

**EFFECTS OF SIMULATION AND GUIDED-INQUIRY STRATEGIES IN
ELIMINATION OF STUDENTS' MISCONCEPTION IN BIOLOGY IN
SENIOR SECONDARY SCHOOL IN RIVERS STATE**

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Abstract

This study looks at the ways that senior secondary schools in Obio/Akpor Local Government Area, Rivers State, can help their biology students get rid of misconception by using guided inquiry and simulation methods. The investigation was guided by the formulation of three research questions and three hypotheses. Pre-test, post-test control group design of quasi-experimental design was used in the study. The study's population consisted of all SSII biology students, with two schools chosen through purposive sampling. The sample size consists of 150 students from the two schools. The Ecology Performance Test (EPT) was the research tool employed. The use of test-retest procedures proved the validity and reliability of the instrument. A 0.95 reliability coefficient was obtained. The research questions were determined by utilizing means and standard deviation. While t-test was used to test the hypotheses. The findings, among other things, demonstrated that students had a lot of preconceptions prior to being exposed to guided inquiry and simulation as a teaching strategy. Both approaches have an impact in dispelling myths about biological concepts related to ecology. The simulation approach was more effective in eliminating biology misconceptions about ecological concepts. Among other things, it was suggested that biology instructors explore the use of simulation techniques in their lessons.

Keywords: Simulation, guided inquiry, misconceptions, Biology teaching, performance

Introduction

It is the greatest scientific discovery of the day, and we are all here to witness it. Man has been able to learn more about the universe thanks to the study of science.

Developing scientifically literate individuals who can understand science content and are able to derive conclusions from scientific problems, and are capable of assessing scientific instances is the aim of science education (Adolphus, 2022). Science is the systematic study of natural phenomena, and through inquiry, critical thinking, and skill demonstration, students have the opportunity to interact with the wonder and richness of the natural world through science education. Usman (2021) as stated, is the goal of scientific education in the twenty-first century, to support students in developing critical thinking skills and to motivate them to contribute to the creation of a more sustainable, socially just, and equitable world.

Alamina (2018) declared that graduates of science programs must be equipped with critical thinking skills, practical experience, and the capacity to explain most scientific findings, theories, and ideas using the most appropriate scientific terminology. Excellence in science and technology as well as the development of scientific literacy can result from effective science teaching and learning. According to Ezendu (2013) Science instruction has frequently shifted to being rote memorization-based, test-score-focused, and teacher-centered. The majority of students think science is boring and just a long list of intimidating terms and statistics that have no bearing on their everyday lives. Students learning biology, is also influenced by the methods and strategies that teachers employ to teach the subject (Hughes & Luddy, 2013).

Biology as one of the fields of science, examines living organisms and their surroundings. It is one of the science courses offered at the nation's high schools. One of the objectives of science education in the nation is scientific literacy, which is aided by knowledge of the subject. According to Muraya and Kimano (2011), Biology provides people with the opportunity to learn about the world around them, which can help them become more aware about their surroundings, their health, and the society they live in. Additionally, studying biology gives students the skills, information, and mindset they need to maintain and govern their surroundings. Scientific literacy is the capacity to use scientific information to solve problems in real-world scenarios that affect people's health, safety, and the environment. It goes beyond simply understanding scientific principles.

Over the world, the teaching profession has focused on assisting students in moving from their starting point of knowledge and comprehension at the optimal learning level required. Misunderstanding is one of the main outcomes of teacher-student interaction. Alamina (2018) describes a misconception as a student's individual understandings that deviate from generally acknowledged scientific information. According to the researcher, students' comprehension of fundamental science ideas is not grounded on science. This means that pupils make improper use of scientific

explanations and concepts. Demonstrating a disjunction in scientific reasoning, which indicates a lack of comprehension of the scientific ideas under learning. This will lead to misunderstandings that frequently signify something different from accurate ideas maintained by scientists. Factors that can result in misconceptions when it comes to teaching and learning were discovered by the researcher as: The deficiency factor and misrepresentation factor. The absence of proper cognitive structure development, which is linked to problem-solving abilities, is referred to as the deficiency factor and the interactions learners have with their surroundings is influenced by their cognitive systems. Misunderstandings will arise from a lack of proper cognitive structures required to relate to the subject matter that the teacher is presenting. The misrepresentation element is related to the improper way that the material to be taught is delivered, which results in a lack of comprehension or misunderstanding of the subject matter.

An impediment to learning is misconception, which must be overcome before a new conception may emerge. Due to a lack of conceptual knowledge, many students have misconceptions. Research has indicated that getting rid of misconceptions in learning is a challenging task. Hughes & Luddy, (2013), determined that instructional tactics ought to be implemented; this implies that inaccurate beliefs can be reorganized through instructional methods in order to rectify misconceptions. It is only when students critically assess their preexisting beliefs and replace them with new, consistent information will learning be successful.

Ogunkola and Samuel (2011) stated that the teachers' utilization of their respective teaching pedagogies is a critical component in creating a productive learning environment in the science classroom. Additionally, a teacher's manner of instruction affects the success or failure of their students. When teachers employ didactic tactics, students tend to become quite passive. Student-centered, innovative teaching strategies are needed to make biology teaching and learning more effective. According to the researcher, guided inquiry techniques and simulation learning may guarantee a deliberate, goal-oriented delivery of biological concepts that can effectively clear up students' misconceptions and improve their academic performance.

Simulation learning, which includes role-playing, games, and models, is a type of learning where students are presented with what is roughly equivalent to a real-life scenario. It can be characterized as an overview of certain actual situations (Perry et al, 2009). According to Obeka (2007) to imitate someone or something is to simulate them. When one produces the appearance or effect of something else, the outcome is the product. One type of experiential learning is simulation. This

strategy fits in very well with the core ideas of student-centered learning. A simulation is comparable to the real world in many ways because it involves participants in roles that are predetermined, and scenarios that need problem-solving tactics. This indicates that there is a great deal of resemblance between simulation and reality. Additionally, simulation can improve students' performance and attitudes toward biology (Ekwe, 2013).

Through a variety of knowledge sources, students can develop a personal viewpoint and a thorough grasp of a subject through guided inquiry (Keeley, 2012). With guided inquiry, students use a range of sources at every learning step, all under the teacher's supervision. The teacher gives the students materials and problems to research; they devise their own method for resolving the issues. It is an activity-based, student-centered teaching method. The instructor helps the students figure out solutions to issues. The instructor might even clarify, offer a hint, or suggest a method for resolving the issue (Byber, 2014).

Wokocha (2019), opined that rather than serving as a knowledge provider, the teacher serves as a catalyst in guided inquiry. The instructor presents the students with difficulties and questions, then encourages them to investigate the nature of the issues and offers advice on how to find solutions. According to Warren, Vossoughi, and Bang, (2020) through the elimination of prior incorrect knowledge, this method helps students become more interested, confident, innovative, and capable of solving problems. They do better in theory and practice as a result. This implies that teaching or instruction in biology needs to be done in a way that emphasizes how biological concepts and processes are transferable and applicable.

Many studies have documented students' misconceptions in science, and numerous research findings have revealed misconceptions being displayed in all the sciences. A study conducted by Hughes and Luddy, (2013), which include 1,002 students from eight secondary schools in Rivers State and examined students' misunderstandings of ecological concepts, the impacts of remediation on accomplishment. Phenomenological probe test for diagnosis. Descriptive and inferential statistics were used to analyze the data. The results showed that between 51 and 100 percent of the students had false beliefs on environmental issues. Also, Eryilmaz (2005) examined how students' misconceptions and performance in relation to force and motion were affected by conceptual assignments and conceptual change discussions. The study's treatment phase lasted for eight weeks. Three hundred and ninety-six high school students from six physics classes participated in the study. Misconceptions and forced accomplishment exams were given as pre- and post-tests to every student. According to the study's findings, students' misconceptions regarding force and motion were reduced by using the

conceptual change discussion as a useful tool. Furthermore, it was discovered that the conceptual change discussion greatly enhanced students' force and motion achievement. But the research did not take into account the guided inquiry approach and simulation technique for dispelling myths in biology, particularly in ecology, which is what this study aims to ascertain.

Statement of the Problem

Biology is a requirement for studying of core science courses (such as medicine, nursing, pharmacy, science education, etc.) in higher education institutions, biology is an essential scientific field in today's society. Osuafor, (2013) revealed that there is a fall in secondary school pupils' general performance in science classes like biology, which has raised major concerns among educators. This indicates that students are not receiving sufficient instruction in biology in terms of knowledge, comprehension, and abilities. The lack of comprehension among students in biology as a subjects might be attributed to inadequate explanations or misunderstanding of the teacher's chosen teaching methodology. This calls into question the effectiveness of the educational strategies that educators employ. Examining the effectiveness of creative teaching techniques in clearing students' misconceptions about biology is relevant. The researcher plans to look into how simulation and guided inquiry techniques affect students' elimination of biological misconceptions in senior high schools in Obio/Akpor, Rivers State. The goal of the study is to determine how guided inquiry and simulation approaches impact students' capacity to shed their false beliefs about biology.

Research Questions

The following research questions will guide the study:

1. What effect does employing simulation teaching method have on elimination of students' misconception in specific ecological concept?
2. What impact does the guided-inquiry teaching approach have on elimination of students' misconceptions in specific ecological concept?
3. What is the difference in the average score of students taught specific ecological concepts with guided inquiry and simulation methods in elimination of misconceptions?

Research Hypotheses

The following (null) hypotheses were developed and put to the test in this investigation:

1. There is no significant difference in students taught with simulation teaching strategy on elimination of students' misconception in ecology.
2. There is no significant difference in students taught with guided inquiry teaching strategy in elimination of student's misconceptions in ecology.
3. There is no significant difference in the post-test mean scores of students taught ecology using simulation and guided inquiry teaching strategy in elimination of student's misconceptions in ecology.

Methodology

A quasi-experimental design was used, pre-test, posttest control group design was chosen and implemented in order to ascertain the impact of guided inquiry and simulation techniques on the elimination of misconceptions among students in Rivers State secondary schools. The study was carried out in the Obio/Akpor Local Government area of Rivers State, in the South-South geopolitical zone in Nigeria. Population of the study includes all Senior Secondary School II Biology students enrolled in the public secondary schools in the Obio/Akpor Local Government Area of Rivers State. Purposive sampling technique was used to choose two schools for the investigation. From one arm of the SS2, two complete classes from each school were chosen at random. The study used 150 senior secondary school (SS2) biology students as the sample. Biological Performance Test (BPT) was the instrument utilized in the study. Three experts validated the test instrument to ensure it met the requirements for both face and content validation. The test-retest method was used to ascertain the instrument reliability. Twenty copies of the instrument were provided to a sample of SS II students from a senior secondary school who are not part of the study. The test was completed by the students. Two weeks later it was given to them again. Using Pearson product moment correlation analysis to determine the correlation of the scores. A correlation of 0.95 was obtained and used for the study. Students in the control group were taught the same ecological concept through guided inquiry, while students in the experimental groups were taught with simulation technique, which includes games and role play. Following four weeks of treatment, post-test results were gathered. Analyzing the pre-test and post-test scores, mean and standard deviation was used. while the hypothesis was analyzed for a significant difference at 0.05 level using T-test.

Results

Tables were used appropriately to display data analysis results.

Research Question One: What effect does employing simulation teaching method have on elimination of students' misconception in specific ecological concept?

Table 1

Mean pre-test and post-test scores of students taught with simulation teaching strategy

simulation strategy	Pre-test	Post-test	Mean gain
Mean (\bar{x})	28.27	69.10	40.83
N	75	75	
SD	9.42	48.52	

From the data obtained, the student's pre-test score was 28.27 and 9.42, as standard deviation according to Table 1 data; in the post-test, their mean score was 69.10

and 48.52 as standard deviation. This suggests that the student performed better in their posttest. It has been demonstrated that students' average performance increases and misconceptions were cleared by using the simulation teaching method.

Research Question Two: What impact does the guided-inquiry teaching approach have on elimination of students' misconceptions in specific ecological concept?

Table 2

Mean pre-test and post-test scores of Guided inquiry teaching strategy

Guided inquiring	Pre-test	Post-test	Mean Gain
Mean (\bar{x})	23.77	52.50	28.77
N	75	75	
SD	6.39	10.21	

Based on the data, the student received a mean score of 23.77 and 6.39 as standard deviation on the pre-test and a mean score of 52.50 and 10.21 as standard deviation on their post-test. This suggests that compared to the pre-test, the pupils performed better on the post-test. The use of guided inquiry as a teaching approach has been found to be effective in helping students overcome misconceptions about ecology and increase their average performance scores.

Research Question Three: What is the difference in the average score of students taught specific ecological concepts with guided inquiry and simulation methods in elimination of misconceptions?

Table 3

Mean pre-test post-test score of teaching methods.

Teaching strategies mean gain	Pre-test	post-test
Simulation 40.83	28.27	69.10
Guide inquiry 28.77	23.77	52.50

Table 4 shows that the mean results from the simulation posttest were higher than the mean scores from the guided inquiry posttest. The post-test mean scores for guided inquiry are 52.50 with a mean gain of 28.77, but the post-test mean scores

for simulation are 69.10 with a mean increase of 40.83. This suggests that using a simulation-based teaching approach rather than a guided inquiry approach to teach ecological concepts in biology to students can help to effectively eliminate misconceptions.

Hypothesis One: There is no significant difference in students taught with simulation teaching strategy on elimination of students' misconception in ecology.

Table 4
T-test analysis on the mean effect of simulation strategy on the concept of ecology

	Mean	SD	N	df	t-cal
t-crit					
Pre-test	26.27	4.42	75		
				138	11.92
2.042					
Post-test	69.10	48.52	75		

This null hypothesis demonstrates that the computed value is 11.72 and the critical t-value is 2.042. The estimated value is greater, rejecting the null hypothesis. This suggests that the simulation approach has a major impact on eradicating misconceptions in the concepts been thought.

Hypothesis Two: There is no significant difference in students taught with guided inquiry teaching strategy in elimination of student's misconceptions in ecology.

Table 5
t-test analysis on the mean effect of Guided inquiry strategy

	Mean	SD	N	df	t-cal	t-crit
Pre-test	23.77	6.39	75			
				138	43.03	2.042
Post-test	52.50	10.21	75			

Table 5 shows that the computed value is 43.03, and the crucial t-value for the degree of freedom is 2.042. The null hypothesis is rejected when the estimated value is greater. This suggests that the guided inquiry teaching approach has a major impact on eradicating misconceptions.

Hypothesis Three: There is no significant difference in the post-test mean scores of students taught ecology using simulation and guided inquiry teaching strategy in elimination of student's misconceptions in ecology.

Table 6

t-test analysis of post-test means performance of students taught using simulation and guided inquiry strategy.

Groups (post-test)	mean (x)	SD	N	df	t-cal
Simulation	69.10	48.52	75	138	11.92
Guided inquiry	52.50	10.21	75		

Table 6 shows that the computed value is (11.92), and the crucial t-value for the degree of freedom is 2.042, it signifies the rejection of the null hypothesis. This suggests that there might be a big distinction between the average student performance when taught through simulation against guided inquiry in terms of students' ability to understand the topic of ecology and elimination of any misconceptions they may have had.

Discussion of Findings

The misconceptions that students had both before and after being exposed to the teaching methodologies were eliminated in Tables 4.1 and 4.2. While guided inquiry and simulation instruction both enhanced students' understanding of ecological concept in biology the simulation method was more effective in elimination of misconceptions ecological concepts. This suggested that employing simulation teaching techniques as an educational strategy will help students grasp the concept of ecology more fully. The results of this investigation validate Ekwe (2013) assertions, who believe that classroom simulations enable students to engage with and successfully apply the concepts been learnt. Supporting students in developing their level of curiosity, confidence, inventiveness, and problem-solving skills; as a result, improving their comprehension of science concept and facilitating easy learning; ultimately, improving performance in theory and practice. This is due to the fact that students are driven to learn, which may sprout from their natural curiosity about how meaningful and successful learning can be when they have the chance to engage with their teachers and ask questions in a relaxed setting.

Conclusion

In the light of the findings, it is made known that the teaching method used by the teacher in the classroom, can make or break a student's misconception. Prior to being exposed to guided inquiry learning strategies and simulations, a significant number of students held misconceptions. Both approaches have an impact in elimination of misconception on biological concepts related to ecology. The

elimination of students' misconceptions about ecological concepts was more effective when simulation learning was used.

Recommendations

In light of the finding, it is suggested that:

1. Instructors of biology should be stimulated to explore how to use simulation strategies in the classroom to help students better comprehend scientific concepts, particularly in biology.
2. In order to include these innovative strategies into their instructional delivery, teacher training institutions (universities and colleges of education) should get training in their application.
3. Since simulation tactics need more time, biology should be given additional time in the school schedule to enable its utilization.

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