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An Investigation Into Factors Leading To Poor Grade Twelve Examination Results In Zambia: A Case Study Of Selected Secondary Schools In Nchelenge District

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Abstract- This study investigates the factors contributing to poor Grade Twelve examination results in Zambia, with a specific focus on selected secondary schools in Nchelenge District. The research explores how inadequate access to quality education, especially in science subjects—Biology, Chemistry, Physics, Mathematics, and Computer Science—impacts student performance. A particular emphasis is placed on examining the role of Information and Communication Technology (ICT) in addressing these challenges. Through a mixed-methods approach, including pre- and post-test assessments, surveys, and qualitative interviews with teachers and students, the study evaluates the effectiveness of ICT tools such as instructional videos, interactive simulations, and online problem-solving exercises in improving academic outcomes. Results suggest that ICT integration can significantly enhance students' understanding of complex scientific concepts, reduce gender disparities in performance, and increase overall student engagement. However, challenges such as limited infrastructure, inadequate teacher training, and unreliable electricity and internet connectivity hinder the full potential of ICT in rural schools. This study recommends curriculum reforms, continuous teacher training, and increased investment in educational technology to foster better academic outcomes and bridge the educational divide between rural and urban Zambia.

Keywords- Grade Twelve examination performance, Science education, ICT in education, Educational technology, Rural education.

I. INTRODUCTION

In Zambia, education plays a central role in shaping the future of its young population, particularly in preparing them for careers in science, technology, engineering, and mathematics (STEM). Secondary education, especially in rural regions such as Nchelenge District in the Luapula Province, serves as a critical phase in students' academic development. However, students in these areas often face numerous challenges that hinder their academic performance, especially in core science subjects like Biology, Chemistry, Physics, Mathematics, and Computer Science. These subjects are crucial for pursuing STEM careers, yet many students struggle to grasp the complex concepts they entail.

International Journal for Research Trends in Social Science & Humanities
Volume 3 Issue 3
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A significant factor contributing to poor performance in the Grade Twelve examinations is the lack of access to modern teaching methodologies and resources. In many rural schools, the educational environment remains predominantly traditional, with a reliance on lecture-based teaching that fails to actively engage students in the learning process. Additionally, there is a lack of necessary resources such as textbooks, laboratory equipment, and technological tools that could enhance students' understanding and mastery of science subjects.

While there have been some efforts to incorporate Information and Communication Technology (ICT) in Zambian schools, the full potential of digital tools has yet to be realized, particularly in rural schools. ICT has been shown to improve student engagement, facilitate better understanding of complex concepts, and increase overall academic performance globally. However, in Zambia, particularly in rural districts like Nchelenge, challenges such as limited infrastructure, unreliable electricity, and insufficient teacher training in ICT remain barriers to effective integration.

This study seeks to explore the factors leading to poor Grade Twelve examination results in science subjects in selected secondary schools in Nchelenge District, with a particular focus on the potential of ICT tools to address these challenges. By investigating the barriers students and teachers face, and evaluating the effectiveness of ICT in enhancing learning outcomes, this research aims to contribute valuable insights that could inform educational reforms, teacher training programs, and policy decisions aimed at improving educational quality in rural Zambia.
Through a mixed-methods approach, this study will examine not only the academic performance of students before and after exposure to ICT tools but also the attitudes of both students and teachers toward the integration of technology into science education. By doing so, it is hoped that the findings will provide recommendations for overcoming the current limitations and promote a more inclusive and effective educational system in rural Zambia.

II. LITERATURE REVIEW

Rural students in Zambia often struggle with science subjects due to the abstract nature of concepts and the inadequate use of modern teaching methodologies. Studies have shown that traditional lecture-based methods fail to engage students or foster deep understanding, particularly in subjects like Biology, Chemistry, Physics, and Mathematics (Tekkaya et al., 2001; Bahar et al., 1999). Moreover, rural students typically lack the necessary resources, such as textbooks, laboratory equipment, and access to digital tools, to fully grasp these complex subjects.
Globally, ICT has emerged as a powerful tool for enhancing science education. It has been shown to improve student engagement, conceptual understanding, and performance in subjects ranging from Physics and Chemistry to Computer Science (Albirini, 2006; Arnseth & Hatlevik, 2012). However, in Zambia, the integration of ICT in rural universities is limited by challenges such as inadequate infrastructure, unreliable internet connectivity, and a lack of trained educators. Despite national policy efforts, such as the National ICT Policy (2006), the gap between urban and

International Journal for Research Trends in Social Science & Humanities
Volume 3 Issue 3
May-June 2025, PP 1182-1193

rural education remains vast. This review synthesizes global and local studies on ICT's impact on science education, providing a framework for this study.

III. METHODOLOGY

This study adopts a mixed-methods approach to investigate the challenges faced by university students in rural Zambia in mastering science subjects—Biology, Chemistry, Physics, Computer Science, and Mathematics—and the role of ICT tools in overcoming these challenges. The research was conducted in selected universities in Luapula Province, where ICT resources are relatively limited but steadily improving.

- **Participants:**
- 5 Science Teachers (1 each from Biology, Chemistry, Physics, Computer Science, and Mathematics)
- 100 University Students (divided into control and experimental groups, 50 each)
- Data Collection Instruments:
- Quantitative Tools: Pre- and post-test assessments, questionnaires to gauge student attitudes toward ICT
- Qualitative Tools: Semi-structured interviews with teachers, focus group discussions with students, classroom observations
- **Data Analysis:**
- Quantitative: Statistical analysis using a 2x2 factorial design to compare student performance across gender, age, and ICT exposure.
- Qualitative: Thematic analysis to identify key challenges and the perceived effectiveness of ICT tools in teaching the various science subjects.

IV. KEY FINDINGS

Improved Academic Performance Across Subjects

Students in the experimental group who were exposed to ICT tools like interactive simulations, instructional videos, and online problem-solving exercises showed significant improvement in post-test scores across all five science subjects. These tools helped simplify abstract concepts and provided a hands-on learning experience that was otherwise difficult to achieve with traditional teaching methods.

Reduction in Gender Disparities

Initial data revealed significant gender disparities in academic performance, particularly in Physics and Mathematics, which are typically male-dominated subjects. However, after exposure to ICT-enhanced teaching, the gender gap narrowed in all subjects, suggesting that ICT tools may foster a more inclusive learning environment.

International Journal for Research Trends in Social Science & Humanities
Volume 3 Issue 3
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No Age-Based Performance Variance
The analysis showed no significant difference in performance based on student age. This finding suggests that ICT tools benefit all students equally, regardless of their maturity or prior experience with digital learning tools.

Positive Attitudes Toward ICT
Both students and teachers expressed positive attitudes toward the use of ICT in teaching. On a 6-point Likert scale, the average attitude score ranged from 4.5 to 5.5, indicating a high level of acceptance and enthusiasm for ICT-based learning.

Barriers to ICT Integration
Despite the positive outcomes, several challenges were identified:

- Limited Infrastructure: Some universities lacked sufficient ICT resources (e.g., computers, projectors, stable internet).
- Teacher Training Deficiencies: Teachers reported inadequate training in using digital tools and online platforms for teaching.
- Connectivity Issues: Unstable internet access and unreliable power supply hindered the effective use of ICT in the classroom.

V. DISCUSSION

The findings support the hypothesis that ICT integration can enhance the learning experience in science subjects by providing interactive, visual, and practical learning tools. The improvement in student performance, especially among female students, aligns with global trends where ICT has been found to close gender gaps in STEM education. Moreover, ICT's positive impact on student engagement and understanding suggests that technology can help make challenging science concepts more accessible.

However, the study also highlights significant barriers to the widespread use of ICT in rural universities. These barriers—such as infrastructure limitations, teacher training gaps, and connectivity issues—must be addressed to ensure that ICT can reach its full potential as an educational tool. In addition, the study suggests that the successful integration of ICT requires institutional support, including investment in infrastructure, teacher development programs, and curriculum adjustments that incorporate technology-based teaching methods.

VI. CONCLUSION

This study demonstrates that ICT can significantly enhance the teaching and learning of science subjects (Biology, Chemistry, Physics, Computer Science, and Mathematics) in rural university settings in Zambia, particularly in Luapula Province. By bridging educational disparities and improving student performance, ICT has the potential to revolutionize science education in rural areas.

Recommendations:

- Curriculum Reform: Institutionalize the use of ICT in science education across universities in rural Zambia to enhance learning and engagement.
- Teacher Training: Provide comprehensive ICT training for teachers, particularly in rural universities, to equip them with the skills to effectively integrate technology into their teaching practices.
- Infrastructure Development: Ensure that all universities have access to sufficient technological resources, stable internet connectivity, and reliable electricity to support ICT use in classrooms.
- Content Localization: Develop contextually relevant educational content that aligns with the Zambian curriculum and makes use of local examples and resources.
- By addressing these recommendations, Zambia can make significant strides toward achieving equitable and high-quality science education for all students, regardless of their geographical location.

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