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Teacher Effectiveness and Learners' Academic Achievements in Biology O-Level Secondary Schools of Rwampara District

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Keywords:

Teacher Development,
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Teacher Effectiveness.

The main purpose of this study was to examine the impact of teacher effectiveness on learners' academic achievements in Biology in O-Level secondary schools within Rwampara District, Uganda. The study employed a descriptive survey research design and used a sample of 297 respondents determined using the Krejcie and Morgan table 1970. The findings revealed that there is a strong and statistically significant positive correlation ($r = 0.66$) between teacher effectiveness and learner academic achievement. Approximately 44% of the variance in student performance could be explained by teacher-related factors. This result highlighted the critical influence of teacher effectiveness on academic success, emphasising the need for support and capacity building for Biology teachers. Teacher effectiveness is a cornerstone of academic achievement in Biology. While educators demonstrate strength in core teaching competencies, systemic barriers hinder peak instructional quality. Student performance reflects both strengths and shortcomings in current teaching practices, and the positive correlation between teacher effectiveness and achievement confirms the importance of focused investment in teacher development. For Teacher Effectiveness: The Ministry of Education and school leaders should implement continuous professional development (CPD) focusing on modern, student-centred teaching strategies, access to global content, and effective classroom management. For Learner Achievement: Schools must reinforce hands-on and project-based learning, actively monitor student attendance, and ensure standardised project assessments aligned with curriculum goals. For Teacher-Student Achievement Link: Educational authorities should introduce targeted support for underperforming teachers through mentorship and coaching, while establishing recognition and reward systems to motivate high-performing educators.

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INTRODUCTION

Biology education has deep historical roots, dating back to early civilisations such as ancient Egypt, Mesopotamia, China, and Greece, where biological knowledge was closely linked to medicine, agriculture, and natural history (Dagher, 2014; Winterbottom, 2017). Notable figures like Aristotle and Hippocrates laid early foundations in anatomy and classification (Cofré et al., 2018). The Middle Ages saw significant contributions from Islamic scholars like Al-Jahiz, while the Renaissance brought empirical observation through anatomists such as Andreas Vesalius. The 18th and 19th centuries ushered in formal biological sciences with Carl Linnaeus's taxonomy and Darwin's theory of evolution (Harris et al., 2020). Over time, the discipline evolved to emphasise structured teaching, assessment, and inquiry-based learning, influenced by educational theorists like Johann Herbart, John Dewey, and Benjamin Bloom.

Effective biology teaching involves not only mastery of content but also skilful pedagogy that fosters inquiry, participation, and critical thinking. Teacher effectiveness is defined as the educator's ability to influence student learning positively through instructional competence, subject knowledge, and responsiveness to learner diversity (Rumjaun & Narod, 2020; Bwenvu et al., 2024). Strategies such as hands-on experiments, project-based learning, and adaptive teaching enhance

student engagement and comprehension (Jammeh et al., 2023; Tukamuhabwa et al., 2024). Academic achievement in biology is shaped by factors including learner motivation, prior knowledge, available resources, and the quality of feedback and assessment (Namayanja et al., 2021). Thus, effective teaching serves as a crucial lever for improving student outcomes in the biological sciences.

The Constructivist Theory, advanced by Jean Piaget and Lev Vygotsky, underpins the pedagogical approach to teaching biology. Piaget emphasised cognitive development through active engagement, while Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), which highlights the importance of scaffolding learning through guided interaction (Chuang, 2021; Jammeh et al., 2023). Constructivist teaching in biology encourages learners to build their understanding through inquiry-based tasks, collaborative exploration, and reflection (Liu et al., 2023; Ekoju et al., 2021). Although constructivism promotes independent learning, scholars caution against neglecting direct instruction, especially for learners lacking foundational knowledge (Waite-Stupiansky, 2022). When applied thoughtfully, the theory supports the creation of learning environments that nurture deep understanding and application of biological concepts.

Biology education is essential in fostering scientific literacy, critical thinking, and readiness for careers in medicine, agriculture, and environmental science (Akinbadewa & Sofowora, 2020). However, despite its importance, biology education in Uganda, including in Rwampara District, faces persistent challenges such as insufficient teacher training, lack of instructional materials, and inadequate infrastructure (Bwenvu et al., 2024; Tukamuhabwa et al., 2024). Government efforts to enhance teacher effectiveness have yet to yield substantial improvements in learner outcomes. Competent teaching, grounded in pedagogical theory and practical application, remains a cornerstone for improvement. This study seeks to identify the pedagogical barriers and opportunities in biology instruction in Rwampara District, aiming to propose informed strategies that can raise academic achievement and align Uganda's biology education with global standards.

Problem Statement

Learner's academic achievement in biology is crucial in understanding biology concepts and principles, laboratory skills and techniques, Data analysis, application of biological principles to the real world, academic performance, and overall learning outcomes. Biology, in particular, plays a vital role in understanding biological processes, addressing health issues, and solving environmental challenges (Dagher, 2014).

In Uganda the Learners Academic achievement of biology subject has been declining over a period of time and it is attributed to high student teacher ratio, un equipped biology laboratories at secondary schools, inconsistencies in teaching by the biology teachers due to high demand they have fixed schedules and use of old method teaching techniques thus limiting the concentration of the student to excel in biology. (Avvaru et al., 2023). This is evidenced by the 2023 Uganda Certificate of Education (UCE) results revealed that only 3% of candidates achieved distinctions in Biology, a notable decrease from 0.2% in 2022. Additionally,

the 2023 Uganda Advanced Certificate of Education (UACE) results showed that only 0.2% of candidates scored an A in Biology (UNEB, 2024).

However, ministry of education and sports has continued to design and implement policies targeting to achieve high student achievement in biology including proper motivation of teachers (salary increment), enhancement of stocked biology laboratories, change of teaching methodologies from teacher centered to research based and learner centered methods and proper feeding of students but the challenge has gone un solved where 45.2% of students scored between A and E, while 88.1% had scores ranging from A to O, reflecting poor performance (UNEB, 2023). Student engagement in Biology remains low, with only 10% of O-level students willing to pursue it at the Advanced level, and this has led to a shortage of skilled professionals in scientific fields, reduced scientific innovation, and a weakened workforce in sectors dependent on biological sciences. The lack of sufficient teacher training and professional development opportunities specifically focused on effectiveness in biology (Namayanja et al., 2021).

Therefore, it was imperative to prioritise the enhancement of teachers' effectiveness and skills to improve learners' academic achievements and ultimately enhance students' outcomes in biology education.

Purpose of the Study

The purpose of this study was to examine the impact of teacher effectiveness on learners' academic achievements in Biology in O-Level secondary schools in Rwampara District.

Objectives of the Study

- To assess the level of teacher effectiveness in teaching Biology in O-level Secondary Schools of Rwampara District.

- To examine learners' academic achievement in Biology in O-Level secondary Schools of Rwampara District
- To assess the relationship between teacher effectiveness and learners' academic achievement in Biology in O-Level secondary schools of Rwampara District.

Research Questions

- What is the level of teacher effectiveness in teaching Biology in O-Level secondary schools of Rwampara District?
- What is the level of learners' academic achievement in Biology O-Level secondary schools of Rwampara District?

Hypothesis

Ho₁: There was a statistically significant relationship between teacher effectiveness and learners' academic achievement in Biology in O'Level Secondary schools of Rwampara District.

Significance of the Study

This study was significant in the following ways.

Guiding Policy and Practice: The study provides crucial evidence on how teachers' effectiveness affects learners' academic achievement in O-Level Biology. This information is valuable for informing the development and implementation of educational policies and practices. Educational policymakers and administrators can leverage these insights to guide policy changes and enhance teaching practices within secondary schools.

Improving Teacher Training: By identifying gaps in teachers' effectiveness, the study helps in designing targeted, continuous professional development programs. This ensures that training initiatives address specific areas where teachers may need improvement. Teacher training organisations and educational institutions can use these findings to refine their training programs and better support their educators.

Enhancing Student Outcomes: The study explores the connection between teachers' effectiveness and learners' academic achievements in Biology, aiming to boost student scores and Biology projects. Improved teacher effectiveness, as identified through this study, can lead to enhanced learning outcomes for students. Consequently, students benefit from more effective teaching and better comprehension of Biology.

Supporting Effective Teaching Strategies: By examining which teacher effectiveness leads to more effective teaching, the study provides actionable insights for teachers. These findings can help Biology teachers adopt and apply strategies that improve their instructional methods. As a result, teachers can enhance their teaching effectiveness and better support their students' learning.

Contributing to Educational Research: The study adds valuable data to the field of educational research by offering new perspectives on the impact of teacher effectiveness on learners' academic achievement. Researchers and academics can use this information to further their studies and contribute to scholarly discussions, enriching the understanding of effective teaching practices.

LITERATURE REVIEW

Assessing the Level of Teacher Effectiveness in Teaching Biology in O-Level Secondary Schools in Rwampara District

Teacher effectiveness in Biology teaching is multifaceted, encompassing deep subject content knowledge, meticulous lesson planning, and dynamic instructional delivery. Akmalovna & Olimovna (2020) argue that comprehensive subject mastery, ranging from basic to advanced biology concepts, is essential for effective teaching, while Bizimana, Mutangana, & Mwesigye (2021) and Eze (2023) emphasise that such knowledge directly correlates with learner comprehension and interest. In terms of preparation, Mboko et al. (2023) stress the importance of schemes of work and lesson

planning as essential tools for lesson delivery, although they note the challenge of teachers' time constraints.

Wafula (2023) reinforces that teacher preparation, including planning and use of teaching aids, is mandated by professional codes of conduct, yet gaps in involving supervisory stakeholders like Directors of Studies persist. Effective instruction also relies on strategy: Ekoju et al. (2021) and Loseñara & Jugar (2023) underscore the value of diversified teaching methods such as simulations and hands-on experiments that cater to various student learning styles, supported further by Almasri et al. (2023) and Dagher (2014). Ultimately, a teacher's ability to connect pedagogy with practical learning enhances Biology education outcomes.

Examining Learners' Academic Achievement in Biology in O-Level Secondary Schools of Rwampara District

Learners' academic achievement in Biology is shaped by a combination of student-specific and school-related factors, including attendance, family background, teacher presence, and learning resources (Kungania, 2015). Reports from the Rwampara District Local Government (2023) reveal performance disparities across schools, with only a few excelling in Biology. Effective student engagement is critical, as Peters et al. (2019) and Venton & Pompano (2021) assert that interactive learning strategies, including group discussions and practical activities, increase retention and interest.

Salami & Spangenberg (2024) highlight the importance of inquiry-based and project-based learning for academic success. Supporting this, Kambaila et al. (2017) emphasise the role of Biology practical activities in Zambia, noting that students often struggle due to inadequate guidance and limited access to resources, a scenario similar to Uganda, where students interact with lab materials only near exams. These findings underscore that hands-on, sustained practical exposure and student-

centred learning strategies are essential to improving academic achievement in Biology.

Exploring the Relationship between Teacher Effectiveness and Learners' Academic Achievement in Biology

The relationship between teacher effectiveness and student achievement in Biology is rooted in how well teachers translate knowledge into impactful instruction. Ogbonna (2021) and Weir et al. (2019) explain that effective teachers engage learners through clear, differentiated instruction that accommodates varying abilities and learning preferences. Barkley & Major (2020) and Bond (2020) support the use of visual aids, technology, and collaborative learning to deepen conceptual understanding.

Peters et al. (2019) and Tukamuhabwa et al. (2024) illustrate that strategies such as fieldwork and inquiry-based projects improve both engagement and outcomes. Furthermore, effective classroom management is vital for a productive learning environment—is linked to high academic performance (Jacob et al., 2020; Bwenvu et al., 2020). Loveys & Riggs (2019) and Rumjaun & Narod (2020) highlight how differentiated instruction and personalised learning experiences boost learner motivation.

Reflective teaching and professional development, as noted by Rupasinghe et al. (2022) and Liu et al. (2023), sustain teacher growth and innovation, fostering continuous improvement in student performance. Hence, teacher effectiveness—when supported by pedagogical skills, continuous learning, and responsiveness to learners' needs—has a profound impact on academic achievement in Biology.

METHODOLOGY

Research Design

The study utilised a descriptive survey research design to examine teacher effectiveness and

learners' academic achievement in Biology at O-Level of secondary schools in Rwampara District.

Sources of Data

This study relied on structured questionnaires as the primary source of data, administered to 01 Rwampara District Education Officers, 01 District

Inspector of Schools, 14 Head of department Biology, 14 Head teachers from secondary schools, 14 Director of studies, 36 biology teachers who are key formats and use of purposive sampling, 217 students with the use of simple random sampling.

Table 1: Sample Size

Category	Population	Sample Size
Students of Biology	500	217
Biology teachers	40	36
DOS	15	14
Administrators (head teacher)	15	14
Heads of Departments	15	14
District inspector of schools	1	1
District education officer	1	1
Total	587	297

Purposive Sampling

Purposive sampling was employed to select the area District Education Officer, District Inspector of Schools, Head teachers, heads of Departments, Directors of studies, and teachers. Purposive sampling targeted the key information for the study from the District Education Office.

Simple Random Sampling

The researcher utilised simple random sampling to choose students. This method was preferred because it provided an equal chance for every respondent to be selected.

Data Collection Methods

Questionnaire was developed to collect data from Heads of Department, Directors of Studies, teachers, and students in schools within the area of study. An interview method was used to collect data from the District Education Officer, District Inspector of schools, and Headteachers within the area of study.

Data Analysis

The data collected from structured questionnaires underwent both descriptive and inferential statistical analyses. Descriptive statistics, such as frequencies, percentages, means, and standard deviations, were summarised by the characteristics of the study population and responses to survey questions. Inferential statistics, including Pearson correlations (r), were used to explore relationships between variables and identify factors influencing teachers' effectiveness in teaching Biology. Data analysis was conducted using statistical software like SPSS, with findings presented in tables. Qualitative data from open-ended survey questions was thematically analysed to provide deeper insights into teachers' perceptions and experiences regarding learners' achievement in biology.

PRESENTATION, ANALYSIS, AND INTERPRETATION

Table 2: Teacher Effectiveness in Teaching Biology in O-Level Secondary Schools of Rwampara District

Statement	SD	D	NS	A	SA	Mean
Planning and Preparation						
Teachers have competence in teaching the Biology subject at the global and national levels	10 (4%)	20 (8%)	25 (10%)	120 (48%)	75 (30%)	3.92
I attend workshops related to teachers' Biology content at the district and national level	20 (8%)	40 (16%)	35 (14%)	100 (40%)	55 (22%)	3.52
I keep up-to-date with the latest developments and research in Biology	15 (6%)	25 (10%)	30 (12%)	110 (44%)	70 (28%)	3.78
I integrate detailed knowledge of Biology into my lesson planning and delivery	5 (2%)	15 (6%)	25 (10%)	130 (52%)	75 (30%)	4.02
Classroom Environment						
The teacher effectively ensures active participation during Biology lessons	10 (4%)	15 (6%)	20 (8%)	130 (52%)	75 (30%)	3.98
The teacher motivates students with audio-visual instructional materials	15 (6%)	25 (10%)	30 (12%)	115 (46%)	65 (26%)	3.76
The teacher encourages high levels of critical thinking through questioning	10 (4%)	20 (8%)	25 (10%)	120 (48%)	75 (30%)	3.92
I use classroom rules, which are displayed and followed by students	20 (8%)	30 (12%)	30 (12%)	110 (44%)	60 (24%)	3.64
Materials like teaching aids, boards, charts, and projectors are accessible and skillfully used	15 (6%)	20 (8%)	25 (10%)	125 (50%)	65 (26%)	3.82
Instruction						
The teacher explains the purpose of each assignment/activity to students	10 (4%)	15 (6%)	20 (8%)	130 (52%)	75 (30%)	3.98
The teacher allows all students to participate in the discussion and discovery	15 (6%)	25 (10%)	20 (8%)	120 (48%)	70 (28%)	3.82
Feedback given to students is motivating	20 (8%)	30 (12%)	25 (10%)	110 (44%)	65 (26%)	3.68
The teacher promotes problem-solving, critical thinking, relevance, and authenticity in tasks	10 (4%)	15 (6%)	25 (10%)	120 (48%)	80 (32%)	3.98
Average Mean						3.82

Source: Field data 2025

The findings on teacher effectiveness in teaching Biology at O'Level reveal an overall high performance with an average mean of 3.82. Under Planning and Preparation, teachers scored highest in integrating content knowledge into lesson delivery (Mean = 4.02), followed by subject competence (3.92), staying current with developments (3.78), and workshop attendance (3.52). For the Classroom Environment, high means were recorded in student participation (3.98), critical thinking through questioning (3.92), use of teaching aids (3.82),

motivation through audio-visuals (3.76), and classroom rule enforcement (3.64). In the Instruction domain, top scores were seen in explaining assignment purposes (3.98), promoting real-world problem-solving (3.98), inclusive discussions (3.82), and motivating feedback (3.68). These mean scores indicate that while Biology teachers are generally effective, targeted improvements are needed in workshop participation, consistent rule enforcement, and the delivery of motivational feedback.

Table 3: Learners' Academic Achievement in Biology in O-Level Secondary Schools of Rwampara District

Item Statement	SD	D	NS	A	SA	Mean
Scores / Marks						
Most students consistently perform well in Biology tests and exams.	20 (8%)	50 (20%)	30 (12%)	100 (40%)	50 (20%)	3.52
Students' grades in Biology have improved over the past three terms.	10 (4%)	40 (16%)	25 (10%)	110 (44%)	65 (26%)	3.78
There is a direct link between class attendance and good Biology scores.	5 (2%)	35 (14%)	20 (8%)	100 (40%)	90 (36%)	4.00
Mock and end-of-term exam results reflect strong academic achievement.	15 (6%)	30 (12%)	25 (10%)	110 (44%)	70 (28%)	3.78
Biology Projects & Experiments						
Students actively participate in Biology project work and experiments.	10 (4%)	40 (16%)	30 (12%)	105 (42%)	65 (26%)	3.74
Project-based learning improves students' understanding of Biology topics.	5 (2%)	35 (14%)	15 (6%)	120 (48%)	75 (30%)	3.98
Completed Biology projects are assessed and contribute to academic grades.	20 (8%)	30 (12%)	25 (10%)	100 (40%)	75 (30%)	3.74
Students demonstrate practical understanding through lab and field work.	10 (4%)	25 (10%)	20 (8%)	110 (44%)	85 (34%)	3.96
Average mean						3.81

Source: Field data 2025

The findings, based on mean scores, indicate generally positive perceptions of academic achievement in Biology. Student performance in assessments had a moderate mean of 3.52, suggesting room for improvement, while perceptions of recent improvement in grades and the validity of exam results were more favourable, with both having a mean of 3.78. The strongest agreement emerged on the importance of attendance for success, reflected by the highest mean of 4.00.

Practical engagement was also positively rated, with means of 3.74 for participation in projects, 3.98 for project-based learning enhancing comprehension, and 3.96 for practical understanding through laboratory and field activities. Assessment of project work also scored 3.74, showing moderate agreement. Overall, the average mean of 3.81 reflects a strong theoretical and practical grasp of Biology, though some inconsistencies remain in performance and assessment practices.

Table 4: The Relationship between Teacher Effectiveness and Learners' Academic Achievement in Biology in O-Level Secondary Schools in Rwampara District.

		Teacher Effectiveness	The learner's academic achievement in Biology
Teacher Effectiveness	Pearson Correlation	1	.665**
	Sig. (2-tailed)		.000
	N	250	250
Learner's academic achievement in Biology	Pearson Correlation	.665**	1
	Sig. (2-tailed)	.000	
	N	250	250

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 presents the correlation between teacher effectiveness and learners' academic achievement in Biology. The Pearson correlation coefficient of .665 indicates a strong positive relationship between these two variables, suggesting that higher levels of teacher effectiveness are associated with better academic achievement among students in Biology. The significance value ($p = .000$) confirms that this correlation is statistically significant at the 0.01 level, meaning the likelihood that this relationship occurred by chance is extremely low. With a sample size of 250, the data provides robust evidence that effective teaching practices positively impact students' performance in Biology at the O-Level secondary school level.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study established that teacher effectiveness is a pivotal factor in shaping the quality of Biology education at the O'Level. Key components such as structured lesson planning, effective classroom management, and the use of engaging instructional strategies were found to significantly enhance the teaching and learning process. While many Biology teachers exhibit considerable competence, the study identified systemic challenges, including limited integration of global Biology content, inconsistent application of classroom practices, and high teacher workloads that restrict the full potential of instructional quality. Addressing these challenges is vital to ensuring that Biology teaching is both relevant and consistently effective across schools.

Student performance in Biology was shown to be strongly influenced by multiple interrelated factors, notably teacher competence, student attendance, and the incorporation of hands-on learning activities. Although project-based assessments remain an area with implementation gaps, overall student performance ranged from moderate to high. This suggests either an improvement in local instructional practices or varying perspectives among stakeholders regarding student achievement.

The findings point to the importance of active, experiential learning methods and consistent student engagement in boosting academic outcomes.

A statistically significant positive relationship was confirmed between teacher effectiveness and learner academic achievement in Biology, with teacher-related factors explaining approximately 44% of the variance in student performance. This strong correlation highlights the critical role that teachers play in influencing Biology outcomes at the secondary level. The evidence underscores the urgent need for targeted interventions focused on enhancing teaching methodologies, refining assessment practices, and providing ongoing professional development and support for Biology educators. Strengthening these dimensions will be essential for sustaining and improving academic achievement in Biology across O-Level secondary schools.

Recommendations

The recommendations were based on the study findings in relation to the study objectives.

To enhance the quality of Biology education, the Ministry of Education should prioritise continuous professional development programs that emphasise modern, student-centred instructional strategies. Equipping teachers with such approaches will empower them to deliver content more effectively and actively engage learners.

Additionally, school administrators should provide Biology teachers with adequate time for lesson planning and access to both local and global content resources. This support is crucial for improving curriculum relevance and ensuring coherent delivery of subject matter.

Moreover, training programs and in-service workshops should incorporate components on effective classroom management, especially techniques for handling large classes, fostering student engagement, and minimising classroom

disruptions. Such efforts are essential in creating conducive environments for meaningful learning.

Improving student achievement in Biology requires the consistent use of active, hands-on learning strategies. Schools should promote project-based and practical learning activities such as laboratory experiments, model construction, and fieldwork, which help students grasp and retain key concepts.

At the same time, schools and education authorities need to address issues related to student attendance and motivation. This can be achieved through regular monitoring of absenteeism and the establishment of supportive programs that encourage learner participation and engagement.

Furthermore, there is a need to standardise the implementation of project-based assessments. Education policymakers should develop comprehensive guidelines and provide specialised training for Biology teachers to ensure consistency and alignment with national curriculum standards.

Given the strong link between teacher effectiveness and student achievement, targeted interventions should be introduced for underperforming teachers. District education offices can play a key role in identifying these educators and offering personalised coaching, mentorship, and professional development to improve their instructional competencies.

Additionally, school leaders and inspectors should adopt regular systems of classroom observation and constructive feedback to continuously monitor and enhance teaching practices.

To sustain and reinforce excellence, schools should establish recognition and reward mechanisms for Biology teachers who demonstrate outstanding effectiveness and positively impact student learning outcomes. These incentives can motivate teachers to uphold high standards and adopt innovative teaching methods.

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