



Effect of Computer-Assisted Instruction In Remediating Misconception of Transport System and Respiration Among Senior Secondary Students in Funtua, Katsina State.

BY

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ABSTRACT

This study investigated the effect of computer assisted instruction on remediating misconception of Transport system and respiration concept among senior secondary school students in funtua, katsina state. The study adopted pre and post test, quasi experimental design. The population consisted of 4,257 SSII biology students of the public secondary school in funtua education zone of katsina state. Out of which 3,166 were male and the rest 1,091 were females. The sample of the study has 105 students from two co-educational schools selected by balloting. Two research questions with two null hypotheses guided the research. A validated instrument, Transport system and respiration Unscientific Preconception Test (TSRUPT) with reliability coefficient of 0.81 was used for data collection. The experimental group was taught using Computer Assisted

Instruction (CAI) within a period of six weeks, while for the same period control group was taught using lecture method,. Descriptive statistics was used to answer the research question, while t-test was used to analyzed the hypothesis at $p \leq 0.5$. Findings of the study revealed that: (1) Students exposed to Computer-Assisted Instruction (CAI) demonstrated significantly greater remediation of misconceptions in transport system and respiration compared to their counterparts taught through conventional instructional methods. (2)CAI was effective in correcting misconceptions for both male and female students, indicating that the intervention was gender-neutral in its impact. (3)The results further suggest that teachers need to give deliberate attention to identifying and addressing misconceptions inherent in abstract biological concepts during instruction. It was recommended that biology teachers: (1) Systematically diagnose and target students' misconceptions, especially in abstract and conceptually demanding topics such as transport system and respiration. (2) Integrate Computer-Assisted Instruction into routine classroom practice to enhance students' conceptual understanding and promote meaningful learning in biology.

Key words: Misconception, Performance, Remediation, CAI.

INTRODUCTION

Biology remains a foundational science subject, yet many of its concepts are abstract and challenging for secondary school students to grasp. Recent studies (e.g., Adeniji & Adeola, 2020; Kähkönen et al., 2021) indicate that students often resort to memorization rather than conceptual understanding, largely due to the breadth of biological content and its high level of abstraction. The predominance of teacher-centred approaches—particularly the lecture method—continues to limit students' cognitive engagement and contributes to persistent learning difficulties (Ogunleye & Akinbola, 2019; Yusuf, 2022). Poor instructional strategies, limited teacher competence in facilitating conceptual learning, and lack of connection between classroom instruction and students' everyday experiences have been linked to widespread misconceptions in biology.

Misconceptions, defined as learners' scientifically inaccurate mental models that conflict with accepted scientific explanations (Sesen & Ince, 2018; Öztürk & Koca, 2020), remain a major barrier to meaningful learning. Research in the past decade consistently shows that misconceptions in topics such as transport systems and respiration are deeply rooted, resistant to change, and often reinforced by textbooks, prior beliefs, and inadequate instructional methods (Aydin & Keleş, 2017; Laugksch & Mpofo, 2022). Misconceptions hinder students' ability to integrate new knowledge, thereby affecting performance and progression to more advanced biological concepts.

The National Research Council framework has identified several types of misconceptions, including preconceived notions, non-scientific beliefs, conceptual misunderstandings, vernacular misconceptions, and factual misconceptions, all of which have been reported in recent empirical studies (Keeley, 2015; Murdoch, 2018; Leaper et al., 2020). These misconceptions cut across gender, background, and ability levels and continue to contribute to poor achievement in secondary school biology (Achor & Eze, 2021).

With advances in educational technology, Computer-Assisted Instruction (CAI) has gained prominence as an effective tool for promoting conceptual understanding and addressing misconceptions. CAI provides visualizations, simulations, and interactive learning environments that enable students to test ideas, confront prior beliefs, and reconstruct accurate scientific concepts (Fakomogbon et al., 2018; Al-Samarraie & Saeed, 2019). Evidence from recent studies shows that CAI enhances learner engagement, supports individualized learning, and significantly improves achievement in science subjects where misconceptions are prevalent (Ajayi & Shuaibu, 2021; Kwache & Nwafor, 2023).

Given the persistent poor performance of students in biology in Nigeria and the documented prevalence of misconceptions in transport system and respiration, the use of CAI presents a promising intervention. This study therefore investigates the effects of Computer-Assisted Instruction on correcting misconceptions in transport system and respiration among senior secondary school students in Funtua, Katsina State.

Funtua

Objectives of the Study

This study aims at investigating the effects of Computer Assisted Instruction on the remediating misconception among biology student taught Transport system and Respiration concepts in Funtua Educational Zone of Katsina State. The following specific objectives are set to;

1. determine the misconceptions held by SSII biology students in Transport and respiration concepts.
2. determine if Computer Assisted Instructions has effect on remediating misconceptions brought into the class when taught Transport and respiration concepts

Research Questions

The following research questions guided the study;

1. what are the misconceptions held by SSII biology students before being taught using CAI?
2. What is the difference between the misconceptions held by SS II biology students taught Transport system and respiration concept using Computer Assisted Instructions and those taught using lecture method?

Null Hypotheses

In line with research questions stated, the following Null hypothesis will be tested at $p \leq 0.05$ level of significance. Research question one does not have any hypothesis.

H₀₂: There is no significant difference in the misconceptions mean scores in Transport system and respiration concepts among biology students taught using computer assisted instructions and those taught using lecture method.

Research methodology

Research Design

The study employed a descriptive survey design to identify students' preconceptions about Transport System and Respiration concepts, followed by a quasi-experimental pretest–posttest control group design to determine the effectiveness of Computer-Assisted Instruction (CAI) in remediating misconceptions. The survey phase used a paper-and-pencil test to elicit students' initial conceptions, after which the experimental group received six weeks of instruction using CAI, while the control group was taught the same concepts using conventional teaching methods. A posttest was subsequently administered to both groups to determine changes in misconceptions.

Population

The population comprised all Senior Secondary School Two (SSII) students in public secondary schools across Funtua and Bakori Local Government Areas of Katsina State, totaling 4,257 students (3,166 males and 1,091 females).

Sample and Sampling Procedure

A sample of 103 SSII students was drawn from two intact classes selected from two co-educational public secondary schools in Funtua and Bakori LGAs. The schools were selected using a balloting technique, while intact classes were used to avoid disrupting school organization.

Instrumentation

The research instrument was the Transport System and Respiration Unscientific Preconception Test (TSRUPT), adapted from Köse (2008) and Galvin, Simmie, and Grady (2015). The instrument consisted of 16 short-answer items designed to diagnose students' misconceptions about Transport System and Respiration. Section A elicited demographic information (name, gender, age), while Section B contained misconception-diagnostic items. Students' responses were scored dichotomously (1 = correct, 0 = incorrect) and later analyzed to determine initial and post-intervention conceptual understanding.

Validity of the Instrument

Content and face validity of the TSRUPT were ensured through expert review by specialists in Biology Education and Measurement and Evaluation. Necessary modifications were made based on reviewers' suggestions to ensure clarity, relevance, and alignment of items with the targeted concepts.

Pilot Study

A pilot test was conducted on a comparable group of SSII students outside the study sample to determine the instrument's clarity and psychometric properties. Data from the pilot study were used to compute the reliability of the instrument.

Reliability of the Instrument

The reliability of TSRUPT was established using the split-half method. Analysis conducted using SPSS yielded a reliability coefficient of $r = 0.81$, indicating that the instrument possessed satisfactory internal consistency. Following Fulekar (2009), the coefficient approximates unity and is considered adequate for research purposes.

Method of Data Analysis

Students' responses were coded and analyzed using descriptive and inferential statistics. Correct responses were scored as 1 and incorrect responses as 0. Misconception patterns for each item were computed as percentages. Descriptive statistics (mean and standard deviation) were used to summarize students' performance, while inferential statistics were conducted at a 0.05 level of significance to test the study hypotheses and determine the effect of CAI on misconception remediation.

RESULTS AND FINDINGS

Question one: what are the misconceptions held by SSII biology students before being taught using CAI?

From the result of TRUPT test administered on the subjects, the following misconceptions were identified and presented in table 1.1

Table 1.1 Types of Identified Misconceptions

S/N	Types Misconceptions Identified	Frequency	%
1.	preconceived notions,	22	21.57
2.	nonscientific beliefs,	30	29.41
3.	conceptual misunderstandings,	14	13.73
4.	vernacular misconceptions,	18	17.65
5.	factual misconceptions.	18	17.65

Result from table 1.1 shows the rate at which misconceptions spread among SSII students in this study. Nonscientific belief has the largest percentage of the misconception held with 30%, followed by preconceived notion with 22%, factual and vernacular misconception had equal percentage, which is 18%. The least being conceptual misunderstanding with 14%.

Question two: What is the difference in the misconception held by SSII biology students taught Transport system and respiration concepts using computer assisted instructions and those taught using lecture method?

Table 1.2: Descriptive statistics on misconception mean scores in Transport system and respiration concepts among biology students experimental and control group

Variable	Groups	N	Mean	STD	Mean Diff
Experimental	52	11.84	3.60		
Misconception					9.80
Control	51	2.04	1.39		

Results of the descriptive statistics in Table 1.2 revealed misconception mean scores are 11.84 and 2.04 by biology students taught using computer assisted instructions and those taught using lecture method respectively. This indicating a mean scores difference of 9.80 in favour of the biology students taught using computer assisted instructions. Therefore significant difference existed in the misconception mean scores.

Testing Null Hypothesis

Hypothesis two: There is no significant difference in the misconception mean scores in Transport system and respiration concepts among biology students taught using computer assisted instructions and those taught using lecture method

Table 1.3: Independent t test on the misconception mean scores in Transport system and respiration concepts between experimental and control group

Variable	Groups	N	Mean	STD	Df	t-comp.	P
Experimental	52	11.84	3.60				
Misconception Mean scores					101	18.14	0.000
Control	51	2.04	1.39				

Calculated $p < 0.05$, computed $t > 1.96$ at $df 101$

Table 1.3 shows that students taught with Computer-Assisted Instruction had a much higher misconception mean score (11.84) than those taught with the lecture method (2.04). The t-test result ($t = 18.14, p < .05$) indicates that this difference is statistically significant. This means CAI was far more effective in correcting students’ misconceptions than the traditional method. Therefore, the null hypothesis of no significant difference between the groups is rejected.

Discussion

The findings of this study revealed multiple categories of misconceptions held by SSII biology students prior to instruction, with nonscientific beliefs being the most prevalent. This pattern supports earlier research indicating that students often develop alternative conceptions from cultural beliefs, everyday experiences, and prior informal learning, which may conflict with scientific explanations (Adeniji & Adebayo, 2023). Such misconceptions persist because traditional lecture-based instruction rarely provides sufficient cognitive conflict to restructure inaccurate knowledge (Okoye & Eze, 2021).

The study further showed a substantial difference between students taught using Computer-Assisted Instruction (CAI) and those taught with the lecture method. Students exposed to CAI demonstrated significantly higher misconception-correction scores than their lecture-taught counterparts. This finding aligns with previous studies showing that CAI improves conceptual understanding and promotes conceptual change by offering visualizations, simulations, and interactive tasks that challenge learners’ prior beliefs (Olatoye & Aremu, 2022). Digital animations and interactive media have been reported to enhance learners’ comprehension of abstract biological processes, particularly systems such as respiration and transport, which are difficult to visualize using traditional methods (Umar & Bello, 2024).

The statistical significance of the difference in misconception mean scores ($t = 18.14$, $p < .05$) indicates that CAI was markedly more effective than lecture-based instruction in addressing students' misconceptions. This supports documented evidence that technology-enhanced instructional approaches not only improve achievement but also facilitate the unlearning of deeply held misconceptions by restructuring students' cognitive frameworks (Yakubu & Gana, 2023). Additionally, studies conducted in Nigerian secondary schools report similar outcomes, demonstrating that CAI increases motivation, engagement, and concept mastery in science subjects (Ibrahim & Musa, 2020).

Overall, the research confirms that CAI provides a more robust pedagogical tool for correcting misconceptions in biology than the traditional lecture method. The interactive, multimodal, and student-centered nature of CAI appears to support deeper understanding, making it an effective strategy for overcoming entrenched misconceptions in complex science topics.

CONCLUSION

Both experimental and control groups were remediated. The CAI has great positive effect on the mean misconception scores in transport system and respiration, even though lecture method also affected the students misconceptions. But not as effective as computer assisted instruction.

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