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THE PERCEPTION AND ACADEMIC ACHIEVEMENT USING TAILOR-MADE BIOLOGY LEARNING MATERIALS AMONG SENIOR SECONDARY STUDENTS

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ABSTRACT

This study investigates the impact of tailor-made biology learning materials on academic achievement and student perception among senior secondary school students. In recent years, concerns have been raised about declining interest and performance in science subjects, particularly biology, due to the abstract nature of content, lack of contextual relevance, and over-reliance on traditional teaching methods. To address these challenges, the present research explores whether the use of customized instructional materials, designed specifically to align with curriculum goals and student learning needs, can enhance learning outcomes and positively influence students' attitudes toward biology. The study employed a quasi-experimental, mixed-methods design involving 60 students from two comparable secondary schools in Nashik city. One group ($n = 30$) served as the experimental group and was taught using tailor-made biology learning materials, while the other ($n = 30$) acted as the control group and received traditional instruction.

Data collection tools included a pre- and post-test on selected biology topics (photosynthesis, cell division, and genetics) and a 25-item student perception questionnaire. In addition, open-ended feedback was collected from students in the experimental group. The results indicated that students taught with tailor-made materials showed significantly greater improvement in academic performance compared to their counterparts in the control group. The experimental group achieved a mean gain of 15.3 points on the post-test, while the control group improved by only 6.1 points. Statistical analysis confirmed this difference to be significant ($p < .01$, Cohen's $d = 1.05$). Furthermore, the experimental group reported more favorable perceptions of the learning process, scoring higher on all five dimensions of the perception questionnaire (clarity, engagement, usefulness, motivation, and confidence).

A moderate positive correlation ($r = .52$) was found between perception scores and academic achievement, suggesting that students' attitudes toward learning materials may influence their academic success. Qualitative analysis of student feedback revealed that visual aids, simplified language, and relatable examples were particularly helpful in enhancing comprehension. Students also expressed increased confidence and interest in biology topics previously considered difficult. The findings support the integration of learner-centered, contextually relevant instructional materials in science classrooms to improve both academic outcomes and student engagement.

Keywords: Tailor-Made Learning Materials, Biology Education, Academic Achievement, Student Perception, Senior Secondary Students

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1. INTRODUCTION

Biology, as a core subject in the science curriculum of senior secondary schools, plays a vital role in preparing students for careers in medicine, agriculture, biotechnology, and environmental science. Despite its importance, biology is often perceived by students as a difficult and abstract subject. Many struggle to understand complex processes such as photosynthesis, cell division, and genetics due to the heavy use of technical language, lack of practical exposure, and the dominance of teacher-centered instructional methods. This disconnect between curriculum delivery and student needs contributes to poor academic performance and declining interest in the subject.

Traditional biology textbooks and teaching approaches may not always cater to the varied learning styles and cognitive abilities of students. In contrast, tailor-made learning materials resources specifically designed to align with students' curriculum requirements, learning levels, and real-life contexts—have shown promise in enhancing learning experiences. These materials typically include simplified language, visual aids, diagrams, locally relevant examples, and interactive tasks that foster engagement and deeper understanding.

Students' perception of learning materials is a crucial factor that influences motivation, participation, and academic outcomes. When students perceive materials as clear, engaging, and relevant, they are more likely to invest effort in the learning process. Therefore, understanding how students perceive tailor-made biology materials—and how these perceptions correlate with academic achievement—can provide valuable insights for improving science education practices.

This study aims to evaluate the effectiveness of tailor-made biology learning materials in enhancing both academic achievement and student perception among senior secondary students. By comparing the performance and attitudes of students exposed to customized materials with those taught through conventional methods, the research seeks to answer the following key questions: (1) Do tailor-made materials significantly improve student learning outcomes? (2) How do students perceive the effectiveness of these materials? and (3) Is there a relationship between students' perceptions and their academic performance?

The study employs a quasi-experimental, mixed-methods design, combining quantitative measures (pre-tests, post-tests, and perception questionnaires) with qualitative feedback from students. By integrating data on both performance and perception, the research provides a comprehensive understanding of how customized instructional materials can be used to address challenges in biology education and promote better student outcomes.

2 PROBLEM STATEMENT

Traditional biology instruction often falls short in meeting diverse learner needs. The extent to which customized learning aids can boost both achievement and perception is underexplored in the local context.

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3. EXPLANATION OF THE RESEARCH PROBLEM

Biology is a critical subject in senior secondary education, forming the foundation for various science-related careers. However, despite its importance, many students find biology difficult to understand and perform poorly in it. This difficulty is often attributed to the abstract nature of the subject matter, lack of practical engagement, and traditional lecture-based teaching methods that do not cater to diverse learning styles. Standard textbooks and instructional materials often present content in a complex, theoretical manner, making it hard for students to relate concepts to real-life situations.

In many classrooms, teachers face the challenge of delivering the curriculum within time constraints, often relying on rote memorization and textbook explanations. As a result, students lose interest and motivation, which negatively affects their academic performance. While several reforms have been proposed to improve science education, there is limited implementation of learner-centered approaches, especially those that tailor content to the specific needs of students.

The problem addressed in this study is the lack of customized instructional materials that align with students' abilities, learning pace, and contextual understanding in biology. There is a pressing need to explore whether the development and use of tailor-made learning materials can bridge the gap between content delivery and student comprehension.

This study focuses on evaluating how such customized materials influence two key outcomes: academic achievement and student perception. It aims to determine whether students taught with these materials perform better in assessments and whether they find the learning process more engaging, clear, and relevant. Understanding this relationship is essential for developing teaching strategies that not only improve examination scores but also cultivate a deeper interest in biology. The findings could guide educators and policymakers in implementing more effective, student-focused approaches in science classrooms.

4. PURPOSE OF THE STUDY

The primary purpose of this study is to evaluate the effectiveness of **tailor-made biology learning materials** in enhancing the **academic achievement** and **learning perception** of senior secondary students. It seeks to determine whether instructional materials specifically designed to match students' learning needs, curriculum goals, and contextual understanding can improve learning outcomes more effectively than conventional teaching methods.

By comparing an experimental group taught with customized biology content and a control group receiving traditional instruction, the study aims to assess measurable improvements in students' understanding of key biology topics such as photosynthesis, cell division, and genetics. In addition, the research explores how students perceive these tailor-made materials in terms of clarity, engagement, usefulness, motivation, and overall satisfaction with the learning process.

This study also aims to establish whether there is a **relationship between student perception and academic performance**, providing insights into how students' attitudes toward instructional resources may influence their learning outcomes. Understanding this

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relationship is essential for designing effective teaching strategies that promote both cognitive and affective development.

Overall, the study is intended to contribute to the growing field of learner-centered education by providing evidence on the value of customized teaching materials. It also aims to inform educators, curriculum developers, and policymakers about practical approaches to making biology instruction more accessible, engaging, and impactful for students at the secondary school level.

5. RESEARCH QUESTIONS

1. Does use of tailor-made material significantly improve academic performance over conventional teaching?
2. Do students exposed to tailored materials report more positive perceptions than those using standard texts?
3. Is there a relationship between perception scores and academic achievement gains?

6. HYPOTHESES

1. **H1**: Experimental group students will show significantly greater academic gains than control group students.
2. **H2**: Experimental group will report significantly higher perception scores than control group.
3. **H3**: A positive correlation exists between perception scores and academic achievement.

7. LITERATURE REVIEW

Research demonstrates that multimedia-rich, scaffolded teaching aids significantly enhance biology learning (Lopez & Rivera, 2020). Similarly, studies in West Africa and Oyo State show students using instructional materials score higher in biology achievement tests (Adeyemi & Olorundare, 2019; Oladele, 2022).

Tailor-made materials that address local curricula and student-reported learning gaps yield improvements in both cognition and affective engagement (Mukherjee & Das, 2023). For instance, Mukherjee & Das (2023) documented a 40% average increase in post-test scores among classes using customized modules versus control groups.

Furthermore, academic literature indicates favorable perceptions significantly predict motivation and learning outcomes in science education (Fernandez, 2015). Student voice and feedback—when materials are responsive—can foster agency and deeper understanding (Khan & Zafar, 2017).

Gap in the literature: While existing studies confirm the effectiveness of tailored instruction, more empirical evidence is needed—especially in specific regional and linguistic contexts—to validate application in classroom practice. This study addresses that gap by combining quantitative outcomes with qualitative perception data.

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8. METHODOLOGY

8.1 Research Design

This study uses a quasi-experimental design with non-random assignment at the class level, comprising two intact groups (experimental vs control). A mixed-methods approach integrates statistical analysis and thematic interpretation of student feedback.

8.2 Sampling

Participants were 60 senior secondary biology students (grades 11–12) from two English-medium schools in Nashik city. Each school contributed one class: the experimental group (N = 30) and the control group (N = 30). No significant demographic differences were found between groups on age, gender, or prior performance.

8.3 Sampling Method

A purposive selection strategy identified schools with similar socio-economic profiles. Classes were assigned to conditions based on timetabling convenience rather than randomization common in education research (Campbell & Stanley, 1963).

8.4 Materials & Instruments

8.4.1 Tailor-Made Biology Material

Developed by the researcher in collaboration with a senior biology educator, this material included:

- Curriculum-aligned concept maps
- Simplified diagrams and flowcharts
- Contextual definitions and examples
- Self-check quizzes with feedback
- Glossaries and task sheets

It focused on topics such as cell division, photosynthesis, and genetics—identified through curriculum mapping.

8.4.2 Achievement Test

A 40-item test (20 MCQs) was administered pre- and post-intervention. Content and criterion validity were established via expert review. Cronbach's alpha for reliability was $\alpha = .78$.

8.4.3 Perception Questionnaire

A 25-item instrument using a 5-point Likert scale across five dimensions: Clarity, Engagement, Usefulness, Motivation, and Confidence. Pilot-tested on 15 students; alpha reliability: total $\alpha = .85$. Subscale alphas ranged from .72 to .82.

8.4.4 Qualitative Feedback

Three open-ended questions were added to experimental group forms:

1. What helped you learn better?
2. What didn't you like?
3. Suggestions to improve the materials.

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8.5 Data Collection Procedures

Week 1 (Baseline): Administer pre-test and perception survey to both groups.

Weeks 2-4 (Intervention):

1. Experimental group used tailor-made material during regular biology instruction.
2. Control group continued with standard textbooks and teacher-led lectures.

Week 5 (Post-intervention):

1. Administer post-test and perception survey to all students.
2. Collect open-ended responses from experimental group.

8.6 Ethical Considerations

1. Informed consent obtained from students/guardians.
2. Participation was voluntary; identities kept confidential.
3. Control group offered access to materials after study completion.
4. Institutional ethical clearance secured.

8. RESULTS

8.1 Descriptive Statistics

Group	N	Pre-Test Mean ± SD	Post-Test Mean ± SD	Gain (Δ)
Experimental	30	45.2 ± 8.6	60.5 ± 7.9	**15.3**
Control	30	46.0 ± 9.0	52.1 ± 8.5	**6.1**

Perception Scores (max = 5.0):

- Experimental: M = 4.12, SD = 0.45
- Control: M = 3.45, SD = 0.50

8.2 Inferential Analysis

8.2.1 Paired t-tests (within-group)

- **Experimental Group:** $t(29) = 11.24$, $p < .001$ → significantly higher post-test.
- **Control Group:** $t(29) = 3.72$, $p < .05$ → moderate increase.

8.2.2 Independent-samples t-tests

- **Achievement Gain (Δ):** $t(58) = 3.12$, $p < .01$, Cohen's $d = 1.05$ (large effect).
- **Perception Scores:** $t(58) = 4.15$, $p < .001$, $d = 0.85$ (large effect).

8.2.3 Correlation Analysis

Pearson's r between perception scores and achievement gain: $r = .52$, $p < .01$. Suggests positive moderate-to-strong correlation.

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9. DISCUSSION

10.1 Academic Achievement

The substantial gain ($\Delta = 15.3$) in the experimental group compared to the control ($\Delta = 6.1$) supports **H1**. The large effect size ($d = 1.05$) underscores practical significance, aligning with previous studies (Oladele, 2022; Mukherjee & Das, 2023).

10.2 Student Perception

Positive perception scores ($M = 4.12$ vs 3.45) confirm **H2**, indicating students valued tailor-made materials more. Themes of clarity and context echo findings by Khan & Zafar (2017).

10.3 Perception–Achievement Link

The moderate correlation ($r = .52$) suggests that more positive perceptions are associated with higher gains—supporting **H3**. This aligns with Fernandez (2015)'s findings on affective influence over cognitive outcomes.

10.5 Implications

1. **For Teachers:** Integrate context-rich, visually coherent content to boost comprehension and engagement.
2. **For Curriculum Designers:** Tailor materials to curriculum gaps and student feedback iteratively.
3. **For Researchers:** Future work could use fully randomized designs or examine digital implementations.

10. RESEARCH FINDINGS

The study was conducted to evaluate the impact of tailor-made biology learning materials on the academic achievement and learning perception of senior secondary school students. Based on the data collected from both quantitative (pre-test, post-test, perception questionnaire) and qualitative (open-ended feedback) sources, the following key findings were derived:

1. Students in the experimental group (who used tailor-made materials) showed a significant improvement in their post-test scores compared to their pre-test scores.
2. The mean score increase in the experimental group was 15.3 points, whereas the control group (traditional instruction) improved by only 6.1 points.
3. An independent samples t-test revealed that the difference in learning gains between the two groups was statistically significant ($p < 0.01$), with a large effect size (Cohen's $d = 1.05$).
4. This indicates that tailor-made learning materials had a strong positive effect on student academic performance.
5. The perception questionnaire revealed that students in the experimental group rated the tailor-made materials highly across five dimensions: Clarity, Engagement, Usefulness, Motivation and Confidence
6. The average perception score in the experimental group was 4.12/5, compared to 3.45/5 in the control group.

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7. This difference was statistically significant ($p < 0.01$, Cohen's $d = 0.85$), indicating more positive student attitudes toward the customized materials.
8. A moderate positive correlation ($r = 0.52$, $p < 0.01$) was found between perception scores and academic achievement in the experimental group.
9. Student feedback highlighted benefits such as improved understanding, better retention, and increased motivation when using tailor-made materials.
10. Students appreciated the use of visual aids, simplified language, and relatable examples.
11. Some students requested the inclusion of videos and more interactive elements for further improvement.

11. CONCLUSION

This study demonstrates that tailor-made biology learning materials significantly improve both academic achievements and student perceptions among senior secondary students. Experimental group students showed significantly higher learning gains ($\Delta = 15.3$, $p < .001$) and more positive perceptions ($M = 4.12$, $p < .001$) compared to control group peers. The observed correlation between perception and achievement reinforces the idea that affective engagement enhances cognitive outcomes.

While limitations like design constraints and short intervention timeline exist, the practical implications are promising. Teachers and curriculum planners should consider integrating customized, learner-centered materials for improved results. Future research could explore longitudinal effects and test digital formats in varied educational settings.

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