classmates succeed. In contrast, negative interdependence results in competition and reduced collaborative efficiency.

Within the framework of JCIS, the Social Interdependence Theory explains why students instructed using this theory exhibit greater performance than those exposed to traditional methods. JCIS establishes circumstances that foster positive interdependence through the individual roles of students in groups, accountability, and by encouraging in-person interaction. The processes enhance knowledge, interest, and memorization of Civic Education materials. The theory also applies to the gender dimension of this study. The structure of social interdependence minimizes the chances of bias and marginalization, as each learner makes a significant contribution to the group's success. Therefore, the nature of differences in achievement between male and female schoolchildren may be analyzed more effectively in the context of interactional dynamics determined by cooperative structures.

Lastly, the application of the Social Interdependence Theory can be linked to aspects of sustainability education, as outlined in SDG 4.7. JCIS develops the civic skills required to participate in a democratic process, build social integrity, and foster sustainable communities through collaboration, empathy, diversity, respect, and responsibility. This theoretical framework, therefore, not only explains why JCIS should be adopted in Civic Education, but also highlights the broader impacts of this on equity, inclusivity, and sustainable development of a society.

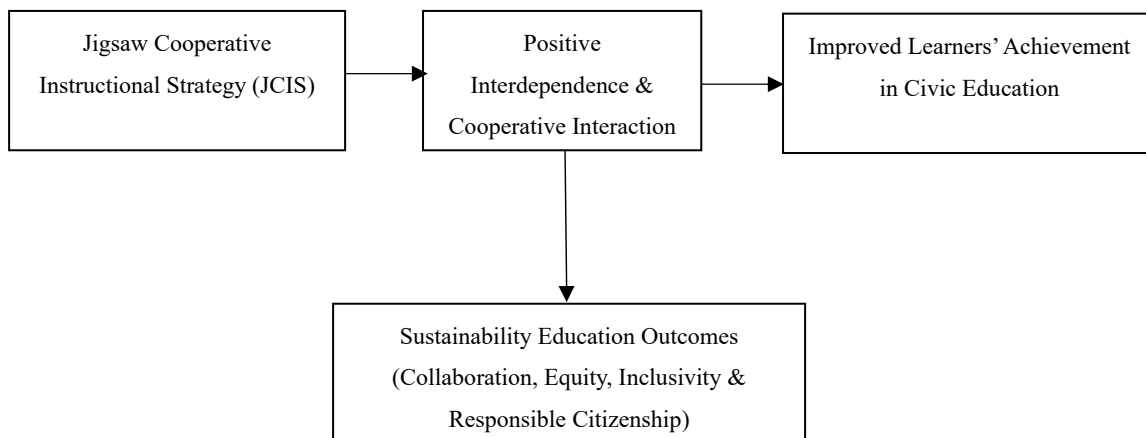


Figure 1. Conceptual Framework Linking Jigsaw Cooperative Instructional Strategy (JCIS), Social Interdependence Theory, Student Achievement in Civic Education, and Sustainability Education Outcomes

The conceptual framework for this study, as presented in Figure 1, is grounded in Social Interdependence Theory. It demonstrates how the Jigsaw Cooperative Instructional Strategy (JCIS) fosters positive interdependence, enhances student achievement in Civic Education, and contributes to sustainable education outcomes, including collaboration, inclusivity, and responsible citizenship.

4.2 Related literature

This research reviewed several existing studies on JCIS and gender in relation to learners' school achievement in Civic Education. The Jigsaw Cooperative Instructional Strategy (JCIS) has been identified as one of the most heavily studied instructional innovations in the past 50 years, as Cooperative Learning has become one of the most popular instructional innovations in the last half-century. JCIS orchestrates interdependence and accountability in small groups. Overall, empirical studies based on various settings also attest to JCIS increasing engagement, retention, and cognitive learning outcomes when compared with teacher-centered approaches (Zarnita et al., 2019; Shofa et al., 2024; Suparwati, 2024; Tukiyantini, 2023). These articles clarify the effectiveness of JCIS due to its core process characteristics: organized roles, interdependence, peer explanation, and repetitive rehearsal, which lead to more intense

processing and distributed cognition. The overall findings are thus consistent with the hypothesis that JCIS is pedagogically sound and can be effectively applied in various subject domains.

Nevertheless, a close analysis of the literature shows some significant nuances and shortcomings that narrow wholesale assertions about JCIS. To begin with, the majority of strong results are obtained in the case of short-lasting interventions (one to several lessons or cycles) and quasi-experimental designs with low randomization (Zarnita et al., 2019; Shofa et al., 2024). Although the designs are functional in actual classrooms, they can be compromised by several factors, including novelty, variation in implementation by the teacher, and maturation. Second, most empirical studies focus on STEM subjects (mathematics, physics, biology) where problem-solving and verification of discrete answers can increase observable learning outcomes (Bernadette et al., 2024; Fasasi & Hussaina, 2022; Mbacho, 2022; Kairo, 2023; Kebede et al., 2025; Nduji et al., 2020). There is relatively little and frequently descriptive evidence directly relevant to JCIS in Civic Education—a subject that foreshadows values, discourse, and civic competence.

Another evidence gap is the gender difference in the results of cooperative learning. Some extensive and cross-national studies indicate that gender differences in achievement and participation may be reduced by enabling cooperative learning, which facilitates shared responsibility and collaborative norms (Kiragu et al., 2023; Prieto-Saborit et al., 2021). On the other hand, there are also smaller research and field-specific reports that reflect continued male advantages in specific contexts related to cooperation, which are often attributed to patterns of interaction, confidence, or group position (Healy et al., 2018; Ifegbo & Onwuagboke, 2024). According to country- and culture-specific studies (Bhardwaj, 2025; Kairo, 2023; Mbacho, 2022), a lack of significant gender interaction is demonstrated; however, the samples and situational peculiarities differ greatly. These contradictions lead to two conclusions: (a) gender effects are context dependent and mediated by group processes and teacher facilitation, and (b) not all of the current studies are constructed to unpack process-level mechanisms (e.g., who talks, who leads, how roles are distributed), thus constraining causal interpretation.

Another weakness of the existing literature is the inadequate association of JCIS results with more comprehensive educational goals, including sustainability education and civic competence. Although researchers state in theory that cooperative learning can lead to the development of the values and skills that are relevant to Sustainable Development Goal (SDG) 4.7, e.g., empathy, dialogue, and collective problem solving, the existing empirical evidence associating JCIS with sustainable development-related dispositions, civic attitudes, or long-term civic behavior is still absent (Prieto-Saborit et al., 2021; Tukiyantini, 2023). The majority of studies identify short-term cognitive results (test scores, immediate engagement), but do not extend to measuring attitudinal change or transfer to practices at the community level that sustainability education aims to achieve.

Methodological gaps also hamper cumulative knowledge. The measurement is commonly restricted to single measures whose reliability has been reported on a short basis; little or nothing is reported on fidelity of implementation (e.g., checklist of adherence, teacher-training records, or independent observation); and the sampling is often based on convenience or intact classes with no intra-cluster correlations being reported or no attempt to adjust for the effects of clustering in the analysis. Such deficits increase the possibility that measured effect sizes are partly due to implementation artifacts, rather than consistent pedagogical effects.

Combined, the available literature confirms the pedagogical potential of JCIS. However, it leaves critical points unanswered: Can JCIS generate meaningful gains in achievement in Civic Education - a subject with much normative and discursive content - in situations where teacher-centered traditions are deeply rooted? What are the gender interactions in JCIS in the context of Nigerian classrooms, specifically where culture and practices in classrooms can influence the participation pattern? Notably, does JCIS add more than cognitive benefits to the sustainability-related outcomes that Civic Education hopes to develop (e.g., inclusivity, civic responsibility, collective problem-solving)?

The current research aims to fill these gaps by implementing JCIS in Civic Education classes within a Nigerian context, utilizing a quasi-experimental design with a pretest and posttest control group, a large sample size ($n = 586$), and ANCOVA to standardize baseline differences. Based on the Social Interdependence Theory, the analysis, in turn, explores the effects of gender on the same and relates the results of achievement to the consequences related to sustainability education. Thus, by emphasizing a non-STEM topic, reporting instrument validity, and multistage sampling of state schools, this study provides empirical data where it is most necessary: the ability of JCIS to support cognitive and normative educational outcomes in Civic Education and the possibility of developing competencies related to sustainability in a Sub-Saharan African setting.

5. Method

This work employed a non-equivalent pretest-posttest control group quasi-experimental design. The design was considered suitable as intact classes were utilized and randomly allocated to the control and experimental groups. The use of intact classes aimed to prevent disruptions to regular classes during the study's duration.

5.1 Population and sample

The research population consisted of 6,102 senior secondary II (SSII) learners from the 65 government-owned schools in the Onueke Education Zone. The multistage sampling methodology, incorporating stratified random and convenience sampling approaches, was utilized to select 586 SSII students for the study as follows: The zone was divided into four parts, each representing one LGA; two LGAs were randomly chosen through balloting with replacement. One LGA, comprising 186 students (77 male and 109 female), was randomly designated as the experimental group. In contrast, the other LGA, comprising 395 students, of which 190 were males and 205 were females, was assigned to the traditional class.

The study utilized a 50-item Civic Education Achievement Test (CEAT) as the data analysis instrument. The validation was conducted by three experts: two from educational tests and measurement, and one in Social Studies at Ebonyi State University. The reliability of CEAT was verified using 20 learners selected from a school located outside the research area. The Kuder-Richardson 20 (KR-20) statistic yielded a reliability coefficient of 0.89, indicating strong internal consistency and rendering the instrument suitable for the investigation. The CEAT was administered as a pretest to both groups used in the research. The researchers conducted this in the classroom with the support of the class teachers. Upon completion of the test, the learners' pretest results were documented and retained for future reference. The identical test was re-given to the learners as a posttest at the conclusion of the six-week trial session, and their performance was documented. The scores obtained from the CEAT testing were analyzed using mean and standard deviation to address the study questions. However, ANCOVA was employed to evaluate the null hypotheses at a 0.05 level of significance.

5.2 Experimental Procedure

Four secondary schools that have intact classes/streams of SSS II were selected and grouped into two. One of the two groups was assigned to the treatment condition as the experimental Group, while the remaining Group was assigned to the control group. At the beginning of the experiment 'Civic Education Achievement Test (CEAT)' was administered to both treatment and control groups as pretest. Four class teachers of Civic Education trained as research assistants and closely supervised by the researchers carried out this task in the classroom. At the end of the test, scores of the students on the pretest were recorded and kept. The same instrument was administered to the students at the end of the experimental period and their achievements recorded as posttest. The treatments were:

- 1) Experimental Group - Use of the Jigsaw cooperative instructional strategy
- 2) Control Group - Use of conventional instructional strategy

6. Result

RQ₁: What is the effect of the Jigsaw co-operative instructional strategy on the mean achievement of male and female students in Civic Education?

Table 1. Mean Achievement of Male and Female Students Taught Civic Education Through Jigsaw Cooperative Instructional Approach

Gender	Mean	SD	Mean diff.
Male	69.01	7.81	
Female	64.49	6.42	4.52

The analysis outcome in Table 1 disclosed that Jigsaw cooperative instructional approach had improved impact on male learners. This is since the male learners had mean value of 69.01 ± 7.81 while the female student had means score of 64.49 ± 6.42 .

RQ₂: What is the interaction effect of instructional strategies and gender on students' achievement in Civic Education?

Table 2. Interaction Effect of Instructional Strategies and Gender on Students' Achievement in Civic Education

Strategy	Male	Female
Jigsaw co-operative	69.01	64.49
Conventional	49.57	49.46

The result in Table 2 showed that the instructional strategies used in teaching Civic Education had no interaction effects on secondary school achievement in both groups. This is because male and female learners in the experimental group, who were instructed with the Jigsaw strategy, had a mean score of 69.01 and 64.49, respectively, while their counterparts in the control group had a mean score of 49.57 and 49.46, respectively. Therefore, there is no interaction effect among instructional approaches and gender on the learner's mean achievement in Civic Education in the study area.

H0₁: Jigsaw cooperative instructional strategy has no significant effect on the mean achievement of male and female students in Civic Education.

Table 3. Analysis of Covariance on the Effect of Jigsaw Cooperative Instructional Strategy on Students' Mean Achievement of Male and Female Students in Civic Education

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.
Corrected Model	100026.267 ^a	4	25006.567	443.441	.000
Intercept	47887.447	1	47887.447	849.187	.000
Pretest	1.448	1	1.443	0.26	.873
Method	51584.740	1	51584.740	914.751	.000
Gender	220.202	1	220.202	3.905	.004
method * gender	16.266	1	16.266	.288	.591
Error	32481.871	576	56.392		
Total	2282713.000	581			
Corrected Total	132508.138	580			

a. R Squared = .755 (Adjusted R Squared = .753)

Table 3 showed a probability value of .004, which is less than the 0.05 alpha level. This outcome indicates that the hypothesis stating the jigsaw cooperative instructional approach has no significant effect on the mean achievement of male and female learners in Civic Education was rejected. This means a significant disparity exists between the mean achievement of male and female learners instructed in the Civic Education classroom with the jigsaw cooperative instructional approach.

H0₂: There is no significant interaction effect of instructional strategies and gender on students' mean achievement in Civic Education.

Table 4. Analysis of Covariance (ANCOVA) for Students' Achievement Based on Instructional Strategies and Gender

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.
Corrected Model	100026.267 ^a	4	25006.567	443.441	.000
Intercept	47887.447	1	47887.447	849.187	.000
Pretest	1.448	1	1.448	0.26	.873
Method	51584.740	1	51584.740	914.751	.000
Gender	220.202	1	220.202	3.905	.004
method * gender	16.266	1	16.266	.288	.591
Error	32481.871	576	56.392		
Total	2282713.000	581			
Corrected Total	132508.138	580			

a. R Squared = .755 (Adjusted R Squared = .753)

The results in Table 4 revealed a probability score of 0.591, which is higher than the 0.05 alpha level. This indicates that the null hypothesis, which holds that there is no significant interaction effect of instructional strategies and gender on learners' average scores in Civic Education, is not rejected.

7. Discussion

The results of this work demonstrate that the Jigsaw Cooperative Instructional Strategy (JCIS) can significantly enhance student performance in the Civic Education area when traditional, teacher-centered techniques are employed. This stand aligns with Social Interdependence Theory (Deutsch, 1949; Johnson & Johnson, 1989), which posits that positive interdependence structures foster promotive interaction, shared responsibility, and mutual support. Each of the students in the JCIS groups had a distinct share in the content, thus forcing them to work collectively and strengthening profound comprehension. The theoretical lens reveals the learning gains demonstrated: students did not passively receive information, but instead built knowledge collaboratively, which resulted in better retention of knowledge and higher test scores.

The observation of a significant positive impact of JCIS on Civic Education results aligns with Zarnita et al. (2019), Shofa et al. (2024), and Suparwati (2024), who all found that JCIS has a positive impact on student engagement and academic performance. On the same note, Tukiyantini (2023) discovered that the model enhances motivation and collaborative learning behavior. However, the majority of these studies were in STEM settings. The current research expands the current knowledge base to the area that is not as widely researched by proving the efficiency of JCIS in Civic Education, which is one of the subjects where values, dialogue, and civic competence receive significant focus (Mbacho, 2022; Kairo, 2023; Kebede et al., 2025). This extension is severe since Civic Education serves at the center of equipping young people with responsible citizenship and sustainability-oriented behavior, implying that JCIS is not merely a cognitive instrument, but also a normative pedagogy.

The findings regarding gender are more subtle. Higher mean scores were observed among male students compared to female students, although the interaction between gender and instructional strategy was not significant. This finding is consistent with the results of Kairo (2023) and Kebede et al. (2025), who found that cooperative learning is a significant contributor to student performance, independent of gender, with no significant gender interaction effects. Meanwhile, the male margin is slight, but this finding aligns with Healy et al. (2018), who found that males tend to report greater perceived gains in communication and leadership skills in cooperative settings. On the other hand, the result contrasts with the study conducted by Prieto-Saborit et al. (2021), who found that cooperative learning can narrow the gender gap, especially in math. These dual trends highlight the contextual sensitivity of the gender influences in cooperative learning. The cultural dynamics, participation norms, and role assignments in Nigerian Civic Education classrooms might impact the experience of male and female learners in JCIS. However, the fact that no strong interaction effect was found in this study suggests that JCIS is, in fact, a fair instructional model.

Notably, the results support the claim that JCIS is especially useful in Civic Education because it improves both academic performance and the civic skills of communicating, empathizing, and being responsible (Igba & Nwafor, 2016). This study amplifies the significance of this issue by presenting strong quantitative data that illustrate a Nigerian context where JCIS could be effectively applied in Civic Education pedagogy.

The most important aspect of this study is that it expands JCIS's potential for sustainability education. JCIS, in contrast to the teacher-centered approach, requires learners to collaborate, empathize with each other, and engage in conversation, which are pillars of Sustainable Development Goal (SDG) 4.7. In particular, JCIS can develop competencies relevant to sustainability: (a) teamwork and collaboration, as students rely on the input of their colleagues; (b) equity and inclusivity, as group achievement needs to involve all members, irrespective of gender; (c) empathy and respect of diversity, as students are asked to engage in deliberation and joint problem solving. These competencies transcend short-term success to equip learners to be responsible citizens, resilient in their community, and sustainable in the long term within society.

The results, therefore, show that JCIS is not only a valuable teaching tool in raising test scores but also a pedagogy that is transformative in enhancing civic dispositions congruent with sustainability education. Connecting the Social Interdependence Theory to empirical findings in Civic Education, the study provides not only a contribution to the theory but a practical model on how to balance the instructional practice with the educational agenda worldwide. In the case of Nigeria, where teacher-centered strategies still dominate the classroom, the adoption of JCIS is a strategic path that will empower the nation to produce a generation of learners possessing the cognitive, social, and civic skills needed to achieve sustainable development in the country.

8. Conclusion

This paper examined how the Jigsaw Cooperative Instructional Strategy (JCIS) influences student performance in Civic Education in Nigeria, with a focus on gender disparities as well as implications of sustainability. The results showed that JCIS did an excellent job in enhancing student performance compared to traditional teacher-centered methods. The mean scores of male students were higher than those of female students. However, the interaction between the genders and the instructional strategy was not significant, indicating that JCIS functions fairly regardless of the group.

These findings, based on Social Interdependence Theory, demonstrate that JCIS fosters positive interdependence, accountability, and promotive interaction, which in turn enhance academic achievement and inclusive learning. Notably, the research builds on the discussion around cooperative learning, demonstrating that JCIS can be applied not only to STEM disciplines but also to Civic Education, which is at the core of equipping students with knowledge of democracy, active citizenship, and sustainable development. JCIS contributes to the competencies described under Sustainable Development Goal (SDG) 4.7 by fostering collaboration, equity, empathy, and dialogue.

This study thus contributes in three ways: (1) empirically confirming the efficacy of JCIS as an effective pedagogy in Civic Education in Nigeria; (2) confirms the effectiveness of jigsaw cooperative learning across gender; and (3) connecting cooperative learning with sustainability learning in a developing country setting. These contributions demonstrate that JCIS is a cognitive and normative pedagogy that can promote quality, inclusive, and sustainability-based education.

9. Recommendations

This research recommends the following:

1. Curriculum Integration: JCIS, along with other cooperative learning strategies, should be regularly incorporated into the Civic Education curriculum as a standard pedagogical method for enhancing academic and civic skills.
2. Teacher Professional Development: The school leadership and teacher training colleges must arrange frequent workshops and capacity-building programs to equip teachers with the necessary practical skills to implement JCIS successfully, as well as to attain fidelity to its core values of positive interdependence and individual responsibility.
3. Gender-Responsive Pedagogy: Educators should be made gender-sensitive to observe participation patterns in JCIS groups, thereby avoiding implicit gender imbalances and promoting equal input from male and female students.
4. Policy and Practice Consistency with SDG 4.7: Policymakers must acknowledge that JCIS is not only a method of teaching but also facilitates the achievement of SDG 4.7 by promoting inclusivity, civic engagement, and sustainability-based learning outcomes in schools in Nigeria.
5. Future Research: The longer-term effects of JCIS on civic dispositions, democratic behavior, and sustainability practices—measures that are not captured by test scores—should be examined in the future using mixed-methods designs to assess both cognitive and affective responses.

10. Implications for Sustainability Education

This research indicates that the Jigsaw Cooperative Instructional Strategy (JCIS) not only enhances academic performance in Civic Education but also helps achieve the long-term objectives of sustainability education. Through the promotion of good interdependence and participation on equal terms, JCIS develops competencies that extend beyond classroom test results, encompassing social, civic, and ethical competencies essential for sustainable societies.

To start with, the strategy enhances cooperation, critical thinking, and inclusiveness, which are cornerstones of economic innovation, social harmony, and environmental accountability. When students rely on each other as a group to achieve results, they develop the transferable skills of working as a team, engaging in dialogue, and collaborating to solve problems, which are essential for sustainable development projects.

Second, JCIS establishes Civic Education as a place of cultivating democratic participation and accountable citizenship. JCIS teaches respect towards diversity, empathy, and civic responsibility because it compels students to build and share knowledge. These are the skills that cannot be eliminated in the process of peace-building, community resilience, and participatory governance, which are key aspects of sustainability.

Third, the observation that JCIS positively influences both male and female learners without interaction effects indicates that it can contribute to gender equity and social inclusion. This finding is directly consistent with the 'leave

no one behind' principle of the Sustainable Development Goals, which aims to close the gaps in participation and place as many learners in similar positions as possible.

Last but not least, the results underscore a systematic need for teacher training in cooperative, learner-centered pedagogies. Providing teachers with the expertise to utilize JCIS effectively will lead to sustainability-based competencies being internalized in day-to-day classroom activities, rather than being viewed as impractical policy aspirations.

Collectively, the implications of this research confirm that JCIS is not merely a teaching method but a revolutionary pedagogy. The progressive application of Civic Education can equip learners to be critically oriented in governance, environmental protection, and social accountability, thereby building a strong, inclusive, and sustainable society.

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Authors contributions

P.I.N., D.F.E., A.P.A. and E.O.O. were responsible for study design and revising. C.U.N., V.S.A., D.I.O., A.O.E. and F.I.A. were responsible for data collection, analysis and discussion of result. P.I.N., D.F.E., A.B.O., E.U.O. and C.U.U. drafted the manuscript and E.O.E., E.M.I., F.C.I., B.E.N., revised it. E.A.D., M.A.E., J.O.O. and E.U.O. proofread it. All authors read and approved the final manuscript.

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