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Instructional Materials Use and Learners' Academic Achievement in Biology: Within Chosen Private Secondary Schools in Ibanda District, Uganda

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Abstract: This research examined the influence of using instructional materials, particularly visual aids, on students' understanding and performance in Biology among private secondary schools in Ibanda District of Uganda. A descriptive mixed-methods research design was adopted involving Head Teachers, Biology Teachers, laboratory Technicians, and Learners. A sample size of 266 participants was obtained from a target population of 520. Information was gathered through questionnaires, interviews, and document analysis. Quantitative information was examined using descriptive statistics and regression techniques, whereas qualitative responses were interpreted using thematic analysis.The results revealed that the use of visual instructional aids positively influences students' comprehension and academic performance in Biology. Regression results revealed that visual aids significantly predict students' performance. The study concludes that consistent and effective use of instructional materials enhances students' understanding and performance in Biology. Recommendations include increasing the availability and use of visual aids, continuous teacher training, and improving laboratory resource management. Future research should explore the integration of digital instructional tools and their long-term effects on student outcomes.

Keywords: *Instructional Materials, Visual Aids, Academic Performance, Biology, Private Secondary Schools, Ibanda District*.

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I. INTRODUCTION

Education is a critical driver of national development, and the quality of teaching resources significantly affects learning outcomes. In Biology education, the use of instructional materials such as visual aids, models, diagrams, and laboratory equipment enhances comprehension, retention, and application of scientific concepts. Despite the importance of instructional materials, challenges such as limited resources, inadequate laboratory facilities, and inconsistent use of teaching aids hinder effective learning in many private secondary schools in Uganda, including Ibanda District.

Visual instructional aids facilitate active learning, stimulate student interest, and promote conceptual understanding. This study aimed to assess the impact of using visual instructional aids on students' understanding and academic performance in Biology, addressing gaps in practical learning and providing evidence-based recommendations to improve instructional practices.

- *Purpose of the Study*

This study aimed at examining the influence of using visual instructional aids on students' understanding and performance in Biology in selected private secondary schools in Ibanda District, Uganda.

II. METHODOLOGY

- *Research Design*

The study employed adescriptive mixed-methods research design. This design allowed for an in-depth understanding of the existing situation regarding instructional materials use and provided a comprehensive examination of the association between visual aids and academic achievement in Biology. Quantitative methods involved questionnaires and statistical analysis, while qualitative

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methods included interviews and thematic analysis to capture perceptions, experiences, and challenges.

➢ *Study Population*

The population comprised 520 respondents, including Senior Three (S.3) to Senior Six (S.6) Biology students, Head Teachers, Biology teachers, and laboratory technicians from ten selected private secondary schools in Ibanda District.

➢ *Sample Size*

A sample size of 266 participants was obtained using Krejcie and Morgan's (1970) sampling table, distributed as follows:

Table 1 Sample Size

Categories	Target Population	Study Sample	Sampling Methods
School Administrators	10	10	Purposive
Biology Teachers	40	36	Systematic Random
Laboratory Technicians	10	10	Purposive
Biology Students	460	210	Simple Random
Total	520	266	-

➢ *Sampling Techniques*

The study utilized purposive, systematic random, and simple random sampling techniques was used. Head Teachers and laboratory technicians were purposively selected due to their direct involvement in school administration and laboratory management. Biology teachers were selected using systematic random sampling from a compiled list, while students were selected via simple random sampling.

➢ *Data Collection Methods*

Questionnaires were administered to students and teachers to capture quantitative data on access to and use of visual instructional aids. Semi-structured interviews were carried out with Head Teachers and laboratory technicians to gather qualitative information regarding the availability, use, and challenges of instructional materials. Document review of school performance records verified students' academic outcomes.

➢ *Data Collection Instruments*

- *Questionnaires:*

Comprised closed- and open-ended items assessing the frequency of visual aid use, engagement in practical sessions, and perceived impact on academic performance.

- *Interview Guides:*

Focused on school policies regarding laboratory and instructional resources, the operational status of laboratories, and administrative support for Biology instruction.

➢ *Validity and Dependability*

- *Validity:*

Confirmed through expert evaluation and computation of the Content Validity Index (CVI = 0.92), confirming that the instruments adequately measured the intended constructs.

- *Reliability:*

Assessed through test-retest with a reliability coefficient of 0.87, indicating consistent and dependable measurement.

➢ *Data Collection Procedure*

Approval was obtained from Ibanda University Internal Research Ethics Committee. Data collection involved distributing questionnaires to teachers and students and conducting interviews with Head Teachers and laboratory technicians at mutually convenient times.

➢ *Data Analysis*

- *Quantitative Data:*

Processed using SPSS software. Descriptive statistical tools including frequencies, percentages, means, standard deviations were used to describe respondents characteristics, while regression analysis determined the predictive effect of visual instructional aids on academic performance. Regression Model: Students' Academic Performance = β_0 + β_1 (Visual Instructional Aids) + ε

- *Qualitative Data:*

Analyzed thematically, identifying recurring patterns and insights from interviews regarding the availability, use, and impact of instructional materials on learning outcomes.

➢ *Ethical Procedures*

Respondents voluntarily consented to participate with privacy and confidentiality were maintained. Participation was voluntary, ethical approval was obtained from the Ibanda University IUIREC.

III. RESULTS

➢ *Participant Response Rate*

Table 2 Participants' Response Rate

Research Instrument	Distributed/Planned	Returned/Completed	Response Rate (%)
Questionnaires	246	240	97.6
Interviews	20	20	100
Total	266	260	97.7

Source: Primary Data (2025)

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Table 2 shows the response rate of Participants involved in the research. Out of the 246 questionnaires administered, 240 were successfully filled and returned, equivalent to a response rate of 97.6% (240/246). This high response rate indicates that most of the targeted respondents were willing and able to provide data for the study. Regarding interviews, all 20 planned interviews were conducted and completed, resulting in a 100% response rate (20/20), which demonstrates full participation from the selected interviewees. Overall, out of the total 266 planned instruments, 260 were successfully completed, yielding an overall response rate of 97.7% (260/266). This shows that the study achieved substantial participation, making the collected data reliable and representative of the target population.

- *Descriptive Statistics*

Use of Visual Instructional Aids

Table 3 Use of Visual Instructional Aids

Item Description	Agree	Neutral Response	Disagree	Strongly Disagree	Average Score	Standard Deviation	
The use visual aids like charts, diagrams, and posters while teaching.	94 (38.8%)	90 (37.2%)	28 (11.6%)	20 (8.3%)	10 (4.1%)	3.99	1.01
Visual aids help explain abstract Biology concepts better.	101 (41.7%)	92 (38.0%)	26 (10.7%)	15 (6.2%)	8 (3.4%)	4.09	0.92
Students retain more information when visual aids are used.	108 (44.6%)	88 (36.4%)	24 (9.9%)	13 (5.4%)	9 (3.7%)	4.13	0.89
Visuals enhance classroom participation and engagement.	96 (39.7%)	94 (38.8%)	30 (12.4%)	14 (5.8%)	8 (3.3%)	4.05	0.95
My school provides enough visual instructional resources.	85 (35.1%)	78 (32.2%)	40 (16.5%)	26 (10.7%)	13 (5.4%)	3.82	1.06
I receive training on how to effectively use visual teaching aids.	88 (36.4%)	79 (32.6%)	40 (16.5%)	22 (9.1%)	13 (5.4%)	3.86	1.04

Source: Primary Data (2025)

Table 3 presents the utilization of visual teaching aids aids in teaching Biology in the selected private secondary schools. Regarding the use of visual aids such as charts, diagrams, and posters, 94(38.8%) of respondents strongly concurred, 90(37.2%) concurred, 28(11.6%) remained undecided, 20(8.3%) didnot agreed and 10(4.1%) completely disagreed. A mean score of 3.99 and a standard deviation of 1.01 suggest that the majority of teachers regularly use visual aids during lessons.

In terms of explaining abstract Biology concepts, 101(41.7%) completely agreed and 92(38.0%) concurred that visual aids improve understanding, while 26(10.7%) were remained undecided, 15(6.2%) did not agree, and 8(3.4%) completely disagreed. A mean of 4.09 and standard deviation of 0.92 suggest that visual aids are effective in simplifying complex topics for students.

Regarding information retention, 108(44.6%) completely agreed and 88(36.4%) concurred students retain more knowledge when visual aids are used, with 24(9.9%) neutral, 13(5.4%) disagreed, and 9(3.7%) completely disagreed. A mean of 4.13 and standard deviation of 0.89 indicate that visual aids positively influence students' memory and comprehension.

On classroom participation and engagement, 96(39.7%) completely disagreed and 94(38.8%) concurred that visual aids enhance interaction, while 30(12.4%) were remainedundecided, 14(5.8%) did not agree, and 8(3.3%) completely disagreed. A mean of 4.05 with a standard deviation of 0.95 reflects that visual aids foster active learning and involvement.

Regarding the provision of sufficient visual resources, 85(35.1%) completely agreed and 78(32.2%) concurred, while 40(16.5%) were remainedundecided(10.7%) did not agreed, and 13(5.4%) completely disagreed. A mean of 3.82 and standard deviation of 1.06 indicate that some schools still face limitations in providing adequate visual instructional materials.

Finally, on training for effective use of visual teaching aids, 88(36.4%) completely agreed, and 79(32.6%) concurred, with 40(16.5%) remained undecided, 22(9.1%) did not agree, and 13(5.4%) completely disagreed. A mean of 3.86 and standard deviation of 1.04 suggest that teacher training on visual aid usage is moderate, highlighting a potential area for professional development. the findings indicate that visual instructional aids are widely used and positively impact students' understanding and engagement, though adequate provision of resources and training remain areas for improvement.

During interviews, respondents reported that visual instructional aids, including charts, posters, models, and diagrams, were frequently used in Biology lessons to explain abstract or complex concepts. Teachers highlighted that visual aids significantly improved students' comprehension and engagement during practical sessions. Challenges cited included limited budgets for acquiring visual materials, insufficient storage, and occasional damage to existing aids.

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Respondents stated that despite these challenges, visual aids were essential in enhancing learning outcomes.

"Students grasp concepts like photosynthesis faster when we use diagrams and charts." – HT4

"Visual aids make lessons more interactive, and students participate more actively." – LT3

"Sometimes the posters and charts are worn out, which makes it difficult to teach effectively." – HT7

"We need more models and diagrams to make the lessons engaging for all students." – LT6

The triangulation of quantitative and qualitative data shows consistency between the survey results and interview insights. Quantitative data highlighted widespread use and perceived benefits of visual aids, while qualitative responses provided context on specific challenges such as resource limitations and the need for teacher training. Together, the data indicate that visual instructional aids greatly contribute to improving learners' understanding, engagement, and academic performance in Biology, though improvements in provision and professional development are necessary to maximize their effectiveness.

➢ *Correlation Analysis*

The association between visual instructional aids and learners' academic achievement was examined using Pearson's correlation coefficient.

Table 4 Correlation Analysis

Variable	Academic Performance	r	Sig. (2-tailed)
Visual Instructional Aids	Students' Performance	0.68	0.000 **

Source: Primary Data (2025)

The correlation findings ($r = 0.68$, $p < 0.01$) revealed a strong positive association between the use of visual instructional aids and students' academic performance. This suggests that increased utilization of visual aids is associated with higher student achievement in Biology examinations.

➢ *Regression Results*

Multiple regression analysis was performed to establish the predictive influence of visual instructional aids on students' academic performance in Biology.

Table 5 Regression Results

Independent Variable	Unstandardized estimates	Standard Error	Standardized Beta values	t-value	Siginificance value(p-value)
Visual Instructional Aids	0.54	0.08	0.54	6.75	0.000 **

Dependent Variable: Students' Academic Performance in Biology

Source: Primary Data (2025)

The results show that visual instructional aids significantly predicted students' academic performance ($\beta = 0.54$, $p < 0.01$). This demonstrates a moderate positive effect on performance in Biology examinations, highlighting the importance of these aids in enhancing learning outcomes.

IV. DISCUSSION OF FINDINGS

The study findings revealed that the use of visual instructional aids positively influences students' understanding and academic performance in Biology. Visual aids support active learning, facilitate conceptual clarity, and enhance engagement during practical sessions. These results are consistent with the work of Adu-Gyamfi (2020), who reported that the use of instructional materials such as charts, diagrams, and models improves students' comprehension and retention in science subjects. Similarly, Mugisha (2019) observed that visual teaching aids enhance classroom interaction and promote higher academic achievement by making abstract concepts more tangible for learners. Furthermore, Owolabi and Oladele (2018) found that students taught with visual instructional aids scored significantly higher in science examinations compared to those taught without such aids, demonstrating the effectiveness of these materials in improving learning outcomes.

Despite these benefits, the study revealed challenges that hinder the optimal use of visual instructional aids, including limited resources, damaged or worn-out materials, and inadequate teacher training. These constraints are similar to those highlighted by Akinsolu (2010), who emphasized that insufficient provision of instructional materials and lack of teacher capacity can limit the effectiveness of teaching aids in enhancing student performance.

The findings show the importance of prioritizing the provision and effective integration of visual instructional aids in schools. Continuous teacher training, coupled with proper laboratory and resource management, emerged as critical factors for sustaining student engagement and improving academic outcomes. Overall, the study reaffirms that while visual instructional aids are essential for enhancing understanding and performance in Biology, their impact is maximized only when schools ensure adequate resources, professional development, and effective utilization.

V. CONCLUSION

The research concluded that utilization of visual instructional aids significantly enhances students' comprehension and academic performance in Biology. Schools that consistently integrate visual aids into practical

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and theoretical lessons report better student outcomes. Gaps in resource availability and teacher capacity should be addressed to optimize the impact of instructional materials on learning.

RECOMMENDATIONS

- Ensure that diagrams, models, charts, and other visual resources are readily available and regularly utilized in teaching.
- Conduct continuous professional development programs to enhance teachers' ability to effectively use instructional materials.
- School management should prioritize the provision and maintenance of laboratory equipment and visual aids.
- Visual aids should be systematically integrated into lesson planning and practical sessions.
- Regular assessments should be conducted to assess the contribution of instructional materials towards learners' academic outcomes.

AREAS FOR FUTURE RESEARCH

- Examine the influence of digital and interactive teaching technologies on students' performance in Biology.
- Investigate long-term effects of instructional materials use on academic achievement across multiple science subjects.
- Examine the role of school management and policy in ensuring effective use of teaching resources.

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