EFFECT OF JIGSAW COOPERATIVE LEARNING STRATEGY ON SECONDARY SCHOOL STUDENTS ACHIEVEMENT AND RETENTION IN ECOLOGICAL SUCCESSION IN BIOLOGY

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A THESIS WRITTEN IN THE DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY, FACULTY OF EDUCATION AND SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS IN SCIENCE EDUCATION (BIOLOGY), UNIVERSITY OF BENIN, BENIN CITY

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CERTIFICATION

We the undersigned, Certify that this study was carried out by **Odinakachi Peace NJOKU** in the Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City, Nigeria.

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DEDICATION

This thesis is dedicated to God Almighty from whom the researcher gained the strength, directions, guidance and protection needed to complete this program successfully.

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ABSTRACT

This study investigated the effect of the Jigsaw Cooperative Learning Strategy (JCLS) on secondary school students' achievement and retention in Ecological Succession in Biology.

The study adopted the quasi- experimental pretest-posttest, non-ramdomized non-equivalent control group design. The study was guided by five research questions and five corresponding null hypotheses, which were tested at a 0.05 level of significance. The population for the study consisted of all senior secondary school students in public schools in Egor Local Government Area of Edo State, Nigeria. The instruments used for data collection were the Biology Achievement Test on Ecological Succession (BATES) and the Biology Retention Test on Ecological Succession (BRTES), both of which consisted of 25 multiple-choice questions which were drawn from the West Africa Senior School Certificate Examination past questions. Data collected were analyzed using mean, standard deviation, t-test, independent sample t-test and Analysis of covariance (ANCOVA).

The findings of the study revealed that the Jigsaw Cooperative Learning Strategy was significantly more effective in enhancing students' academic achievement and retention than the Conventional Teaching Method. The results showed a statistically significant difference in the mean achievement and retention scores of the students taught using the Jigsaw Cooperative Learning Strategy (JCLS) compared to those taught using the conventional method. Furthermore, the study found no significant difference in the mean achievement and retention scores between male and female students taught with the Jigsaw Cooperative Learning Strategy (JCLS). This finding suggests that the Jigsaw Cooperative Learning Strategy (JCLS) is a gender-neutral instructional strategy. Based on the findings, it was concluded that the Jigsaw Cooperative Learning Strategy is a potent instructional strategy for improving student academic achievement and knowledge retention in Biology.

The study recommends among others that since the Jigsaw Cooperative Learning Strategy had a significant effect on students' achievement and retention, then it should be recommended for all secondary School teachers as an instructional strategy to be used in teaching their lessons.

CHAPTER ONE

INTRODUCTION

Background to the Study

In Nigeria, secondary school science students study Biology as an important subject. It is a key component of science education, centered on understanding life and living things. Biology relevance is particularly significant at the senior secondary school level for equipping learners with foundational knowledge and skills in the life sciences, preparing them for further academic pursuits and careers in science-related fields. Biology helps students understand life and how living things exist, their characteristics and interactions with the environment (Michael 2017). The main goals of biology at the secondary school level are for students to graduate with sufficient knowledge and skills, with the capacity to apply scientific knowledge to real-world situations (Smith, 2018). This science subject is very important because it explains how living things function, including how we digest food, breathe, sweat, and how our nervous system works. Ghumdia and Adams (2020) also explained that Biology contributes to other fields of study such as Agriculture, Biotechnology, Nursing, and Medicine among others. All of these aid in economic growth and development in any country such as Nigeria.

Despite the important of Biology in secondary schools, students' performance in external examinations, including the West African Examinations Council (WAEC) and the National Examinations Council (NECO), has remained consistently below expectations over the years (Adekunle and Femi-Adeoye 2016). There is a call for immediate attention of all educators and stakeholders in the field of Biology to implement more effective teaching methods where students will be active participants during teaching and learning process (William, 2017). In response to these challenges, educators, researchers, and policymakers recommend adopting innovative teaching methods that prioritize greater student engagement (Kahu & Nelson, 2018) and improved instructional effectiveness (Chiu & Cheng, 2017).

At the senior secondary school level, Biology encompasses numerous concepts, among which Ecological Succession an essential component of Ecology, remains particularly challenging for students to grasp and understand effectively. Ecological succession is the study of how living communities rebuild after natural or human-caused disturbances. It is a key concept in Biology and helps explain many important ideas in the field (Egerton, 2015). A new community forms when species that can survive in the habitat and dwells with species from nearby habitat that are already suited to the new environment (Olinger et al, 2021). Ecological succession slows as the community reaches a steady equilibrium with the environment (Verma and Agarwal, n.d., 2014). Science instructors play a major role in determining the level of success of teaching science in the classroom, this depends on the type of teaching methods used to implement the subject topic.

In Nigerian secondary schools, research has revealed that the predominant instructional strategy is the conventional teaching method. This method largely emphasizes memorization and recall of facts, positioning the teacher as the central figure while rendering students passive, inactive, and primarily as observers, thereby placing them at a disadvantage (Chukwu & Arakoyu, 2019). Exclusive reliance on this strategy often results in rote learning, which impedes students' ability to retain information, construct meaningful understanding, and develop critical thinking skills. Consequently, this contributes to unsatisfactory academic performance in examinations. To enhance the teaching and learning of Biology, Wasserman (2017) advocated for the adoption of interactive instructional strategies such as team-pair-solo, jigsaw, think-pair-share, and guided inquiry. For the purpose of this study, the Jigsaw Cooperative Learning Strategy (JCLS) will be employed.

Jigsaw Cooperative Learning Strategy was originally developed by Elliot Aronson in 1971 in Austin, Texas, in this strategy, Aronson suggests dividing the class into small, diverse groups of 4 to 6 students, known as "Home groups". The day's lesson is broken down into segments, and each student in a home group is assigned one segment to learn.

Once students have become familiar with their individual segments, they form new "Expert Groups" with students from other Home Groups who have been assigned the same material. In these Expert Groups, they collaborate, share information, and learn the material together.

After this expert training, students return to their original Home Groups. There, they take turns teaching their segment to their group members. In this strategy, the teacher functions as a facilitator by overseeing group activities, providing targeted assistance to students who encounter challenges, and regulating disruptions or dominant behaviors. This instructional strategy has been reported to enhance positive educational outcomes while promoting meaningful interaction among students.

Ecological Succession can be divided into several subtopics, with each student assigned a specific subtopic to master and subsequently teach to their peers. This process ensures that all group members develop a comprehensive understanding of the entire concept. The Jigsaw cooperative learning strategy promotes both cooperative learning and accountability, as the success of the group depends on the active contribution of each member. According to Kelly (2016), Jigsaw enhances social relationships while fostering diversity within the classroom. This strategy encourages active participation, facilitates mastery of subject matter, and stimulates critical thinking among students. Furthermore, it has been shown to build students' confidence in tackling challenging content (Nilson, 2016). The Jigsaw cooperative learning strategy also develops essential skills such as communication, critical thinking, interdependence, accountability, positive peer interaction, and consensus building, all of which collectively contribute to improved academic achievement (Jeppu et al., 2023).

Achievement refers to the successful attainment of a goal, objective, or standard of performance through effort, skill, and perseverance (Hornby, 2020). Academic achievement is defined as the performance outcome that reflects the extent to which students have achieved the goals and objectives of an instructional program (Oyovwi, 2019). In biology, students' achievement measured through their knowledge, skills, and understanding assessed via tests is significantly influenced by the teacher's subject-matter expertise and instructional skills. According to Wu and

Kuo (2021), academic achievement encompasses not only the acquisition of factual knowledge but also the ability to apply learned concepts in diverse contexts, including examinations and real-life situations. It represents a critical outcome of learning, demonstrating the extent to which instructional objectives have been accomplished. Therefore, the implementation of teaching strategies that encourage collaborative learning and active student participation is vital for enhancing academic achievement. Ekweoba (2014) highlighted that the method of lesson delivery exerts a substantial influence on students' performance across various subjects, and several studies have affirmed that effective teaching methods play a significant role in improving students' academic outcomes.

The Jigsaw cooperative learning strategy has been found to enhance academic performance across various subjects (Juweto, 2015). Research indicates that students who engage in the Jigsaw strategy demonstrate improved critical thinking skills and more positive attitudes toward learning science through active participation in discussions and idea exchange within expert and home groups. This suggests that the Jigsaw strategy not only enhances academic performance but also promotes the long-term retention of biology concepts (Abdullahi & Salisu, 2017).

Retention of concept is an important factor in determining student achievement. Retention is defined as how well students can remember what they have learned, (Njoku and Nwagbo, 2020). Retention is the ability to remember and recall information or experiences later. How well people remember depends on the teaching methods used and how meaningful the material is. With the use of appropriate teaching methods students will be able to retain the subject content which will lead to a greater academic achievement, (Idris, 2014). Students' achievements and retention is determined by the type of instructional strategy used to implement, this plays an important role in their academic success. A student's success in education is determined by their academic achievement and retention (Ekweoba, 2014).

Retention of concepts constitutes a fundamental determinant of students' academic achievement. It is defined as the learner's capacity to store, retain, and accurately retrieve previously

acquired knowledge over a sustained period (Njoku & Nwagbo, 2020). The level of retention is profoundly influenced by the instructional strategies employed and the meaningfulness of the learning experiences provided. When effective and learner-centered teaching strategies are utilized, students are better equipped to retain essential subject matter, which in turn Cultivate enhanced academic performance (Idris, 2014). Both academic achievement and retention are interdependent and largely shaped by the instructional methods implemented, as these methods play a Significance role in determining students' overall academic success. Thus, retention, alongside academic achievement, serves as a key indicator of the extent to which educational objectives have been attained (Ekweoba, 2014).

Gender imbalance in science education has long been a focus of scholarly investigation. However, research findings regarding the influence of gender on academic achievement remain inconclusive. Gender, distinct from biological sex, refers to the socially constructed roles, behaviors, and attributes associated with femininity and masculinity, and it is widely recognized as a factor shaping students' socio-cultural experiences and academic performance. Unity and Igbudu (2015) reported no significant gender differences in academic performance, challenging earlier assumptions that disparities in cognitive roles were linked to differences in brain size and intelligence quotient between males and females. Similarly, Mobark (2014) found no significant difference in the academic performance of male and female students. In contrast, Falemu, Oyeniyi, and Adumati (2017) observed a significant difference in the academic performance of male and female students in Biology, with female students outperforming their male counterparts in the West African Examinations Council (WAEC) results. Owing to these inconsistencies in previous findings, there is a clear need to further explore the influence of gender on academic achievement, particularly in the context of the Jigsaw Cooperative Learning Strategy (JCLS) and its effect on the achievement and retention of male and female students in the topic of Ecological Succession.

Statement of the Problem

The main goal of biology education in Nigerian secondary schools is to develop active learners who can contribute to the country's growth. However, the quality of science graduates is declining despite government efforts to improve education (Chukwu & Arakoyu, 2019). Mastery of biological concepts and their applications significantly contributes to the industrial, medical, and technological development of any nation. Despite its immense importance, the teaching and learning of Biology at the secondary school level in Nigeria continue to face persistent challenges.

Students often experience difficulties in comprehending Biology, largely due to its complex and abstract nature, compounded by the predominance of conventional teaching methods. These methods, which emphasize rote memorization over active participation and critical thinking, have resulted in consistent challenges such as poor conceptual understanding, low problem-solving ability, low retention and inadequate engagement among students. WAEC chief examiners (WAEC, 2018-2023), reported that the weakness associated with candidates' performance includes; inability to properly define climax community, inability to define ecological niche, inability to state the role of mango in its ecological niche.

The observed students poor performance and weaknesses in Biology in Nigeria is a strong indication of student poor conceptual knowledge which might have been caused by the teaching methods used by Biology teachers. The effectiveness of teaching methods in promoting students' academic achievement has remained a significant focus in educational discourse, particularly in Biology, as with other science subjects. In spite of persistent advocacy by science educators for the integration of innovative, learner-centred instructional strategies suited to the demands of the 21st century, a considerable number of biology teachers in Nigeria continue to adopt the Conventional teaching methods. This method have been widely critiqued for it's limited capacity to promote active learner participation, which often results in diminished motivation, weak knowledge retention, and insufficient development of critical thinking and problem-solving skills.

Could the integration of Jigsaw Cooperative Learning Strategy improve student achievement and retention in Ecological Succession in Biology? This study therefore investigated the effect of jigsaw cooperative Learning strategy on secondary school student achievement and retention in ecological succession in Biology in Edo State.

Research Question

The following research questions were raised to guide the study;

1. Is there any difference in the mean pre and posttests achievement scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional method?
2. Is there any difference in the mean achievement score of biology students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional lecture method?
3. Is there any difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using the conventional teaching method?
4. Is there any difference in the mean achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy?
5. Is there any difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy?

Research Hypothesis

Research questions were hypothesized and was tested at 0.05 level of significance as follows;

1. There is no significant difference in the mean pre and posttests achievement scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional teaching method.

2. There is no significant difference in the mean achievement scores of biology students taught Ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.
3. There is no significant difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.
4. There is no significant difference in the mean achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.
5. There is no significant difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.

Purpose of the Study

The purpose of this study is to investigate the effect of Jigsaw Cooperative Learning Strategy on senior Secondary School Students' achievement and retention in Ecological Succession in Biology. Specifically, the study would seek to:

- The difference in the mean pre and posttests achievement scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional teaching method.
- The difference in the mean achievement scores of biology students taught Ecological succession using jigsaw cooperative learning strategy and those taught with conventional teaching method.
- The difference in the mean achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.
- The difference in the mean retention scores of student taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.

- The difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.

Significance of the Study

The findings of this study will be of benefit to students, teachers, curriculum planners, researchers, and school administrators and other stakeholders involved in curriculum development and Instructional practices.

The findings of this study will be of benefit by encouraging students to work together, collaborate to create a sense of teamwork and will meet the intellectual needs of all students of different academic abilities. It will help students to gain a deeper understanding of the topic, because they are responsible for teaching their segment. This active participation promotes critical thinking and retention of the subject matter. It encourages students to work together, by building a stronger relationship, and making learning process effective and interesting by creating interactions where students assist, discuss, debate with each other, share their knowledge, address any gaps in understanding, and work together to solve problems. One key benefit is that it promotes active listening, mutual assistance, and problem-solving skills among students as they learn together. In a regular classroom situation, students who might be reluctant to raise questions may find this peer-to-peer connection especially beneficial.

The findings of this study the teacher will provide teachers with a highly effective teaching method, by dividing a complex topic into smaller sections and assigning each group a specific part to become an expert on, this makes teaching instruction easier for the teacher to implement and helps in classroom management by creating a more engaging classroom environment. This instructional strategy also builds stronger teacher-student relationships by creating a supportive and interactive classroom environment, when the teacher guides the jigsaw process, they work closely with students, giving help and support. This will build trust and respect between teachers and students by making instruction an interesting process.

The findings of this study will benefit curriculum planners, jigsaw cooperative learning strategy is an innovative approach, it benefits Curriculum planners because it supports modern educational goals by creating well rounded learning experiences and helping students develop important skills needed for the 21st century. It will also provide insight into more innovative strategies that could be added to the existing one. It supports the design of learning by making teaching and learning process easy to implement, curriculum planners integrate this strategy to ensure that students from diverse background feel equally valued and accommodating multiple perspective by promoting cultural and social interactions.

The findings of this study will benefit school Administrators, the Jigsaw learning strategy will promotes a learning environment where all students contribute to the achievement of the group in line with the objectives of school administrator to promote adequate educational instructional practices and eliminate disparities, it will facilitates openness and reduces social isolation. Beyond the classroom, the Jigsaw cooperative learning strategy will encourage the development of essential interpersonal skills like problem-solving, teamwork, communication, and leadership skills, school administrators benefit from students acquiring these skills as they reflect positively on the institution's ability to prepare learners for real-world challenges. The Jigsaw learning strategy keeps students actively engaged in the classroom, it minimizes disruption and disciplinary issues.

This findings of this study will serve as baseline information for other researchers and a source of reference for upcoming research endeavors.

Scope and Delimitation

The study is conducted to examine the Effect of Jigsaw Cooperative Learning Strategy on Secondary School students' Achievement and Retention in Ecological Succession. The study is delimited to senior secondary school two Biology students in public schools in Egor Local Government Area of Edo State.

Definition of Terms

The following terms were operationally defined as in the study:

Academic Achievement: Academic achievement is the attainment of the behavioral objectives, which is the learning outcome after treatment.

Biology: Biology is the scientific study of life. It covers all facets of the existence of a wide range of living things, from single-celled bacteria to enormous redwood trees.

Retention: Retention refers to the ability of students to store, recall, and apply previously learned concepts in Biology over a specified period after instruction.

Conventional method of teaching: The conventional method of teaching involves the teacher delivering biological content through lectures, textbooks, and demonstrations, with students playing a relatively passive role in receiving information.

Ecological Succession: Ecological succession is the continuous and progressive alteration of a species in a particular area in response to a changing environment. It is a natural process that is both predictable and unavoidable since all biotic components must adapt to changes in their surroundings.

Gender: This is the collection of male and female Biology students that will take part in the study.

Jigsaw Cooperative Learning Strategy: Is an instructional strategy that helps pupils comprehend and communicate concepts to their peers by breaking up lengthy texts into digestible portions.

Retention: The ability of pupils to remember ecological succession lessons after a little period of time.

CHAPTER TWO

Review of Related Literature

This chapter presents the review of related literature under the following subheadings;

- Theoretical Framework of the Study
- Concept of Jigsaw Cooperative Learning Strategy
- Concept of Ecological Succession in Biology
- Jigsaw Cooperative Learning Strategy and Conventional Teaching Strategy
- Jigsaw Cooperative Learning Strategy and Achievement
- Jigsaw Cooperative Learning Strategy and Retention
- Gender issues on Students Achievement in science (Biology)
- Summary of Reviewed Literature

Theoretical Framework

This study is anchored on Lev Vygotsky's Social Constructivist Learning Theory (1978), which posits that learning is fundamentally a social process facilitated through interaction and collaboration with others. Social constructivism, a branch of cognitive constructivism, emphasizes the role of social interaction, guided participation, and collaborative engagement in the construction of knowledge. According to this theory, learners develop understanding most effectively within the Zone of Proximal Development (ZPD), where they receive guidance, scaffolding, and support from teachers, peers, and more knowledgeable others (Karpov, 2023). The theory underscores the importance of dialogue, peer interaction, and active participation in achieving meaningful learning. Knowledge is not passively absorbed, rather, it is constructed through discussions, sharing of perspectives, and the application of learned concepts in authentic contexts.

The Jigsaw Cooperative Learning Strategy (JCLS) directly aligns with these principles. In Jigsaw, students are divided into expert groups where each member learns a specific subtopic. They subsequently return to their home groups to teach their peers. This process promotes active engagement, reciprocal teaching, and peer-to-peer interaction, which are central to Vygotsky's

theory. By explaining, questioning, and clarifying concepts within a collaborative setting, students reconstruct and reinforce their understanding, thereby enhancing both comprehension and long-term retention of knowledge (Loh & Ang, 2020). The Jigsaw Cooperative Learning Strategy (JCLS) promotes active student engagement and collaboration, enabling learners to collectively address academic challenges that may be difficult to resolve individually. Rooted in Vygotsky's assertion that education is fundamentally a social endeavor, this strategy reflects the principle that cognitive growth occurs through interaction, dialogue, and shared experiences within a learning community (Vygotsky, 1978).

Social constructivism posits that knowledge is not passively received but actively constructed through meaningful interactions with others and the surrounding environment. It emphasizes cooperation, discussion, and the exchange of ideas as key mechanisms for deep learning. Within this framework, the Jigsaw Cooperative Learning Strategy (JCLS) serves as a practical application of social constructivist principles by positioning students as both learners and teachers in a cooperative structure. In the Jigsaw approach, each learner becomes an expert on a specific segment of the subject matter, which they subsequently explain to their peers in a home group setting. This method promotes positive interdependence, where the academic success of the group depends on the contribution of each member. Students are not passive recipients of information; rather, they engage in discussions, share insights, and clarify concepts collaboratively.

This process of peer teaching and mutual accountability requires students to thoroughly comprehend their assigned sections, facilitating deeper cognitive processing and long-term retention. Furthermore, by encouraging interaction with both peers and instructional materials, the JCLS reinforces experiential learning, active participation, and the co-construction of knowledge. According to Kapur (2018), he noted that people build knowledge in many ways and places. This can happen through group discussions, teamwork, or other forms of interaction in schools, training centers, social media, religious settings, or markets. When students interact with others and their surroundings, they learn and gain the experiences needed to live successfully.

According to Vygotsky's theory, children can achieve more with support than they can alone. Children may solve complex problems beyond their mental age with the help of classmates, instructors, and parents who provide necessary experiences. Social Constructivism Learning Theory places a strong emphasis on how students actively create their own understanding through social interaction. Knowledge is not only constructed individually but also largely in social and cultural contexts. This indicates that rather than just taking in information, students are actively creating knowledge through interactions, this interaction allows them to build upon each other's knowledge and perspectives, Students clarify their own understanding and pinpoint areas that need more research through explanation and discussion.

Collaborative Learning in the Zone of Proximal Development

Vygotsky (1978) emphasized the Zone of Proximal Development (ZPD) as the space where meaningful learning occurs. The ZPD represents the gap between a learner's current developmental level and their potential level of development, achievable with appropriate guidance from a teacher or collaboration with more knowledgeable peers. Learning is most effective when learners receive assistance within this zone. Social interaction plays a central role in the ZPD, as it provides the context in which knowledge is constructed, internalized, and later applied independently. According to Vygotsky, interaction with teachers, classmates, and peers facilitates the acquisition of higher-order thinking skills and supports the transition from assisted to autonomous learning.

The Jigsaw Cooperative Learning Strategy (JCLS) operationalizes the principles of the ZPD by creating structured opportunities for students to collaborate, exchange ideas, and build understanding collectively (Gillies, 2022). Within this framework, students are encouraged to work in expert and home groups, thereby scaffolding one another's learning. Teachers guide the process by facilitating discussions, asking probing questions, and encouraging reflection, thus ensuring that students engage meaningfully within their respective ZPDs.

For example, in teaching Ecological Succession, the jigsaw cooperative learning strategy (JCLS) provides an effective platform where students define hypotheses, share observations, compare

experimental results, and collaboratively evaluate findings. This approach not only enhances conceptual understanding but also promotes critical thinking, problem-solving, and social interaction skills essential for 21st-century science education.

Social constructivism have demonstrated its importance in the classroom, especially when it comes to creating meaningful learning opportunities, by involving students in group project, conversation, and cooperative activities, teachers can support the development of deeper comprehension and critical thinking skills in their students. Jigsaw Cooperative learning strategy, which prioritize peer participation, and meaningful negotiation, provide strong support for Vygotsky's theory, (Feerick et al., 2022). Students collaborate and communicate with one another in a group context to resolve issues or comprehend difficult ideas, generating individual ZPDs for each participant, Morgan, D., & Skaggs, P. (2016). Through conversation, teamwork, problem solving, students can build meaningful relationship, and gain mastery of content for greater achievement and retention together through Jigsaw Cooperative learning Strategy which encourages student's involvement. This method supports social constructivism by establishing a collaborative atmosphere where students may work out meaning, and build on each other ideas to understand a difficult concept in other to retain and have a good academic achievement.

Social constructivism learning Theory and Jigsaw Cooperative Learning Strategy

Social constructivism and the jigsaw strategy creates a learning environment that emphasizes collaboration, active participation, and understanding. By engaging in jigsaw Cooperative Learning Strategy, students experience the ZPD, as they rely on peers to acquire new knowledge and skills. This peer-assisted learning mirrors Vygotsky's assertion that social interaction is fundamental to cognitive development (Vygotsky, 1978). The jigsaw Cooperative Learning Strategy promotes the development of critical thinking, problem-solving skills, active participating, peer tutoring, communication and cooperation with one another which is the Emphasis of Social constructivism. According to a study by Nadrah (2023), students engaged in cooperative learning environments

showed enhanced critical thinking abilities, which are essential for academic achievement and Retention.

Implications of social constructivism on teaching methods

Teaching methods are the foundation of effective education. They incorporate the methodologies, ideologies, and classroom management approaches that educators use to transfer knowledge and skills to pupils. Teaching methods are the methods and procedures for the planned and organized formation of the processes of science, and therefore methods of organizing and implementing teaching and learning (Ahmed, 2015).

Social constructivism is a learning theory that focuses on the social aspects of knowledge acquisition. In contrast to conventional teaching methods, social constructivism sees students as active participants who create their own understanding by means of interactions with others and their surroundings. Deeper comprehension and a sense of control over learning are promoted by active engagement (Fredricks et al., 2015). This emphasizes the role of students as active participants in their education and provides creative explanation for teaching and learning. Activities are the various ways that teachers use their teaching methods to assist students in learning.

Teachers are encouraged to establish safe space, use effective teaching methods that promote active participation and communication. The jigsaw cooperative learning strategy have been seen to be an effective strategy because it promotes cognitive growth, cooperative learning, and holistic student development. Student inquiry, problem-solving, and discovery are the main objectives of instruction. As facilitators, teachers help students navigate the learning process (Crawford 2020). Students engage with the topic more deeply when knowledge is constructed through interaction, which improves retention. Working together creates a more engaging classroom environment and improves the relationship between teachers and learners. Social constructivism promotes cooperation, active participation and interactive practices in the classroom, this has a big impact on instructional strategies. But can only be achieved thorough planning, professional development, and a positive

learning environment, which are necessary for the successful implementation of these strategies (D. C. P. Leong, 2022).

Concept of Jigsaw Cooperative Learning Strategy

Jigsaw Cooperative Learning Strategy is a teaching-learning Strategy that encourages students to be motivated to study, to have positive attitudes. It teaches ways to solve problems, which enables each student to benefit from the prior experiences, expertise, and comprehension of peers (Winschel et al., 2015). Cooperative learning is now widely used as an educational method with significant impact and potential in the teaching-learning environment. Among the cooperative learning techniques is the Jigsaw Cooperative Learning Strategy. Jigsaw cooperative learning strategy creates an instructional guideline to improve student learning. Jigsaw places a strong emphasis on peer learning by assigning the learning activities to small student groups to enhance their interpersonal skills, and to achieve more. According to Igwe (2020), the Jigsaw instructional strategy adopts the principles of cooperative learning which makes it a cooperative learning strategy.

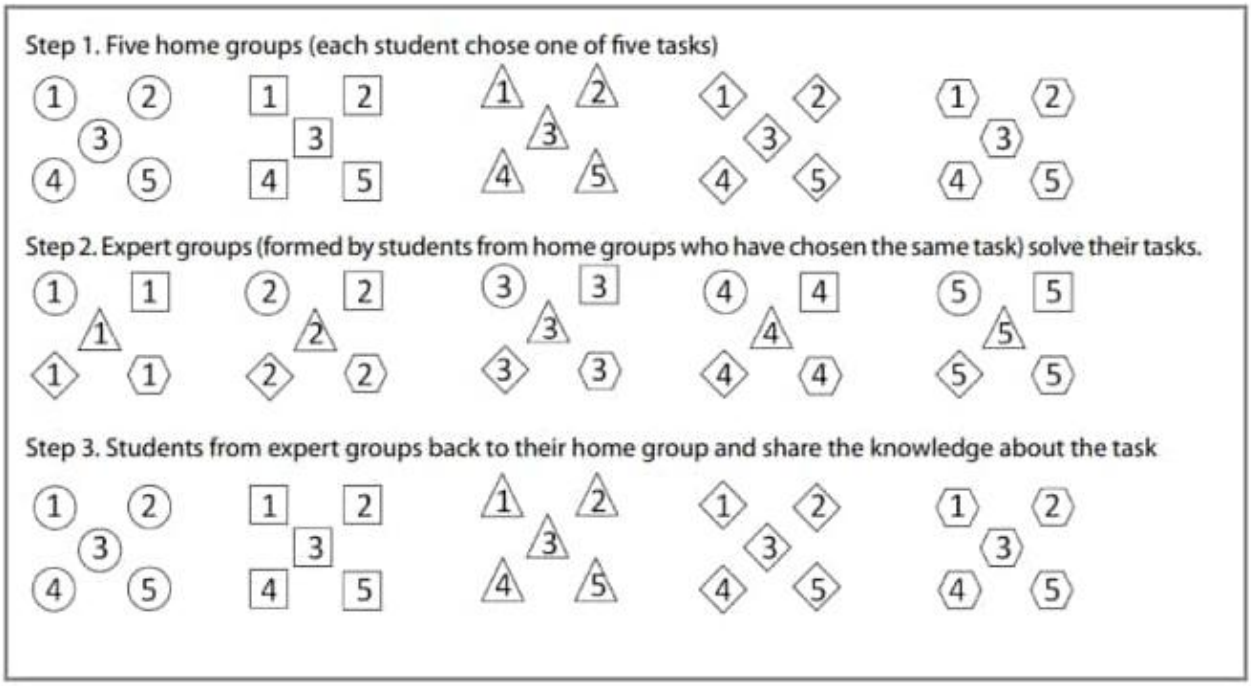
It was developed by Elliot Aronson and colleagues in 1978. Students are encouraged to actively communicate with one another and rely on one another for success through jigsaw instruction. Each group is given a responsibility to put together and assist in finishing a problem when the class is divided into groups (Gillies et al., 2023). Students can benefit from the innovative learning experience provided by the Jigsaw Cooperative Learning Strategy. In order to implement this learning approach, pupils are first placed in groups and then tasked with searching for information in expert groups. The primary objective of this type of learning is to communicate the content being taught, in order to prevent students from simply showing up, sitting down, recording the content, and then answering the questions. Students are also taught how to communicate effectively, cooperate well, and grasp the information quickly when using the Jigsaw Cooperative learning Strategy. According to Sophia (2016), relying too heavily on the Conventional teaching Method has been criticized for developing students into passive recipients of the teacher's

information and making them highly dependent on them for almost all of what they learn. there are other benefits to using cooperative learning activities like Jigsaw in the classroom, including enhanced academic achievement, increased self-esteem, retention and more favorable opinions about education in general (Winslow, 2020). The adoption of a teacher-centered approach appears to be the root cause of low student achievement and retention in the sciences. The Jigsaw Cooperative Learning Strategy is a contemporary student-centered teaching technique that encourages students to collaborate in groups of four to six in order to finish assignments, share ideas, and establish their own areas of expertise. According to studies, Jigsaw Cooperative Learning Strategy lessons are beneficial for improving retention and meaningful learning, as well as cognitive and affective aspects (Gumel, 2015). Students can actively participate in group learning in the classroom by using the Jigsaw Cooperative Learning Strategy, the group learns new concept and impacts it to others, each member contributes to the group's success and helps the group construct its cognitive structure for learning. The learning process is broken down into phases or portions by the teacher in a Jigsaw puzzle. Individuals within a group receive the subtopics from the teacher. In order to have an intergroup conversation on the subtopic provided for individual research, students from various groups studying the same subtopic get together. Cooperative learning in biology teaching encourages social support and engagement, which helps student retention difficult biological ideas (Kebede et al., 2024).

Jigsaw cooperative learning strategy is one that emphasizes giving students the chance to truly assist one another in developing comprehension. Students can be divided into small groups according to proficiency levels using this strategy. It is the duty of each group member to become an expert on a particular area of the given material to instruct the other team members in that area. When students actively participate in the process, they learn the most. Jigsaw is a widely recognized Cooperative Learning method among educators because it is simple to use and can integrate academic learning with sociability (Cochon Drouet et al., 2023). Student who studies in small groups, regardless of the subject matter, generally retain and learn more of what is taught than those who

receive instruction in other methods. Jigsaw cooperative learning helps students exhibit high levels of motivation when collaborating, exchanging ideas, striving towards shared objectives, and promoting self-worth. By participating in the activities, students focus on developing their listening, speaking, cooperation, reflection, and problem-solving abilities while also working with one another and developing a sense of belonging. By dividing students into expert and home groups, the jigsaw strategy aims to improve cooperation and teamwork. (Engül et al., 2014). Individual responsibility mean that students can work well, are skilled in presenting ideas, do proper report assignments, help groups in work, and are always collaborative with group members. Students' self-confidence can improve by maintaining a small number of group members (Sun et al., 2017). They tend to communicate more intensely in small group. Nigerian educators are beginning to understand the importance of helping students truly retain and succeed in science. Many things affect how well students remember what they learn, such as their natural abilities, how fast they process and store information, and how well they focus on what's important. When teachers mostly use the Conventional teaching methods which are the teacher-centered methods, students tend to retain less and struggle with important skills (Martinez et al. 2020). To improve learning and memory, teaching methods should focus more on students' needs. One modern approach is the jigsaw method, where students work in small groups to learn, share ideas, and become more knowledgeable. Research shows that the jigsaw method helps students remember better, it enhances retention and meaningful learning (Gumel, 2015).

Jigsaw Steps



Concept of Ecological Succession in Biology

Ecological succession is the study of how living communities rebuild after natural or human-caused disturbances. It is a key concept in Biology and helps explain many important ideas in the field (Egerton, 2015). A new community forms when species that can survive habitat and dwells with species from nearby habitat that are already suited to the new environment (Olinger et al, 2021). Ecological succession refers to the process by which ecosystems change and develop over time, transitioning through various stages from a relatively uninhabited or disrupted environment to a stable climax community. It is the study of how ecosystems re-assemble after natural or man-made disturbance (Egerton, 2015).

Ecological succession describes the process by which the structure of a biological community evolves over time. Succession occurs after a disturbance or the creation of a new habitat and involves stages from colonization to a climax community. Early models emphasized predictable, ordered progressions, but recent studies highlight the complexity of these processes, influenced by factors such as climate change, human activity, and random disturbances (Walker & Wardle, 2014).

Johnstone et al. (2016) explored succession in boreal forests, noting that repeated fires caused by warming temperatures are transforming the ecosystem from conifer-dominated forests to mixed-wood systems with greater fire resilience. Coral reef ecosystems, succession following bleaching events has received significant attention. Hughes et al. (2018) showed that repeated bleaching events due to rising ocean temperatures are shifting coral reefs towards algal-dominated systems, altering their recovery trajectories.

There are various subtopics or stages that comprises Ecological Succession:

- Types of Ecological Succession
- Factors affecting Ecological Succession
- Pioneer species
- Effect of Ecological succession
- Climax communities

Each group of students will be assigned one of these subsections to become experts. Students are divided into expert groups, each of which has the responsibility of thoroughly studying a particular stage of the ecological succession. One group, for instance, will investigate primary succession, concentrating on the formation of ecosystems from barren, lifeless conditions. A different group might investigate the idea of climax communities and the elements that either support or undermine them. Students will conduct individual research or use teacher-provided materials to learn more about their particular topic in expert groups. Articles, films, case studies, and other materials on ecological succession could be included under this category.

Jigsaw Cooperative Learning Strategy on Ecological Succession

The Jigsaw Cooperative Learning Strategy (JCLS) has been shown to be effective in enhancing students' academic achievement and retention in science subjects, particularly in Biology. Ecological succession a topic that explains the progressive changes in plant and animal communities over time has often been reported as challenging for secondary school students to understand (Olaoye & Adegbite, 2022). Through jigsaw cooperative learning strategy (JCLS), the topic is

divided into manageable subtopics, with each student assigned to learn one part as an expert and subsequently teach it to members of their home group. This approach promotes active participation, cooperation, and meaningful social interaction, thereby facilitating deeper learning (Ahmed et al., 2023). Empirical evidence indicates that students taught using Jigsaw Cooperative learning strategy significantly outperform their counterparts taught through conventional teaching methods. For instance, Eze and Oguche (2023) reported higher test scores among students exposed to Jigsaw, attributing this success to increased peer support, active involvement, and shared responsibility inherent in group learning.

The Jigsaw method aligns with Vygotsky's Zone of Proximal Development (ZPD), as it enables learners to act as both teachers and students, thereby scaffolding one another's understanding. Its effectiveness is particularly evident for abstract concepts such as ecological succession when complemented with visual aids, group discussions, and simulations (Nwachukwu & Oboh, 2021). In the Nigerian educational context, where traditional lecture-based teaching predominates, Jigsaw Cooperative learning strategy (JCLS) offers a more engaging, learner-centered alternative. Furthermore, Bello and Mohammed (2024) demonstrated that students taught using the Jigsaw strategy exhibited superior retention compared to those instructed through conventional teaching methods.

Benefits of Using Jigsaw for Ecological Succession:

i. Students gain deeper retention by exchanging ideas and information with one another.
ii. Each student is accountable for becoming an expert in their assigned section,
iii. Cultivating responsibility.
iv. It keeps students active, and creates a deeper relationship between students and Teachers and also creates a deeper relationship between students and their peers.
v. It helps to make the teaching learning process simplified

vi. It also makes other teaching method like hands on experiment, inquiry based approach etc more simplified with the help of jigsaw cooperative learning strategy.

Jigsaw strategy and conventional teaching method

Biology is a cornerstone of the life sciences, providing learners with a foundational understanding of the structure, function, growth, and evolution of living organisms. It equips students with the analytical skills necessary to explore the complexities of biological systems, understand their interconnections, and develop an informed appreciation of biodiversity and ecological balance (Bioexplorer, 2018).

However, in many Nigerian secondary schools, Biology instruction remains predominantly anchored in conventional teaching methods, which are largely teacher-centered and characterized by rote memorization and the passive reproduction of facts (Isa et al., 2020). These strategies typically emphasize the unidirectional transmission of information through lectures, textbooks, and demonstrations, positioning students as passive recipients rather than active participants in the learning process.

Such methods often fail to foster higher-order cognitive skills such as critical thinking, problem-solving, and conceptual application. As a result, students frequently experience difficulties in grasping abstract biological concepts and in transferring theoretical knowledge to practical, real-world contexts. This instructional limitation has been identified as a contributing factor to suboptimal performance in Biology and a diminished interest in science-related disciplines among secondary school students in Nigeria (Bello & Mohammed, 2024).

The Jigsaw Cooperative Learning Strategy is a student-centered pedagogical approach designed to enhance active participation, teamwork, and peer teaching. In this strategy, students are organized into small collaborative units known as home groups, where each member is assigned a specific segment of the lesson to study and later teach to their peers. This method requires students to engage in a range of active learning activities, including reading, writing, discussing, and

problem-solving. Active learning not only sustains students' attention but also improves academic achievement, enhances retention, and develops critical thinking skills. Furthermore, it provides meaningful support for students who may struggle with complex concepts (Koselyn et al., 2017).

Examples of active learning techniques that align with the Jigsaw strategy include role-playing, case studies, collaborative projects, team-based quizzes, debates, peer teaching, group discussions, and classroom demonstrations. By fostering interaction and mutual accountability, the Jigsaw strategy creates an environment where students are both learners and instructors, thereby deepening their understanding and promoting shared responsibility for learning. Sittar (2023) found that students who engaged in the Jigsaw strategy exhibited significantly higher levels of academic motivation and self-efficacy compared to their counterparts taught through conventional methods. Similarly, Puger (2023) reported that the strategy substantially enhanced students' retention and mastery of biology concepts due to the active role students assume in both teaching and learning processes.

Conversely, the conventional teaching method also referred to as traditional or teacher-centered instruction relies primarily on lectures, direct explanations, and structured note-taking. Within this method, the teacher serves as the central authority and primary source of knowledge, while students adopt a passive role, primarily listening and recording information with minimal opportunities for discussion, collaboration, or application (Wang et al., 2019; GrOvia North Eastius, 2017). Conventional teaching often emphasizes the transmission of content over the construction of knowledge, which limits students' ability to engage deeply with biological principles, analyze complex concepts, and develop higher-order thinking skills (Graff & Birkenstein, 2017).

Although experienced educators may effectively deliver structured content through conventional instruction, this approach has been criticized for its inability to foster active engagement, intrinsic motivation, and meaningful understanding among learners (Falasi, 2024). In many Nigerian classrooms, this method remains prevalent, leading to rote memorization, disengagement, and low retention rates in subjects such as Biology. The unidirectional flow of

information often results in students being passive recipients rather than active constructors of knowledge, which negatively impacts their long-term academic achievement and performance in science. Students who need regular changes in activity or stimulation may find it difficult to stay engaged when using the convectional teaching methods. Learners who do not participate fully in the process of learning may grow disinterested and lose interest in the subject matters, learning passively frequently results in forgetting what you've learned.

Students find it difficult to recall information that they haven't actively applied or struggled with. Intrinsic motivation, or the desire to learn for the purpose of learning, may not be developed in conventional classrooms. Pupils' long-term engagement with the subject matter may be impeded if they start to depend on outside benefits or consequences. According to Ardeleanu's research (2019), small group talks and other cooperative learning methods like the Jigsaw Cooperative Learning Strategy help students develop their critical thinking and attention spans, which boosts their retention and mental capacity to solve real world situations.

Convectional teaching method is passive and teacher dominated it cannot accommodate different learning styles, Students interaction is limited. Series of studies has been carried out on conventional teaching method. A study by Dutta (2014) found that conventional teaching methods in medical schools often rely on rote memorization, which will not be of help in real world application. Cooperative learning methods Like the Jigsaw Cooperative Learning Strategy can enhance critical thinking, communication and problem solving skills in student, while conventional teaching method is limited. In the past Socrates was a strong supporter of teaching in small groups. Because there is more interaction between the teacher and the pupils, Teachers can also better supervise the students as a result of the smaller class size and there is increased communication and cooperation between students and teachers.

Ardeleanu (2019) in his research concluded that the learners gain more attention and problem solving skills in small group discussion, which involves cooperation between the learners utilizing these problem solving skills to solve future problems. According to Darling Hammond et al., (2020)

conducted a research which shows that convectional teaching method encourages passive learning, which can limit students ability to develop critical thinking and problem solving skills. To better serve the varied needs of students, Jigsaw Cooperative Learning Strategy are being included for effective administration of instruction. Cooperative learning strategies like the Jigsaw in teaching and learning of ecological concepts can be conceptualized as a teaching and instructional method where students are placed in groups to work on specific actions in order to promote student interaction (Tuan, 2014). For majority of occupations in today's world require emotional intelligence, teamwork ability and communication skills. All of those essential lifetime skills can be furthered by students through cooperative learning, which helps students interact more socially, and minimize emotional difficulties, stress, victimization, and other issues, (Van Ryzin and Roseth 2018).

Studies by Anwar et al., (2020) demonstrate that cooperative learning significantly boosts students' academic progress. In a biology classroom, Cooperative learning may be adopted using different methods, students can be grouped in pairs, small groups, large groups, heterogeneous groups, homogeneous groups. Effective teamwork promotes unique set of skills and social competencies, encompassing adaptability, leadership, effective communication, conflict management. Hart (2019) identified the significant development of teamwork skills. According to Mukuka et al. (2019), student conversation inside the group determines the effectiveness of Jigsaw cooperative learning strategy, Humans use conversation to give things meaning, therefore discussing an issue contributes to understanding and meaning making. Students' retention is improved when they are required to clarify and discuss their solutions to a peer. Whether the replies are correct or incorrect, the debating process itself is what matters in these exchanges.

According to Klang et al. (2021) each team member is accountable for both learning what is taught and assisting teammates in learning during cooperative learning activities, which fosters a culture of achievement. The aim behind Jigsaw cooperative learning strategy is that greater number of students engaged in learning in compared to Conventional teaching method, cooperative learning encourages greater student participation in the learning process. Usually, only one or two students

can be actively involved in active learning at once while utilizing the later method. All students participate fully in a learning assignment when more cooperative learning approaches are used, requiring students to work in groups. Rather than being passive consumers of knowledge who merely listen, watch, and take notes, students become more active participants in their education (Vartiainen et al., 2020). Students learn to support each other. Jigsaw Cooperative Learning Strategy promotes learning.

Jigsaw Cooperative Learning Strategy and achievement in biology

Ugwuanyi and Okeke (2020) defined academic achievement as the extent to which learners benefit from instruction in a particular subject area. It reflects how well students meet the set learning objectives and is commonly measured through standardized tests, classroom assessments, or examination scores. Academic achievement in Biology demonstrates the depth of knowledge and skills students acquire, while the quality of teaching largely depends on the teacher's competence and mastery of the subject matter. Sophia (2016) noted that there is a strong relationship between teachers' subject knowledge and the level of understanding attained by students.

Biology occupies a significant place in the secondary school curriculum as a core life science subject, providing students with the foundation for understanding living systems, ecosystems, and environmental interactions. Given its importance, it is essential for educators and curriculum developers to continually assess and improve student performance in Biology. However, teaching and learning Biology in secondary schools face persistent challenges, including inadequate laboratory facilities, ineffective teaching methodologies, overcrowded classrooms, and insufficient instructional resources. These factors have contributed to persistent low achievement levels in Biology, raising public concern over the declining standards of science education.

The Jigsaw Cooperative Learning Strategy has proven beneficial in promoting students' achievement in Biology. This method promotes active participation, peer instruction, and collaborative learning by dividing students into small groups where each member is assigned a

specific portion of the topic to study and teach to others. Through this structured interaction, students are held accountable for their learning while also contributing to the understanding of their peers. Studies have demonstrated that this cooperative approach enhances comprehension, promotes shared responsibility, and significantly improves academic performance compared to traditional lecture-based teaching methods.

According to Ezeaghasi and Obochi (2021), examined the effect of Jigsaw learning strategy on senior secondary school students' academic performance in biology concepts in Soba Local Government Area, Kaduna State. The study established that students taught using the Jigsaw strategy demonstrated superior achievement relative to those taught through the traditional method.

The use of Jigsaw Cooperative Learning Strategy improved achievement, increased student engagement, peer teaching, and collaborative learning. According to Ahiakwo, Adolphus, Omeodu, and Oduh (2023) conducted a study focusing on the influence of the Jigsaw strategy on students' attitudes and achievement in the human respiratory system topic in a government secondary school in Abua, Rivers State. Findings from this research that those taught using the Jigsaw Strategy demonstrated better understanding, retention, and higher achievement scores compared to students in conventional classrooms. The study stated the positive effect of the strategy in promoting inclusive learning and promoting cooperative behavior among students.

According to Akubuilo, Nnabuike, Nkechinyere, and Odinakachukwu (2025) explored the effects of collaborative learning methods, including the Jigsaw strategy, on the academic achievement of SS1 biology students in Enugu State. Their findings indicated that students taught using cooperative learning strategies achieved higher academic performance than those taught through conventional methods. The knowledge gained from biology is useful in fields like medicine, biochemistry, pharmacy, microbiology, and agriculture etc. The Jigsaw makes it less stressful for students to learn and helps them achieve better results. The Jigsaw Cooperative Learning Strategy improves students' academic achievement in biology by promoting active learning, peer teaching, teamwork, and responsibility. This help students gain a deeper retention of biology and perform

better in their studies. The decline in students' achievements in biology necissitated more studies, (Chinna and Reddy 2017). Students can engage with one another in the same group to learn and practice the subject matter components in order to solve problems and finish tasks that lead to improved academic achievement.

Jigsaw Cooperative Learning Strategy and retention

In Biology, retention is very important because it helps students understand and apply concepts. Properly organizing new information in memory makes it easier to recall without much effort (Ntibi & Ibok, 2021). Retention is an important factor influencing biology students' academic success, students who lack support and responsibility when working with others also lack learning, which results in memorizing to perform better (Rosanna et al. 2023). It has been believed that by encouraging students to work together, this method of instruction will lessen competitiveness in the classroom (Wilson etal 2017).

Retention refers to the ability to remember information or ideas over time. According to Ibok and Unoh (2019), meaningful learning happens when students can recall and use what they were taught, even after some time has passed. This occurs when the information is effectively stored in memory. Teaching strategies are tools that teachers can adjust to boost students' retention. According to Achor, Ogbeba, and Amadu (2014), senior secondary school students' poor biology achievement could be improved by implementing an effective teaching and learning strategy that encourages high retentions. To enhance students' achievement and retention in Biology, cooperative instructional strategies are essential (Ibok, Meremikwu, & Umoh, 2020). The Jigsaw is an instructional approach which priotize peer participation and provides strong support, this will have a positive outcome on student's retention. Retention of learned content is a critical outcome in biology, especially given the subject's complexity and abstract nature. The Jigsaw Cooperative Learning Strategy has proven effective in improving students' retention by promoting engagement, peer teaching, and social interaction. This strategy involves dividing a lesson into subtopics, assigning each student a specific

subtopic to become an expert in, and then regrouping students to teach each other in mixed teams. This collaborative and interdependent structure promotes active learning and long term retention.

How Jigsaw Cooperative Learning Strategy Enhances Retention

The Jigsaw Cooperative Learning Strategy is an instructional strategy where students are divided into small groups, each responsible for learning and teaching a specific segment of the subject content to their peers. This approach promotes active engagement, accountability, and peer teaching, all of which contribute to improved retention.

1. Active Engagement and Peer Teaching: By teaching their peers, students reinforce their own understanding, leading to better retention.The act of teaching others reinforces knowledge, making it more durable in long-term memory (Fiorella & Mayer, 2016).
2. Collaborative Learning Environment: Jigsaw Cooperative Learning Strategy promotes collaboration and cooperation among students. When students interact more with each other it encourages deeper processing of information, which aids in memory retention.When students discuss and clarify content with peers, they engage in elaborative discussion, which is known to improve retention better than passive review (Slavin, 2019).
3. Increased Motivation and Accountability: Knowing that they are responsible for teaching others motivates students to learn the material thoroughly, enhancing retention. The Jigsaw Cooperative Learning Strategy is an evidence-based method that significantly enhances students' retention in biology by promoting deep learning, peer interaction, and accountability. Its structured, student-centered format aligns with the principles of Vygotsky's Sociocultural Theory, emphasizing the importance of social interaction in cognitive development.

Gender issues on Students Achievement and Retention

Gender refers to the socially and culturally constructed roles, responsibilities, and attributes that a given society assigns to males and females (Undelikwo, Ibok, & Ubi, 2022). These roles are

shaped by societal expectations rather than biological factors and often influence behavior, participation, and learning outcomes. For instance, males are frequently perceived as bold, assertive, logical, intelligent, and confident, whereas females are commonly regarded as submissive, talkative, and less tactful (Meremikwu & Ibok, 2020). Such perceptions can affect students' academic achievement and retention, particularly in science subjects such as Biology.

In the Nigerian context, gender-based stereotypes remain prevalent, with a widespread belief that boys are physically stronger, more intelligent, and better at logical reasoning than girls (Ezeh, 2014). Consequently, male students are often perceived as performing better in science-related subjects, including Biology, Chemistry, and Physics, both in internal and external examinations. This persistent disparity continues to raise concerns about gender equity in science education.

Empirical evidence further supports these disparities. For example, Gondden (2016) investigated the comparative effects of using analogy instructional strategies on the problem-solving abilities of male and female students in electrolysis. The study revealed a statistically significant difference in favor of male students. Similar findings were reported by Ademola (2020), suggesting that gender can significantly influence learning preferences and achievement in science.

However, the relationship between gender differences and learning outcomes remains a subject of debate. Shuib and Azizan (2015) noted that the influence of gender on preferred learning methods is complex and contested among researchers. It has been argued that effective teaching and learning strategies that foster cooperation, problem-solving skills, and high retention rates may help minimize or even eliminate gender-related disparities in Biology achievement. Research has indicated that strategies such as the Jigsaw Cooperative Learning Strategy may exert differential effects on male and female students, offering an inclusive and participatory method to science education.

For instance, a study by Umanah and Etiubon (2023) investigated the effects of Roundrobin and Jigsaw cooperative learning strategies on chemistry students' academic achievement in Uyo, Akwa Ibom State. The study found that students taught using the Jigsaw strategy performed better,

with notable differences observed based on gender. This suggests that cooperative learning strategies can impact male and female students differently. According to Adeyemi and Bello (2022) examined the effect of concept mapping instructional strategy on senior secondary school students' retention levels in biology in Kwara State. Their findings indicated that the concept mapping strategy significantly improved students' retention, particularly among female students. In Katsina State, Olasehinde and Olatoye (2014) compared the learning outcomes of male and female senior secondary school students in science subjects. The study revealed that female students outperformed their male counterparts, indicating the influence of gender on academic achievement in science. Madaki, Paul, and Adamu (2024) explored the effect of instructional materials on the retention of biological concepts among secondary school students in Yola North Local Government Area, Nigeria. The study concluded that the use of instructional materials enhanced students' academic performance and concept retention, with implications for gender-based learning outcomes.

According to Ji Meng, (2017), this researched a comparison between the effect of cooperative learning and lecture teaching on Comprehensive English classes in a Chinese Independent College. The objective of this was to ascertain the effectiveness of cooperative learning on comprehensive English classes. The research employed a pretest, posttest, questionnaire and interviews. Compared with traditional instructions, cooperative learning as pedagogy can improve students' performance on course exams, but not necessarily their language competence as shown in national English competency tests taken before and after the experiment. Test results also indicate students from experiment class who excelled in competency test outnumbered those from control class, revealing that cooperative learning has positive impacts especially on students at a relatively higher academic level.

Falemu, Oyeniyi, and Adumati (2017), explored the predictive influence of gender on the academic performance of biology students in secondary schools within Ado Local Government Area, Ekiti State. The objective of the study was to ascertain the influence of gender on biology students' achievements. The study used an ex-post facto research design and targeted schools that had

registered students for the 2014 and 2015 final year WAEC Biology exams. A total of 150 biology students were randomly selected from five secondary schools in the area. Three research hypotheses guided the study, and data were analyzed using t-test statistics. The results showed no significant difference in the academic performance of male and female students in biology mock exams in secondary schools. However, there was a significant difference in WAEC exam results, with female students outperforming male students.

Eseine-Aloja (2021), investigated the effect of gender on the academic performance of biology students attending extra-mural classes in public senior secondary schools in Esan Central Local Government Area, Edo State. The objective of the study The study employed a descriptive survey method and included biology students from 13 government-owned schools in the area. A sample size of 180 biology students was used, and data were collected using a structured achievement test with a reliability coefficient of 0.83. The research questions were answered using frequency counts, means, and percentages, while the hypothesis was tested at a 0.05 significance level using Analysis of Covariance (ANCOVA). The study concluded that there was a significant difference in the performance of male biology students who attended extra-mural classes compared to female students who did not, with male students performing better.

Osuolale (2014) investigated the problems of teaching and learning science in junior secondary schools in Nassarawa state, Nigeria. The objective of the study was to identify the factors that militate against teaching and learning of basic science. The research design was survey. The sample consisted 150 science students from J. S. S. in the state and 20 sience teachers. The instrument for data collection was questionaire. The result shows that teaching and learning environment are not conducive.

Summary of Literature Review

From the reviewed literature. It is evident that there have been past studies which investigated the effect of Jigsaw Cooperative Learning Strategy on Secondary School students

Achievement and Retention in Biology. It is shown that jigsaw cooperative learning strategy consistently enhances students' academic achievement and retention by fostering active participation, peer interaction, and collaborative problem-solving. Through its structured method, where each learner is responsible for mastering and teaching a segment of the content, jigsaw cooperative learning strategy (JCLS) promotes deeper understanding and improved academic outcomes when compared with conventional teacher-centered methods.

Several studies have examined the moderating effect of gender on students' performance under jigsaw cooperative learning strategy (JCLS). While some reported significant differences in achievement and retention between male and female students, others demonstrated that jigsaw cooperative learning strategy can reduce gender-related disparities by creating equitable opportunities for engagement, peer support, and shared responsibility in learning. Nevertheless, stereotypes in science education persist in some contexts, where male students are often perceived as more competent in science-related subjects such as Biology, Chemistry, and Physics.

Despite the growing body of literature affirming the positive effect of jigsaw cooperative learning strategy, most studies have adopted a general perspective, with limited focus on its application to specific subjects such as Biology. The underlying mechanisms by which jigsaw cooperative learning strategy influences students' achievement and retention in Biology remain underexplored, particularly at the senior secondary school level. Additionally, the long-term effects of JCLS implementation have not been explored. These identified gaps highlight the need for a focused investigation into the effects of the Jigsaw Cooperative Learning Strategy on secondary school students' achievement and retention in ecological succession in Biology.

CHAPTER THREE

METHODOLOGY

The section discusses the study's research methodology under the following sub headings:

- Research design
- Population of the study
- Sample and sampling technique
- Research instrument
- Validity of the instrument
- Reliability of the instrument
- Method of data collection
- Method of data analysis

Research Design

This study employed the quasi-experimental design, pretest-posttest non-randomized equivalent control group design. The study consists of experimental and control groups of two randomly assigned intact classes with no randomization of subjects into group.

Table 1: Design over variable

Groups	**Pretest**	**Treatment**	**Posttest**
Experimental group	O_1	X_1	O_2
Control group	O_1	X_2	O_2

Where O_1 = Pretest

O_2 = Posttest

X_1=Treatment (Jigsaw Cooperative Learning Strategy) for experimental group

X_2 = Treatment (Conventional teaching Method) for the control groups

The independent variables are Jigsaw Cooperative Learning Strategy and Conventional teaching Method while the dependent variables are Academic achievement and Retention.

Population of the Study

The population of the study consists of all public senior secondary school two (S.S.1) Biology students in Egor Local Government Area of Edo State. There are thirteen public senior secondary Schools in Egor Local Government Area. The secondary school two (S.S.2) students are made up of 1,297 males and 1,247 females, making a total of 2544 students.

Table 2. Data on public Senior and Junior Secondary Schools in Ovia North East, Edo State

		No. of students (SS1)		
S/N	**Name of School**	**Male**	**Female**	**Total**
1.	Asoro Grammar School	188	197	385
2.	Edo boys Secondary School	180		180
3.	Egor Secondary School	70	99	169
4.	Eweka Grammar School	39	31	70
5.	Evbareke Secondary School	141	119	260
6.	Evbuotubu Secondary School	107	113	220
7.	Government Science and Technical college	336	90	420
8.	Iyoba College		258	258
9.	Okhokhugbo Secondary School	37	53	90
10.	Ohonre Grammar School	30	58	88
11.	Useh Secondary School	62	143	205
12.	Utselu Secondary School	77	43	120
13.	Uwelu Secondary School	30	43	73
	Total	**1,297**	**1,247**	**2,544**

Source: Edo State Ministry of Education (2025).

Sample and Sampling Technique

The study sample consists of a total of seventy two students comprising 39 males and 33 females from two intact classes formed the sample of the study. The experimental group consists of 29 students (16 males and 13 females) while the control group is made up of 43 students (23 males and 20 females).

The simple random sampling method was used to select two schools from the eleven co-educational public senior secondary schools in Egor Local Government Area. This method ensures that all

schools had an equal chance of being selected, enhancing the external validity of the use of co-educational schools is deliberate to guarantee the inclusion of both male and female students, ensuring a balanced gender representation within the sample. The gender distribution in both groups reflects the co-educational nature of the schools and ensure that any observed effects of the intervention can be generalized across both male and female students (See Table 3).

Table 3: Distribution of Students by Sex

The summary is presented in the table below

Group Type	Total No of students	No of Male	No of Female
Experimental Group A	29	16	13
Control Group B	43	23	20
Total	**72**	**39**	**33**

Research Instrument

The instruments for data collection were Biology achievement test on Ecological Succession (BATES) and Biology Retention test on Ecological succession. The two instruments consisted of 25 multiple-choice questions on ecological succession concepts. The BRTES consisted of the rearranged version of BATES. The multiple choice questions were gotten from West Africa Senior Secondary Certificate Examination (WASSCE) past questions papers between 2018 - 2023.

Validity of the Instrument

The research instruments' validity was evaluated by a team of three experts, which included the researcher's supervisor and two specialists from the Department of Curriculum and Instructional Technology at the University of Benin. To ensure face validity, the experts reviewed the instruments for clarity and appropriate wording. For content validity, they used a table of specification to

confirm that the questions accurately measured the intended variables. Based on the constructive feedback provided by this experts, the instrument was revised before being used in a field trial.

Table 4: The table of specification is presented below:

Content	Knowledge (25%)	Comprehension (20%)	Application (10%)	Analysis (25%)	Interpretation (20%)	Total (100%)
Definition	1(1)	1(9)	1(21)	1(8)	1(3)	5
Types of Ecological Succession	1(2)	1(7)	1(20)	1(5)	1(19)	5
Pioneer species	1(16)	1(17)	0	1(14)	1(23)	4
Factors affecting Ecological Succession	1(11)	1(25)	0	1(12)	0	3
Effects of Ecological Succession	1(4)	0	0	1(6)	1(24)	3
Climax community	1(13)	1(15)	1(9)	1(22)	1(18)	5
Total	**6**	**5**	**3**	**6**	**5**	**25**

Reliability of the Instrument

A pilot test was carried out to determine the reliability of the BATES. A co-educational school which was not part of the main study was used for this pilot testing. The instruments was administered over a period of 40 minutes, after which the researcher collected them. The scores obtained from the 30 (SSII) students who participate in the pilot testing was analyzed using the Kuder-Richardson Formula 21 and found to have reliability index of 0.8520. The kuder-Richardson Formula was used because of the level of difficulty of each test questions.

Method of Data Collection

The Study is an experimental research which employed a quasi- experimental pretest, posttest non-equivalent control group design. Two intact classes from the two randomly selected

schools were used for the study. The two intact classes were randomly assigned to experimental group A and control group B. The study lasted for a period of six weeks. The topic used for the study is Ecological Succession. The two groups were taught simultaneously, the Biology teachers in the experimental group was trained on how to use Jigsaw Cooperative Learning Strategy, while the teacher in the control group received guidelines and lesson plans which was prepared by the researcher. The researcher monitored the processes and ensured proper coordination of the two groups. The students were grouped into seven groups with a total of 4 students per group

Procedure for Experimental Group

The pretest was conducted in week one, the teaching commenced in week two by the Biology teacher, who also served as the research assistant. Who taught the weekly topics according to the Biology scheme of work, Instruction spanned three weeks. The Jigsaw Cooperative Learning Strategy was implemented as the instructional method. A posttest was then administered at the conclusion of the lessons in week four.

The steps for the lesson presentation over the three-week period were as follows:

Introductory phase

- The research assistant introduced Jigsaw cooperative learning strategy to the Students and how it operates. She also encourages them to maximize the opportunity and work according to the rules given to them.

Step One: Group Formation (Home Groups)

- The research assistant formed heterogeneous "home groups" of four students each, ensuring a mix of abilities based on their pretest scores. Each group member was assigned a specific portion of the material to become an "expert" on.

Step Two: Expert Group Session

- After the home groups were formed, students from different home groups who were assigned the same portion of the material gathered to form "expert groups." In these groups, the

students collaborated, discussed the content, and helped each other understand their assigned section thoroughly. The teacher presented a brief overview of the entire concept and provided the necessary materials and support to these expert groups.

Step Three: Return to Home Groups and Teach

- The students then returned to their original home groups. Each "expert" was responsible for teaching their portion of the material to their home group members. The students took turns presenting their learned content, ensuring that all members of the group understood the entire lesson. This process of teaching and learning from peers fostered a collaborative and interactive environment.

Step Four: Individual Assessment and Data Collection

- Following the Jigsaw learning activity, a posttest was administered to all students. This posttest was designed to assess the students' individual understanding of the entire lesson, not just their specific "expert" portion. This allowed for the measurement of the effectiveness of the Jigsaw strategy on achievement and retention. Two weeks after the posttest, a retention test (BRTES) was administered to measure long-term learning. Test results are scores objectively analyzed to determine the effect of the Jigsaw Cooperative Learning Strategy on students' academic achievement and retention in Ecological Succession in Biology.

Control of Extraneous Variables and Threats to Validity

To enhance the internal validity of the study and mitigate potential sources of bias, a number of extraneous variables were systematically controlled. The following measures were adopted in the research design:

Control of Teacher Variables: To ensure instructional consistency, participating teachers were selected based on their graduate-level qualifications. Furthermore, the researcher standardized the teaching process by providing and enforcing the use of detailed, pre-prepared lesson plans. The researcher also maintained custody of the test instruments to prevent unauthorized access and potential compromise.

Mitigation of Interaction Effects: The potential for inter-group interaction was addressed by conducting the study across two distinct schools. This physical separation of the experimental and control groups ensured that students could not influence one another, this was done to preserve the integrity of the research intervention.

Ensuring Homogeneity of Instruction: Consistency in the instructional environment was maintained by ensuring that all lessons adhered strictly to the established timetable and lesson plans. This rigorous approach guaranteed that the content delivered to both groups was uniform, isolating the treatment variable as the primary cause of any observed effects.

Addressing Pretest Sensitization: To prevent students from performing better on the posttest due to prior exposure to the test items, two key steps were taken. First, the time interval between the pretest and posttest was set at a minimum of six weeks. Second, the test instruments were promptly collected from both students and teachers after each administration to prevent any opportunity for review or rehearsal.

Method of Data Analysis

Paired sample t-test, was used to examine changes within groups, Independent sample t-test to compare the differences between groups and Analysis of Covariance (ANCOVA) to compare Posttest scores while controlling for pretest scores. All hypotheses were tested at a 0.05 level of significance.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This chapter presents, interprets and discusses the results obtained from the analysis of data using the various statistical procedures. The data are presented in tables and are arranged according to research questions and hypotheses.

Research Question 1: Is there any difference in the mean pre and posttests achievement scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional method?

Table 5: Mean and standard Deviation of Pretest and Posttest achievement score of students taught with the two methods

Groups	No Exp	Pretest		Posttest		Mean Gain
		Mean ($\bar{X}$)	SD	Mean ($\bar{X}$)	SD	
Experimental	30	22.1	6.60	61.14	9.05	31.10
Control	30	22.63	5.45	47.0	9.90	24.33

The data in table 5 shows that the experimental group got a mean score of 22.10 and a standard deviation of 6.60 in the pretest and a mean score of 61.14 and a standard deviation of 9.05 in the posttest making a pretest-posttest mean gain of 31.10. The Table also shows that the control group got a mean score of 22.63 in the pretest, a standard deviation of 5.45 and a mean score of 47.0 and a standard deviation of 9.90 in the posttest giving rise to a pretest-posttest mean gain of 24.33. The findings indicate that students achieved more in the posttest than in the pretest. Furthermore, the experimental group, which was taught using the Jigsaw cooperative learning strategy, recorded a higher mean gain than the control group, which was taught using the conventional teaching method. To conclude on the mean and observed differences in the mean pretest and posttest achievement scores, ANOVA was used. The result of the analysis is presented in the table below.

Hypothesis one: There is no significant difference in the mean achievement scores of biology students taught Ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.

Table 6: One-Way Analysis of Variance (ANOVA) of Students' Pre and Posttest Achievement Scores

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig**.
Between groups	8095.87	3	2699.01	33.07	.000
Within groups	8487.70	104	82.0		
Total	16583.57	107			

Table 6 presents the findings from the one-way ANOVA conducted on the pre and posttest achievement scores of students. The study compared a group of Biology students in Egor Local Government Area of Edo State who were taught the ecological succession using the Jigsaw Cooperative Learning Strategy against those taught using a conventional teaching method.

The ANOVA results indicated a statistically significant difference between the groups, as shown by an F-statistic of $F(3, 107) = 33.07$ with an associated p-value of .000. Since this p-value is less than the .05 significance level, the null hypothesis that there is no difference in the mean achievement scores was rejected.

Research Question 2: Is there any difference in the mean achievement scores of biology students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional lecture method?

Table 7: ANCOVA table on mean achievement score of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional lecture Method

Dependent Variable: ACHIEVEMENT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.192[a]	1	7.192	20.247	.000
Intercept	171.279	1	171.279	482.165	.000
GROUPS	7.192	1	7.192	20.247	.006
Error	31.971	90	.355		
Total	209.000	92			
Corrected Total	39.163	91			

a. R Squared = .184 (Adjusted R Squared = .175)

The ANCOVA result (Table 6) revealed a significant difference between the groups, with an F-value of 20.247 and a significance level of .006. Since the p-value (.006) is less than the alpha level of .05, the null hypothesis of no significant difference is rejected.

Students taught with the jigsaw cooperative learning strategy achieved significantly higher scores compared to those taught with the conventional method. The null hypothesis was therefore rejected. The findings indicate that the teaching method had a significant effect on student achievement. Specifically, there was a statistically significant difference in the mean achievement scores between the students who were taught with the Jigsaw Cooperative Learning Strategy and those taught with the Conventional Lecture Method. It shows the effectiveness of the jigsaw cooperative learning strategy in enhancing students' academic achievement in biology. The result is consistent with Vygotsky's (1978) Social Constructivist Theory, which posits that learning occurs through social interaction and collaboration. In a jigsaw classroom, students become active participants,

constructing knowledge by teaching and learning from peers, which leads to deeper retention and improved achievement (Gillies, 2016).

Hypothesis Two: There is no significant difference in the mean achievement scores of biology students taught Ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.

Since the p-value (.006) is less than the alpha level of .05, the null hypothesis of no significant difference is rejected. This means there is a significant difference in the mean achievement scores of Biology students taught Ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.

RESEARCH QUESTION 3: Is there any difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using the conventional teaching method?

Table 8: ANCOVA table on mean Retension score of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional lecture Method

Dependent Variable: RETENTION

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.152[a]	1	7.152	21.247	.000
Intercept	151.247	1	151.247	397.164	.000
GROUPS	5.142	1	5.142	21.341	.004
Error	28.678	89	.355		
Total	204.000	83			
Corrected Total	37.163	82			

a. R Squared = .184 (Adjusted R Squared = .175)

The ANCOVA result (Table 7) revealed a significant difference in retention scores between the two groups ($F(1, 89) = 21.341$, $p = .004$). Students in the jigsaw group retained significantly more information than their counterparts in the conventional group. The null hypothesis was rejected. This result indicates that the jigsaw cooperative learning strategy promotes long-term retention of knowledge. According to Ausubel's (2012) theory of meaningful learning, students are more likely to remember concepts when they engage in active learning experiences that link new information to prior knowledge. The peer-teaching and interactive nature of jigsaw activities promotes repeated cognitive engagement, leading to better retention (Olawale & Olusola, 2022).

Hypothesis 3: There is no significant difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.

The ANCOVA analysis on retention scores shows that the effect of groups was statistically significant. The F-value was 21.341, and the significance level was .004. As the p-value (.004) is less than .05, the null hypothesis of no significant difference is rejected. The results show that the teaching method had a significant effect on students' retention of knowledge. There was a statistically significant difference in the mean retention scores between the group taught with the Jigsaw Cooperative Learning Strategy and the group taught with the Conventional Lecture Method. Therefore there is a significant difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.

RESEARCH QUESTION 4: Is there any difference in the mean achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy?

Table 9: independent t-test on significant difference of the mean achievement score of male and female students taught ecological succession using Jigsaw Cooperation Learning Strategy.

Variable	No Exp.	$\overline{X}$	SD	t	Df	Sig (2-tailed)	Decision
MALE	39	4.70	1.15	.021	62	.983	H_0 Accepted
FEMALE	33	4.71	1.06				

The independent t-test (Table 8) showed no significant difference between male (M = 4.70, SD = 1.15) and female (M = 4.71, SD = 1.06) students (t(62) = .021, p = .983). The null hypothesis was accepted. This finding suggests that the jigsaw cooperative learning strategy benefits both genders equally in terms of achievement. It also suggest that gender did not have a significant effect on student achievement when using the Jigsaw Cooperative Learning Strategy. The observed difference in the mean scores between male and female students was not statistically significant.

It aligns with the findings of Okoro and Blessing (2021), who observed that gender has minimal influence when cooperative learning methods are implemented effectively. This supports the strategy's suitability for inclusive education practices.

Hypothesis 4: There is no significant difference in the achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.

The male students had a mean score of 4.70 (SD = 1.15), and the female students had a mean of 4.71 (SD = 1.06). The test yielded a significant value of .983, which is greater than the .05 alpha level. Consequently, the null hypothesis was accepted.

RESEARCH QUESTION 5: is there any difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.

Table 10: independent t-test on significant difference of the mean Retention score of male and female students taught ecological succession using Jigsaw Cooperation Learning Strategy.

Variable	No Exp.	$\overline{X}$	SD	t	Df	Sig (2-tailed)	Decision
MALE	39	1.60	0.56	.00	62	.288	H_0 Accepted
FEMALE	33	1.76	0.65				

(Table 9)The independent t-test comparing male and female students' retention scores shows that the male students had a mean of 1.60 (SD = 0.56) and the female students had a mean of 1.76 (SD = 0.65). The t-test resulted in a significant value of .288, which is greater than the .05 alpha level. The null hypothesis (H_0) was accepted. There was no statistically significant difference in the mean retention scores between male and female students taught with the Jigsaw Cooperative Learning Strategy. The minor differences in their scores could be attributed to chance.

Hypothesis 5: There is no significant difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.

No significant difference in retention scores between male (M = 1.60, SD = 0.56) and female (M = 1.76, SD = 0.65) students (t(62) = .00, p = .288). The null hypothesis was accepted. This result shows that both male and female students benefit equally from the retention advantages provided by the jigsaw cooperative learning strategy. It further demonstrates the gender-neutral nature of Jigsaw Cooperative Learning Strategy.

Discussion of findings

The findings of the study indicated a statistically significant difference in favour of students taught using the Jigsaw cooperative learning strategy compared to those taught using the conventional teaching method, with respect to their mean achievement scores in Biology. This implies that the application of Jigsaw cooperative learning strategy enhances students' academic performance more effectively than conventional teaching method. The improved achievement scores among students

exposed to the Jigsaw strategy may be attributed to its emphasis on peer learning and active participation. Learners are engaged in meaningful discussions, collaborate with peers, and teach one another Biological concept. Such interactive engagement, as opposed to the passive nature of conventional teaching method appears to contribute to improved academic achievement. Furthermore, by taking responsibility for teaching segments of the content, students enhance their comprehension, critical thinking, and overall understanding of the subject concept. These findings align with Johnson et al. (2020), who reported that the Jigsaw cooperative learning strategy significantly improved students' mastery of complex biological concepts compared to the conventional teaching method. Their study also revealed that students involved in Jigsaw activities demonstrated superior academic achievement and knowledge retention over time. Similarly, this outcome supports the work of Freeman (2014), who observed that students exposed to active learning strategies, such as Jigsaw, achieved substantially higher academic achievement compared to their counterparts in conventional teaching method.

The results align with Vygotsky's (1978) Social Constructivist Theory, which emphasizes the importance of social interaction in knowledge construction. By engaging in expert and home groups, students actively participated in knowledge exchange, peer teaching, and collaborative problem-solving, which facilitated deeper learning.

Furthermore, the retention scores indicated that students taught using Jigsaw Cooperative Learning Strategy (JCLS) retained knowledge significantly better than their counterparts in the conventional group. This could be attributed to the active involvement and accountability inherent in this jigsaw strategy, where students teach their peers and, in turn, reinforce their own understanding. This aligns with the findings of Bello and Mohammed (2024), who reported improved long-term retention among students taught through cooperative learning strategies.

Regarding gender, the study found no significant difference in the achievement and retention scores of male and female students. This suggests that JCLS is an inclusive strategy that supports both

genders equally. This result supports the findings of Falemu, Oyeniyi, and Adumati (2017), who reported no substantial gender disparities in biology performance under active learning strategies.

Overall, the discussion confirms that the Jigsaw Cooperative Learning Strategy (JCLS) provides an interactive, learner-centered environment that enhances comprehension, critical thinking, and memory retention, more evidently than the conventional teaching methods.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the effect of the Jigsaw Cooperative Learning Strategy on the academic achievement and retention of secondary school students in Ecological Succession in Biology. The study was prompted by the consistently poor achievement of Nigerian students in Biology examinations. There is need for students' academic achievement to be improved and there is need for students to be equipped with the foundational knowledge needed for the 21st century. Students experience difficulties when taught with the conventional teaching method which is the teacher centered method. In Biology Students tend to encounter conceptual difficulty as a result of using the Conventional Teaching method.

The use of cooperative learning strategies such as the jigsaw cooperative learning strategy meets students' demands by promoting higher academic achievement and increased retention of knowledge and skills.

The following research questions guided the study:

1. Is there any difference in the mean pre and posttests achievement scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional method?
2. Is there any difference in the mean achievement score of biology students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional lecture method?
3. Is there any difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using the conventional teaching method?
4. Is there any difference in the mean achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy?

5. Is there any difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy?

Based on the research questions, the following hypotheses were formulated and tested at 0.05 levels of significance;

1. There is no significant difference in the mean pre and posttests achievement scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught with the conventional teaching method.
2. There is no significant difference in the mean achievement scores of biology students taught Ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.
3. There is no significant difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.
4. There is no significant difference in the achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.
5. There is no significant difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.

The study employed a quasi-experimental non-randomized control group design. Intact classes were used so as not to disrupt the school academic programme used for the fieldwork. The independent variables are Jigsaw Cooperative Learning Strategy and Conventional teaching Method while the dependent variables are Academic achievement and Retention. The instruments for data collection were Biology achievement test on Ecological Succession (BATES) and Biology Retention test on Ecological succession (BRTES). BATES instrument consisted of 25 multiple-choice questions on ecological succession concepts. The multiple choice questions were extracted from West Africa Senior Secondary Certificate Examination (WASSCE) past questions papers between,2014-2023. BRTES was a rearranged version of BATES. To determine the validity of the instruments, both face

and content validity was carried and to determine the reliability for BATES AND BRTES, the responses from the (25) S.S.1 Biology students was subjected to kuder-Richardson Formula 21 due to the level of difficulty of each question and was found to have a reliability statistics of 0.8520. The hypotheses were tested using, mean, standard deviation, t-test statistics, Independent t-test, Analysis of variance (ANOVA) and Analysis of covariance (ANCOVA). All hypotheses were tested at 0.05 level of significance.

The following are the findings of the study;

1. There is a significant difference in the mean pretest and posttest achievement scores of students taught with the two methods.
2. There is a significant difference in the mean achievement scores of Biology students taught Ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.
3. There is a significant difference in the mean retention scores of students taught ecological succession using jigsaw cooperative learning strategy and those taught using conventional teaching method.
4. There is no significant difference in the achievement scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.
5. There is no significant difference in the mean retention scores of male and female students taught ecological succession using jigsaw cooperative learning strategy.

Conclusion

Based on the findings of the study, it was concluded that:

1. The Jigsaw Cooperative Learning Strategy is an effective teaching method for improving secondary school students' academic achievement in Biology.
2. The Jigsaw Cooperative Learning Strategy significantly enhances students' long-term retention of knowledge compared to the conventional teaching method.

3. Jigsaw Cooperative Learning Strategy student achievement and retention in Biology is not influenced by gender. The strategy benefits both male and female students equally, making it a gender-neutral instructional approach.
4. Jigsaw Cooperative Learning strategy significantly improved the social interaction among students
5. Jigsaw Cooperative Learning Strategy significantly improved students' knowledge construction and problem solving skills

Recommendations

Based on the findings and conclusions of this study, the following recommendations are made:

1. Biology teachers should adopt and consistently use the Jigsaw Cooperative Learning Strategy in the classroom. This student-centered approach will encourage active participation, peer teaching, and collaboration, which can lead to a deeper understanding of complex topics like Ecological Succession and improve academic achievement.
2. Curriculum planners and developers should integrate the Jigsaw Cooperative Learning Strategy and other interactive, learner-centered instructional methods into the Biology curriculum. This will help align the curriculum with modern educational goals and prepare students with essential 21st-century skills such as teamwork, communication, and critical thinking.
3. School administrators should promote and support the use of the Jigsaw Cooperative Learning Strategy by providing teachers with the necessary training, resources, and a supportive environment for implementing this innovative method. This will help create a more engaging and effective learning environment, which can also lead to fewer disciplinary issues.
4. The results of this study can serve as a baseline for future research. Further studies could explore the effects of the Jigsaw Cooperative Learning Strategy on other difficult topics in Biology or other science subjects. Additionally, researchers could investigate the long-term impact of the strategy beyond the retention period studied in this research.

Contribution to Knowledge

This study contributes to the existing body of knowledge in educational pedagogy, particularly in science education, in the following ways:

1. It provides empirical evidence of the significant positive effects of the Jigsaw Cooperative Learning Strategy on both academic achievement and knowledge retention among secondary school students studying Biology.
2. The findings are highly relevant to the Nigerian education system, addressing the persistent issue of poor student performance in Biology by offering a validated, practical instructional alternative.
3. The research establishes that the Jigsaw strategy is a gender-neutral teaching method for the topic of Ecological Succession, demonstrating its potential to be an equitable instructional approach that benefits both male and female students equally, thus helping to reduce gender-based achievement gaps in science.

Based on the conclusion and recommendations of the study, the following areas are suggested for future research:

1. Longitudinal Studies: A similar study could be conducted over a longer duration to better assess the long-term retention of knowledge enhanced by the Jigsaw Cooperative Learning Strategy.
2. Broader Subject Areas: Future research could investigate the effect of the Jigsaw strategy on students' achievement and retention in other science subjects (e.g., Chemistry, Physics) or other academic disciplines to determine its versatility as a teaching tool.
3. Wider Population and Location: Replicating this study in different geographical locations (e.g., other states in Nigeria) and with a more diverse population (e.g., private school students) would help to confirm the generalizability of the findings.
4. Teacher Training and Implementation: Further studies could explore the challenges and best practices associated with implementing the Jigsaw Cooperative Learning Strategy in a classroom setting, focusing on the role of teacher training and support.

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APPENDIX A

Faculty of Education,
Department of Curriculum
And Instructional technology,
University of Benin,
Benin City.

BIOLOGY ACHIEVEMENT TEST:

EFFECT OF JIGSAW COOPERATIVE LEARNING STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT AND RETENTION IN ECOLOGICAL SUCCESSION IN BIOLOGY

This instrument is to assist in gathering data on the effect of Jigsaw Cooperative Strategy on secondary school students' in ecological Succession in Egor Local Government Area in Edo state. Your school has been selected to be part of this important survey. Your support is therefore solicited to enable the researcher gather the needed data for this exercise. Please respond as accurately as possible.

Thank you.

INSTRUCTION:

Provide the necessary information needed in the column. Kindly tick (✓) for the appropriate responses.

SECTION A

Demographic Date

Gender: Male: ☐ Female: ☐

SECTION B.

In the section pick (√) the appropriate option.

Biology Achievement Test on Ecological Succession

1. What is ecological succession?

a. The rapid growth of an organism in a new environment b. The gradual and natural change in species composition of an ecosystem over time c. The extinction of species due to climate change d. The artificial introduction of species into an ecosystem

2. What is a community in ecological terms?

a. A single species living in an area b. A collection of different species living in the same area

c. An organism's role in its environment d. The non-living components of an ecosystem

3. What is Ecological niche?

a. Where an organism lives and the role it plays in an ecosystem

b. An artificial introduction of Species into an ecosystem

c. An area that has never supported life before

d. An increase in the number of different species within an ecosystem.

4. One of the following is not a factor that could be responsible for the fluctuations in the number of species in the community

a. Death rate b. Disease c. Competition d. Health living

5. _____ are species whose population has become so small that it can be completely wiped out or become extinct.

a. Succession b. Endangered species c. Competition d. Migration

6. _____ creates a variety of habitats and microhabitats, supporting a wider range of species and promoting biodiversity.

a. Succession b. habitats c. Plants d. Climate

7. Which of the following best describes secondary succession?

a. It occurs in an area that has never supported life before b. It starts from bare rock with no soil present c. It occurs after a disturbance such as a wildfire or flood. d. It leads to the extinction of all species in the area

8. The sequence of steps in the process of succession is :

a. Migration → Ecesis → Aggregation → Reaction → Stabilization

b. Reaction →→ Aggregation → Ecesis → Migration → Stabilization

c. Ecesis Migration → Aggregation → Stabilization → Reaction

d. Aggregation → Stabilization Migration → Aggregation → Ececis

9. What is the term for a group of individuals of the same species living in a specific area? a. Community b. Ecosystem c. Population d. Habitat

10. _____ is the ecological succession that occurs after the initial succession has been disrupted and some plants and animals still exist.

a. Plant succession b. Secondary succession c. Animal succession c.Primary succession.

11. The following are factors that affect ecological succession except

a. Topographical b. Soil c. Climate d. wood

12. What factor is primarily responsible for the nutrient content in soil? a. Temperature b. Precipitation c. Parent material d. Wind speed

13. What is the climax stage of succession?

a. The climax is the when a natural disaster leaves no topsoil behind

b. The climax stage of succession is the final stage in which the ecosystem is balanced and relatively stable.

c. When environmental changes allow new plant species to outcompete existing plant species in a recovering ecosystem.

d. None of the above

14. Which term refers to species that are the first to colonize newly created or recently disturbed environments during the processes of primary and secondary succession?

A) Keystone species

B) Pioneer species

C) Indicator species

D) Endemic species

15. How does climate influence ecological succession?

A) It has no effect on the development of plant communities

B) It determines which species can survive and thrive in an area

C) It speeds up succession to reach the climax community faster

D) It only affects animal populations, not plants

16. Why do pioneer species play a crucial role in succession?

A) They prepare the environment for more complex organisms by modifying soil and nutrients

B) They are the largest species in the ecosystem

C) They eliminate competition among species

D) They prevent succession from occurring

17. Which of the following is an example of a pioneer species in primary succession?

A) Oak trees

B) Grasses

C) Lichens

D) Large shrubs

18. Which factor is most important in determining the type of climax community that will develop in an area?

A) The type of pioneer species present

B) The rate of animal migration

C) The climate of the region

D) The presence of human settlements

19. A farmer abandons a piece of farmland, and over the years, grasses, shrubs, and eventually trees begin to grow. What type of succession is occurring, and how does the soil composition change over time?

a. Primary succession; soil forms from bare rock as organisms break it down

b. Secondary succession; nutrients in the soil increase as organic matter accumulates

c. Climax succession; the soil remains unchanged as new species replace old ones

d. Tertiary succession; the soil loses its nutrients over time, preventing further plant growth

20. A barren landscape of rocks will progress through _____

a. Primary ecological succession to become a climax community

b. Secondary succession

c. Climax succession

d. Terrestrial succession

21. What is Ecology?

a. The study of rocks and minerals

b. The study of human anatomy

c. The study of interactions between organisms and their environment

d. The study of ancient civilization

22. Population refers to ___

a. Group of individuals of the same species living in a specific area

b. Community of people living differently

c. Ecosystem

d. Habitat

23. Which term refers to the role an organism plays in its environment?

a. Niche b. Habitat c. Community d. Ecosystem

24. What is a major limitation of ecological succession models?

a) They assume that succession always follows a linear path.

b) They do not account for human interference in ecosystems.

c) They focus only on plant species and ignore animal involvement.

d) All of the above.

25. Which factor has the greatest influence on the rate of succession?

a) The presence of decomposers in an ecosystem

b) The size of an ecosystem

c) The type of disturbance and environmental conditions

d) The number of species present at the start of succession

APPENDIX B

ANSWERS TO Biology Achievement Test on Ecological Succession QUESTIONS

S/N	ANSWERS
1.	B
2.	B
3.	A
4.	D
5.	B
6.	A
7.	C
8.	A
9.	C
10.	B
11.	D
12.	C
13.	B
14.	B
15.	B
16.	A
17.	C
18.	C
19.	A
20.	A
21.	C
22.	C
23.	A
24.	A
25.	C

APPENDIX C

Biology Retention Test on Ecological Succession

In the section pick (√) the appropriate option.

1. What is the climax stage of succession?

a. The climax is when a natural disaster leaves no topsoil behind

b. The climax stage of succession is the final stage in which the ecosystem is balanced and relatively stable

c. When environmental changes allow new plant species to outcompete existing plant species in a recovering ecosystem

d. None of the above

2. What is a community in ecological terms?

a. A single species living in an area

b. A collection of different species living in the same area

c. An organism's role in its environment

d. The non-living components of an ecosystem

3. What is the term for a group of individuals of the same species living in a specific area?

a. Community

b. Ecosystem

c. Population

d. Habitat

4. One of the following is not a factor that could be responsible for the fluctuations in the number of species in the community

a. Death rate

b. Disease

c. Competition

d. Healthy living

5. What is the term for group of individuals of the same species living in a specific area?

a. Community

b. Ecosystem

c. Population

d. Habitat

6. Why do pioneer species play a crucial role in succession?

a. They prepare the environment for more complex organisms by modifying soil and nutrients

b. They are the largest species in the ecosystem

c. They eliminate competition among species

d. They prevent succession from occurring

7.___ is the ecological succession that occurs after the initial succession has been disrupted and some plants and animals still exist.

a. Plant succession

b. Secondary succession

c. Animal succession

d. Primary succession

8. What is Ecological niche?

a. Where an organism lives and the role it plays in an ecosystem

b. An artificial introduction of species into an ecosystem

c. An area that has never supported life before

d. An increase in the number of different species within an ecosystem

9.What is Ecology?

a. The study of rocks and minerals

b. The study of human anatomy

c. The study of interactions between organisms and their environment

d. The study of ancient civilization

10. A farmer abandons a piece of farmland, and over the years, grasses, shrubs, and eventually trees begin to grow. What type of succession is occurring, and how does the soil composition change over time?

a. Primary succession; soil forms from bare rock as organisms break it down

b. Secondary succession; nutrients in the soil increase as organic matter accumulates

c. Climax succession; the soil remains unchanged as new species replace old ones

d. Tertiary succession; the soil loses its nutrients over time, preventing further plant growth

11.Which of the following best describes secondary succession?

a. It occurs in an area that has never supported life before

b. It starts from bare rock with no soil present

c. It occurs after a disturbance such as a wildfire or flood

d. It leads to the extinction of all species in the area

12. The sequence of steps in the process of succession is:

a. Migration → Ecesis → Aggregation → Reaction → Stabilization

b. Reaction → Aggregation → Ecesis → Migration → Stabilization

c. Ecesis → Migration → Aggregation → Stabilization → Reaction

d. Aggregation → Stabilization → Migration → Aggregation → Ecesis

13. What is ecological succession?

a. The rapid growth of an organism in a new environment

b. The gradual and natural change in species composition of an ecosystem over time

c. The extinction of species due to climate change

d. The artificial introduction of species into an ecosystem

14.____ are species whose population has become so small that it can be completely wiped out or become extinct.

a. Succession

b. Endangered species

c. Competition

d. Migration

15. Which term refers to the role an organism plays in its environment?

a. Niche

b. Habitat

c. Community

d. Ecosystem

16. _____ creates a variety of habitats and microhabitats, supporting a wider range of species and promoting biodiversity.

a. Succession

b. Habitats

c. Plants

d. Climate

17. Which of the following is an example of a pioneer species in primary succession?

a. Oak trees

b. Grasses

c. Lichens

d. Large shrubs

18. Which factor has the greatest influence on the rate of succession?

a. The presence of decomposers in an ecosystem

b. The size of an ecosystem

c. The type of disturbance and environmental conditions

d. The number of species present at the start of succession

19. What factor is primarily responsible for the nutrient content in soil?

a. Temperature

b. Precipitation

c. Parent material

d. Wind speed

20. A barren landscape of rocks will progress through ___

a. Primary ecological succession to become a climax community

b. Secondary succession

c. Climax succession

d. Terrestrial succession

21. Which term refers to species that are the first to colonize newly created or recently disturbed environments during the processes of primary and secondary succession?

a. Keystone species

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22. What is a major limitation of ecological succession models?

a. They assume that succession always follows a linear path

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23. How does climate influence ecological succession?

a. It has no effect on the development of plant communities

b. It determines which species can survive and thrive in an area

c. It speeds up succession to reach the climax community faster

d. It only affects animal populations, not plants

24. What is the most important factor in determining the type of climax community that will develop in an area?

a. The type of pioneer species present

b. The rate of animal migration

c. The climate of the region

d. The presence of human settlements

25. The following are factors that affect ecological succession except:

a. Topographical

b. Soil

c. Climate

d. Food

APPENDIX D

ANSWERS TO Biology Retention Test on Ecological Succession QUESTIONS

S/N	ANSWERS
1.	b
2.	b
3.	c
4.	d
5.	c
6.	a
7.	b
8.	a
9.	c
10.	b
11.	c
12.	a
13.	b
14.	b
15.	a
16.	a
17.	c
18.	c
19.	c
20.	a
21.	b
22.	d
23.	b
24.	c
25.	d

APPENDIX E

CHARACTERIZED LESSON PLAN FOR THE CONVENTIONAL GROUP

WEEK ONE: PRE-TEST

TOPIC: ECOLOGICAL SUCCESSION

WEEK TWO

SUB-TOPIC: DEFINITION , TYPES OF ECOLOGICAL SUCCESSION, AND IMPORTANCE

Performance Objective	Content	Teacher's Activities	Students Activities	Instructional Material	Evaluation
Students should be able to; 1. Define Ecological succession 2. Identify and explain the types of ecological succession 3. Explain the importance of ecological succession 4. Give examples of ecological succession in nature	1.Definition of ecological succession 2. Types of ecological succession 3. Examples of ecological succession in nature 4. Importance of ecological succession	1. Teacher introduces the lesson by asking questions from the students on the view about the concept to be taught. 2. Teacher explains the topic and use the required instructional materials 3. Teacher explains the topic and use the required instructional materials 4. Teacher writes note on the chalkboard for the students and gives them assignment	1.Students listen to the teacher 2. Students listen to the teacher and ask questions where necessary 3. Students answer teachers questions 4. Students copy their note	1. Essential Biology 2. Chart of different stages of succession 3. Chalkboard 4. Content of instruction	1. What is ecological succession 2. Give two examples of ecological succession in nature 3. What is the difference between primary and secondary succession 4. State two importance of ecological succession

WEEK THREE

SUB-TOPIC: FACTORS AFFECTING ECOLOGICAL SUCCESSION AND PIONEER SPECIES

Performance objectives	Content	Teacher's Activities	Students Activities	Instructional Materials	Evaluation
Students should be able to 1. Identify the factors that affect ecological succession. 2. Explain how each factors influences the process of succession 3. Explain what a pioneer species is 4. Give examples of pioneer species	1. Factors affecting ecological succession 2. Definition of pioneer species 3. Examples of pioneer species	1. Teacher introduces the the lesson by asking why does a forest grow faster in some areas but take much longer in other areas? 2. Teacher explains the concept and use the required instructional materials 3. Teacher explains the concept in relation to the instructional objectives. 4. Teacher writes note on the chalkboard for the students and gives them assignment.	1. Students listens to the teacher 2. Students ask questions where necessary 3. Students answers the teachers questions 4. Students copy their note	1. College Biology by Idodo umeh and essential Biology 2. Chalkboard 3. Chart 4. Content of instruction	1. List three factors affecting ecological succession 2. Explain two factors that affect ecological succession 3. What is a pioneer specie.

WEEK FOUR

SUB-TOPIC: EFFECT OF ECOLOGICAL SUCCESSION AND ECOLOGICAL NICHE

Performance objectives	Content	Teacher's Activities	Students Activities	Instructional materials	Evaluation
Students should be able to; 1. Define Ecological niche 2. Explain the meaning and types of ecological niche 3. Give examples of ecological niche 4. List the effect of ecological succession	1. Ecological niche 2. Types of ecological niche. 3. Examples of ecological niche 4. Effect of ecological succession	1. Teacher introduces the lesson to the students by asking a question based on previous knowledge 2. Teacher explains the concept and use the required instructional materials 3. Teacher writes note on the chalkboard and gives assignment	1. Students listens attentively 2. Students ask questions where necessary 3. Students answers the teachers questions 4. Students copy their notes.	1. Lesson notes 2. Chalkboard 3. Chart	1. List two factors that affect ecological succession 2. Define Ecological niche 3. Give two examples of ecological niche

WEEK FIVE

SUB-TOPIC: CLIMAX COMMUNITY

Performance objectives	Content	Teachers Activities	Students Activities	Instructional materials	Evaluation
Students should be able to 1. Define Climax community 2. Explain how climax community is formed 3. Identify characteristics of climax community 4. Explain the importance of climax community to ecosystem stability	1. Definition of climax community 2. The formation of climax community 3. Characteristics of climax community 4. Importance	1. Teacher introduces the lesson by asking a question based on the previous knowledge 2. Teacher explains the concept and uses the required instructional materials 3.Teachr writes note on the chalkboard and gives assignment	1. Students listens attentively in the classroom 2. Students ask questions where necessary 3. Students answers the teachers questions 4. Students copy their notes.	1. Essential Biology 2. Chart showing climax community 3. Chalkboard 4. Content of instruction	1. Explain climax community. 2. Mention importance of climax community

APPENDIX F

RELIABILITY OF BIOLOGY ACHIEVEMENT TEST INSTRUMENT USING KUDER-RICHARDSON, FORMULA 21

KR- 21

where

K= 30 (Number of items)

$\bar{x}$ = 23.30 (scale mean)

S^2 = 29.50 (scale variance)

$$r = \frac{K}{K-1}\left[1 - \frac{\bar{x}(k-\bar{x})}{K5^2}\right]$$

$$= \frac{30}{30-1}\left[1 - \frac{23.30(30-23.30)}{30(29.50)}\right]$$

$$= \frac{30}{30-1}\left[1 - \frac{23.30(6.7)}{885}\right]$$

$$= \frac{30}{29}\left[1 - \frac{156.11}{885}\right]$$

$$= \frac{30}{29}[1 - 0.1764]$$

$$= \frac{30}{29}[0.8236]$$

$$= 1.0345(0.8236)$$

= 0.8520

OUTPUT

Hypothesis 1:

One-Way Analysis of Variance (ANOVA) of Students' Pre and Posttest Achievement Scores

	Sum of Squares	df	Mean Square	F	Sig.
Between groups	8095.87	3	2699.01	33.07	.000
Within groups	8487.70	104	82.0		
Total	16583.57	107			

RESEARCH QUESTION 2

Hypothesis 2:

Between-Subjects Factors

		Value Label	N
GROUPS	1.00	CONTROL	32
	2.00	EXPERIMENTAL	30

Tests of Between-Subjects Effects

Dependent Variable: ACHIEVEMENT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.192[a]	1	7.192	20.247	.000
Intercept	171.279	1	171.279	482.165	.000
GROUPS	7.192	1	7.192	20.247	.006
Error	31.971	90	.355		
Total	209.000	92			
Corrected Total	39.163	91			

a. R Squared = .184 (Adjusted R Squared = .175)

RESEARCH QUESTION 3

Hypothesis 3:

Between-Subjects Factors

		Value Label	N
GROUPS	1.00	CONTROL	32
	2.00	EXPERIMENTAL	30

Tests of Between-Subjects Effects

Dependent Variable: RETENSION

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.152[a]	1	7.152	21.247	.000
Intercept	151.247	1	151.247	397.164	.000
GROUPS	5.142	1	5.142	21.341	004
Error	28.678	89	.355		
Total	204.000	83			
Corrected Total	37.163	82			

a. R Squared = .184 (Adjusted R Squared = .175)

RESEARCH QUESTION 4

Hypothesis 4:

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
ACHIEVEMENT	MALE	39	4.7000	1.14921	.20982
	FEMALE	33	4.7059	1.05971	.18174

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ACHIEVEMENT	Equal variances assumed	.672	.416	-.021	62	.983	-.00588	.27616	-.55792	.54615
	Equal variances not assumed			-.021	59.438	.983	-.00588	.27758	-.56124	.54947

RESEARCH QUESTION 5

Hypothesis 5:

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
RETENTION	MALE	39	1.6000	.56324	.10283
	FEMALE	33	1.7647	.65407	.11217

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
RETENTION	Equal variances assumed	.847	.361	-1.072	62	.288	-.16471	.15362	-.47178	.14237
	Equal variances not assumed			-1.082	61.969	.283	-.16471	.15218	-.46890	.13949