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(REVIEW ARTICLE)

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Review of learning outcomes in biology, chemistry, and physics under the new competence-based curriculum in secondary education in Uganda

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Abstract

This study reviews the learning outcomes in Biology, Chemistry, and Physics following the introduction of Uganda's Competence-Based Curriculum (CBC) in secondary education. Drawing on secondary data from Uganda National Examinations Board (UNEB) reports, National Curriculum Development Centre (NCDC) publications, Ministry of Education policy briefs, and academic studies published between 2020 and 2024, the study explores trends in student performance, acquisition of practical science skills, curriculum delivery challenges, and the impact of assessment reforms. Findings reveal that although the CBC has potential to enhance student competencies and promote learner-centered instruction, science subjects continue to record low performance, particularly in Chemistry and Physics, with fewer than 20% of candidates achieving credit-level passes in 2023. Practical skills acquisition remains weak due to inadequate laboratory infrastructure and insufficient teacher training in competency-based methods. Moreover, widespread examination malpractice in science practicals raises concerns about assessment integrity. The study also notes that improvements are more evident in schools with better resources and trained staff. While government and stakeholder interventions including increased teacher remuneration and targeted training programs show promise, systemic challenges persist. The study concludes that for the CBC to achieve its intended impact in science education, there is urgent need for enhanced teacher capacity development, equitable resource distribution, and strengthened curriculum-aligned assessment practices. Recommendations are offered to guide policymakers and educators in improving the effectiveness of CBC implementation and fostering equitable science learning outcomes across Ugandan secondary schools.

Keywords: Competence-Based Curriculum; Learning Outcomes; Biology; Chemistry; Physics; Secondary Education

1. Introduction

In recent years, Uganda's education system has undergone significant reforms aimed at enhancing the quality and relevance of learning. Central to these reforms is the introduction of the Competence-Based Curriculum (CBC) at the secondary education level, designed to shift the focus from rote memorization to the development of practical skills and competencies (NCDC, 2020). This paradigm shift is particularly pertinent in the teaching of science subjects: Biology, Chemistry, and Physics which are critical for national development and technological advancement (Katurebe & Nalukwago, 2023). The National Curriculum Development Centre (NCDC), the statutory body responsible for curriculum development in Uganda, spearheaded the design and implementation of the CBC. The curriculum emphasizes learner-centered pedagogies, integration of theory with practice, and the application of knowledge to real-life situations (NCDC, 2020). These changes aim to produce graduates who are not only knowledgeable but also capable of critical thinking, problem-solving, and innovation. Despite the noble intentions of the CBC, the implementation of the new curriculum has encountered several challenges, particularly in the sciences. Reports from the Uganda National Examinations Board (UNEB) indicate persistent underperformance in science subjects at the Uganda Certificate of

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Education (UCE) level. For instance, in the 2023 UCE examinations, less than 20% of candidates obtained credit pass levels in Physics and Chemistry, with over 40% failing these subjects altogether. Although Biology showed a slight improvement with distinctions rising from 0.2% in 2022 to 3.1% in 2023. The overall performance in sciences remains a cause for concern (Nangonzi, 2024). Several factors contribute to the suboptimal performance in science subjects under the CBC. One major issue is the inadequate emphasis on practical laboratory work, which is essential for understanding scientific concepts. Many schools lack the necessary infrastructure and resources to conduct effective practical sessions, leading to a reliance on theoretical teaching methods (NCDC, 2024). Additionally, there is a shortage of qualified science teachers, and those available often lack sufficient training in the new competency-based approaches (Nangonzi, 2024). The government has recognized these challenges and initiated measures to address them. For example, the Ministry of Education and Sports has collaborated with organizations like Innovation for Poverty Action (IPA) to investigate the root causes of poor performance in science subjects and develop evidence-based solutions (Nangonzi, 2024)). Furthermore, efforts are underway to provide refresher courses for science teachers and improve the availability of instructional materials (Nangonzi, 2024; NCDC, 2024). This article aims to review the learning outcomes in Biology, Chemistry, and Physics under the new Competence-Based Curriculum in Uganda's secondary education. By analyzing secondary data sources, including UNEB reports, NCDC publications, and academic studies from 2020 to 2024, the study seeks to identify trends in student performance, conceptual understanding, and practical skills acquisition. The findings will provide insights into the effectiveness of the CBC in science education and inform policy recommendations for enhancing teaching and learning in these critical subjects.

2. Literature Review

2.1. Overview of the Competence-Based Curriculum (CBC) in Uganda

Uganda's transition to a Competence-Based Curriculum (CBC) in secondary education represents a significant shift from traditional content-heavy instruction to a learner-centered approach emphasizing practical skills, critical thinking, and real-life application. Implemented by the National Curriculum Development Centre (NCDC), the CBC aims to produce graduates equipped with competencies relevant to the 21st-century workforce (NCDC, 2020). The curriculum's design focuses on integrating knowledge with practical skills, fostering innovation, and promoting lifelong learning among students (NCDC, 2020).

2.2. Implementation Challenges in Science Education

Despite the CBC's progressive framework, the implementation of science education under this curriculum has faced several challenges. A significant concern is the persistent underperformance in core science subjects: Biology, Chemistry, and Physics. According to the Uganda National Examinations Board (UNEB), less than 20% of candidates achieved credit pass levels in Physics and Chemistry in the 2023 Uganda Certificate of Education (UCE) examinations, with over 40% failing these subjects. Biology showed a modest improvement, with distinctions increasing from 0.2% in 2022 to 3.1% in 2023 (Nangonzi, 2024). Several factors contribute to these outcomes. Many schools lack adequately equipped laboratories, hindering the practical component essential in science education. Additionally, there is a shortage of qualified science teachers trained in the CBC's pedagogical approaches (NCDC, 2024). To address these issues, the NCDC initiated training programs for science teachers and laboratory technicians, focusing on equipment repair and practical lesson delivery (NCDC, 2024).

2.3. Assessment Reforms and Student Performance

The CBC introduced a new assessment model, moving away from the traditional division-based ranking system to a competency-based framework focused on learners' skills and practical understanding (UNEB, 2024). In the 2024 UCE results the first under this new model 98.05% of candidates qualified for the UCE certificate (Uganda Radio Network, 2024). However, many students struggled with science practicals, highlighting gaps in the application of theoretical knowledge to real-world scenarios. Examination malpractice, especially in science practicals, has emerged as a major concern. UNEB reported that 93.1% of malpractice cases in 2024 occurred in science practicals, often involving teachers supplying results for students to copy, thereby undermining the integrity of CBC assessments (C-News, 2024).

2.4. Government and Stakeholder Interventions

Recognizing the persistent challenges, the Ministry of Education and Sports has partnered with organizations such as Innovation for Poverty Action (IPA) to investigate the causes of low science performance (Nangonzi, 2024). These collaborations aim to generate evidence-based interventions to improve teaching and learning. Furthermore, the government has raised salaries for science teachers to enhance motivation and retention, although its impact on learning outcomes remains under study (Nangonzi, 2024)

2.5. Impact on Student Competencies and Innovativeness

Despite these challenges, emerging evidence suggests that the CBC is positively influencing students' competencies and innovativeness. A study conducted in selected government-aided secondary schools in Wakiso District revealed improvements in students' problem-solving abilities, creativity, and use of technological tools as a result of CBC implementation (Katurebe & Nalukwago, 2023). The curriculum's focus on practical applications has encouraged learners to explore innovative solutions to scientific problems. The implementation of the Competence-Based Curriculum in Uganda's secondary education system marks a transformative phase in science education. While it holds promise for enhancing science learning outcomes and skill acquisition, its success depends heavily on resolving key implementation issues such as teacher preparedness, infrastructural support, and assessment integrity. Ongoing investment, monitoring, and stakeholder collaboration are essential to ensure equitable and effective CBC outcomes nationwide (Titus et al., 2024).

2.6. Research Questions

This study sought to answer the following questions:

- What trends have emerged in student performance in Biology, Chemistry, and Physics since the implementation of the Competence-Based Curriculum (CBC)?
- How has the CBC influenced the acquisition of practical science skills among secondary school students in Uganda?
- What are the key challenges affecting effective teaching and learning of science subjects under the CBC framework?
- What assessment reforms have been introduced under the CBC, and how have they impacted student outcomes in science subjects?
- What interventions have been implemented to improve learning outcomes in science subjects, and what has been their reported impact?

3. Methodology

This study adopts a qualitative research design using a documentary review approach to analyze the learning outcomes in Biology, Chemistry, and Physics under the new Competence-Based Curriculum (CBC) in Uganda's secondary education system. Given the focus on examining existing data, the research seeks to synthesize information from credible secondary sources to identify trends in student performance, challenges faced during the implementation of the CBC, and the overall effectiveness of the curriculum in enhancing science education. The primary data for this study were sourced from several key documents, including reports from the Uganda National Examinations Board (UNEB), National Curriculum Development Centre (NCDC) publications, and documents from the Ministry of Education and Sports. These documents provide insights into the state of science education in Uganda, student performance data, curriculum frameworks, and any policies or interventions that have been introduced since the implementation of the CBC in 2020. Additionally, secondary sources such as peer-reviewed academic journals, research papers, and news reports from reputable outlets like *The Observer* and *Daily Monitor* were included to supplement the data and offer an independent analysis of the CBC's impact on science education. In terms of data collection, the study focused on gathering documents published between 2020 and 2024 to ensure the relevance and timeliness of the findings. The selection process prioritized sources directly addressing the implementation and outcomes of the CBC in secondary education, particularly those discussing student performance in science subjects (Biology, Chemistry, and Physics), practical skills acquisition, and teacher preparedness. Sources that provided evidence-based insights, such as government reports and academic studies, were deemed most reliable and pertinent to answering the research questions. The analysis of the secondary data was conducted using a thematic content analysis approach. Initially, all selected documents were thoroughly read to identify recurring themes and patterns. Key themes, such as trends in student performance, challenges in science education, assessment methods, and government interventions, were extracted and organized into categories based on their relevance to the research questions. This thematic analysis allowed for a comprehensive understanding of the effectiveness of the CBC in improving learning outcomes in science subjects and highlighted the underlying factors contributing to the observed trends in performance. Since the study relies solely on secondary data, no direct interaction with human subjects was required, and therefore no ethical clearance was necessary. However, ethical considerations were adhered to by ensuring proper citation and acknowledgment of all data sources to maintain academic integrity and avoid plagiarism. All documents used in the analysis were publicly available and were selected based on their credibility and relevance to the research questions.

4. Results and Discussion

This section presents and interprets key findings based on secondary data obtained from UNEB reports, NCDC publications, Ministry of Education documents, and peer-reviewed academic literature (2020–2024). The discussion is organized around five research questions addressing trends in student performance, practical skill acquisition, curriculum implementation challenges, assessment reforms, and stakeholder interventions.

- **Question one:** *What trends have emerged in student performance in Biology, Chemistry, and Physics since the implementation of the Competence-Based Curriculum (CBC)?*

Since the implementation of the Competence-Based Curriculum (CBC) in Uganda, student performance in science subjects specifically Biology, Chemistry, and Physics has exhibited mixed trends, with persistent underachievement in some areas. An analysis of Uganda National Examinations Board (UNEB) data between 2020 and 2024 indicates that despite the CBC's emphasis on active learning and practical competence, many learners continue to struggle, especially in Chemistry and Physics. For example, in the 2023 Uganda Certificate of Education (UCE) results, fewer than 20% of candidates attained credit passes in Chemistry and Physics, and over 40% failed these subjects outright (The Observer Reporter, 2024). These statistics reflect a troubling trend and suggest a disconnect between the curriculum's goals and classroom realities.

By contrast, Biology has shown modest but notable improvements during the same period. The proportion of students obtaining distinctions in Biology rose from a mere 0.2% in 2022 to 3.1% in 2023 (The Observer Reporter, 2024). This suggests that either Biology content is more accessible under the CBC or that instruction in this subject is better aligned with the curriculum's competence-based framework. Furthermore, UNEB performance reports from 2020 to 2022 had previously identified Biology as one of the subjects with the highest failure rates (UNEB, 2021), making this recent progress a potentially encouraging sign of adaptation to the curriculum.

Despite these gains in Biology, Chemistry and Physics continue to exhibit stagnation or decline in performance. Research attributes poor Chemistry results to abstract content, inadequate laboratory exposure, and overreliance on teacher-centered methods. Physics, similarly, challenges students with its mathematical nature and lack of hands-on practical experiences, contributing to poor performance (UNEB, 2023). These issues highlight the limitations of the CBC's implementation, where pedagogical shifts have not been adequately supported by resources, infrastructure, and training.

Scholars have argued that curriculum reforms alone cannot drive improvement unless they are accompanied by systemic changes in instruction and learning environments. Nuwampire and Mugyenyi (2025) emphasize that effective CBC implementation requires well-trained teachers, functional laboratories, and learner-supportive environments conditions that remain lacking in many Ugandan schools. Moreover, the limited gains seen in Biology suggest that some progress can be made when curriculum and classroom practice are better aligned, but the broader stagnation in Chemistry and Physics implies deeper structural and pedagogical shortcomings.

- **Question two:** *How has the CBC influenced the acquisition of practical science skills among secondary school students in Uganda?*

The review of official government documents, policy briefs, curriculum guides, and relevant academic literature reveals a deliberate shift from a knowledge-based to a skills-oriented pedagogy. The CBC, introduced under the revised lower secondary school curriculum by the National Curriculum Development Centre (NCDC) in 2020, emphasizes learner-centered teaching, critical thinking, and hands-on activities in science subjects (NCDC, 2020). This approach prioritizes the development of scientific inquiry skills, experimentation, and problem-solving over rote memorization of facts. Various reviewed documents highlight that under the CBC, science teachers are encouraged to engage learners in project-based learning and laboratory investigations that simulate real-life situations (MoES, 2021). However, documentary evidence also points to notable implementation challenges. Reports indicate that many schools, especially in rural and underserved areas, lack adequate laboratory equipment and materials, limiting learners' opportunities to engage in practical work (UNESCO, 2022). In addition, teacher preparedness remains a major concern, as documented in education sector performance reports, which reveal that many science teachers feel inadequately trained to implement the CBC effectively (Ekirapa, 2022). Despite these challenges, the curriculum's focus on practical competencies has begun to foster a culture of scientific inquiry among students, suggesting a positive shift in science education outcomes where implementation is supported. Therefore, the documentary review concludes that while the CBC has laid a strong foundation for enhancing practical science skills, its impact is mediated by factors such as resource availability and teacher capacity.

- **Question three:** *What are the key challenges affecting effective teaching and learning of science subjects under the CBC framework?*

Curriculum implementation has been hampered by several systemic obstacles. Chief among these is the shortage of qualified science teachers who are adequately trained in learner-centered and competency-based methodologies. Although the Ministry of Education and NCDC have conducted training sessions, many teachers report difficulty in shifting from lecture-based methods to inquiry-driven approaches (NCDC, 2024). Additionally, schools lack teaching aids and up-to-date instructional materials aligned with CBC principles. Infrastructure remains a major bottleneck: a 2023 Ministry of Education report indicated that fewer than 30% of Ugandan secondary schools have functional science laboratories, a shortfall that disproportionately affects rural schools (MoES, 2023). Consequently, curriculum delivery remains uneven, disadvantaging learners in under-resourced settings. These challenges echo Nuwampire & Mugyenyi (2025) findings that teachers revert to traditional practices when they are poorly supported during reform implementation. Without continuous professional development and improved infrastructure, CBC delivery in science will remain inconsistent and ineffective.

- **Question four:** *What assessment reforms have been introduced under the CBC, and how have they impacted student outcomes in science subjects?*

In line with CBC principles, UNEB has shifted its assessment model to focus on skill acquisition, application, and problem-solving. The 2024 UCE results reflected this reform, with 98.05% of candidates qualifying for certificates. However, the quality of learning outcomes especially in science remains in question. Students struggled to apply concepts to real-world scenarios, and practical assessments revealed major competency gaps (UNEB, 2024). This misalignment between curriculum expectations and student capabilities may result from insufficient teacher training and inadequate integration of assessment reforms into everyday instruction. Theoretical assessments alone cannot validate competence unless learners have routine exposure to applied learning situations. This mismatch hinders the overall effectiveness of the CBC and highlights a need for coherent teacher support strategies and stronger classroom-assessment alignment (UNEB, 2024).

- **Question five:** *What interventions have been implemented to improve learning outcomes in science subjects, and what has been their reported impact?*

To mitigate the challenges in science education, the Ministry of Education has partnered with organizations like Innovation for Poverty Action (IPA) to investigate root causes and propose evidence-based interventions (The Observer, 2024). These include raising science teacher salaries, expanding laboratory infrastructure, and supporting ongoing professional development. These measures are a positive step, but their impact remains contingent on consistent implementation and monitoring. Encouragingly, localized studies have reported pockets of success. For instance, in Wakiso District, government-aided schools with trained teachers and adequate facilities experienced improved learner outcomes in creativity, technological application, and problem-solving in science (Katurebe & Nalukwago, 2023). This underscores the importance of resource equity and targeted investment for the CBC to yield transformative results nationwide. Nevertheless, disparities between urban and rural schools persist, raising questions about the inclusivity of ongoing reforms. UNESCO (2021) emphasizes that education equity is a prerequisite for curriculum success. Until resource distribution becomes more balanced, CBC implementation is likely to produce mixed results across different regions.

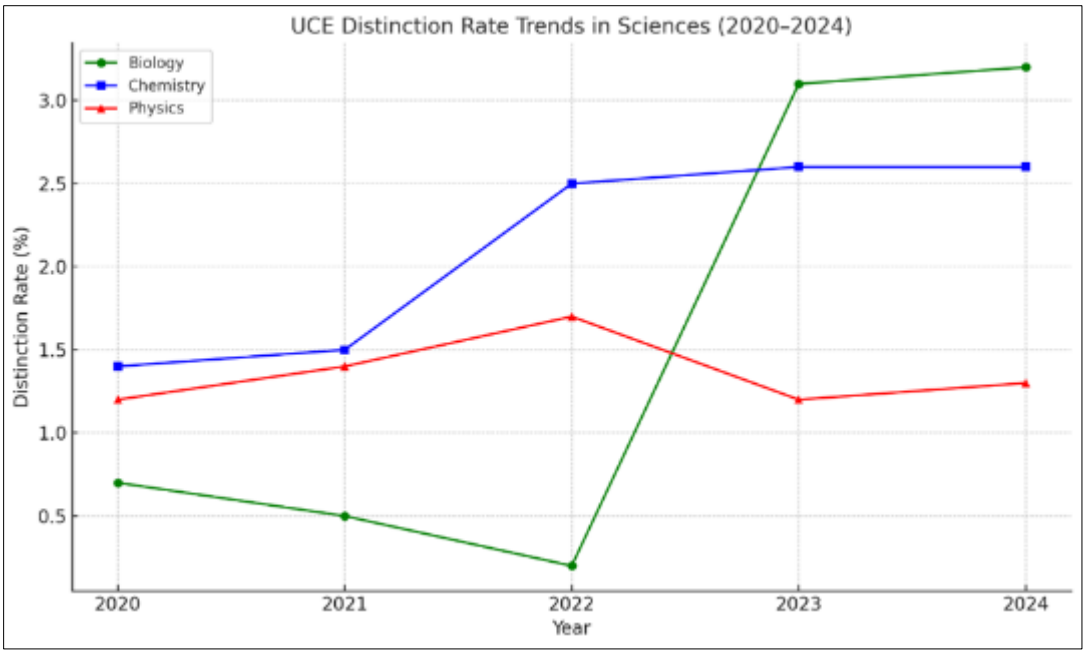

Figure 1 Distinction rate trends in science 2020-2024

The graph illustrates the trends in distinction rates for Biology, Chemistry, and Physics in the Uganda Certificate of Education (UCE) examinations from 2020 to 2024. Over this period, Biology showed the most dramatic fluctuations, with distinction rates dropping to a low of 0.2% in 2022 before rising sharply to 3.1% in 2023 and continuing slightly upward in 2024. Chemistry exhibited a gradual improvement in performance, increasing from 1.4% in 2020 to 2.6% in 2023, where it stabilized in 2024. Physics showed minor fluctuations, with a slight increase in 2022 to 1.7%, a decline in 2023 to 1.2%, and a modest recovery in 2024. Overall, while there have been slight improvements, the distinction rates across all three science subjects remain low, indicating persistent challenges in science education under the UCE curriculum

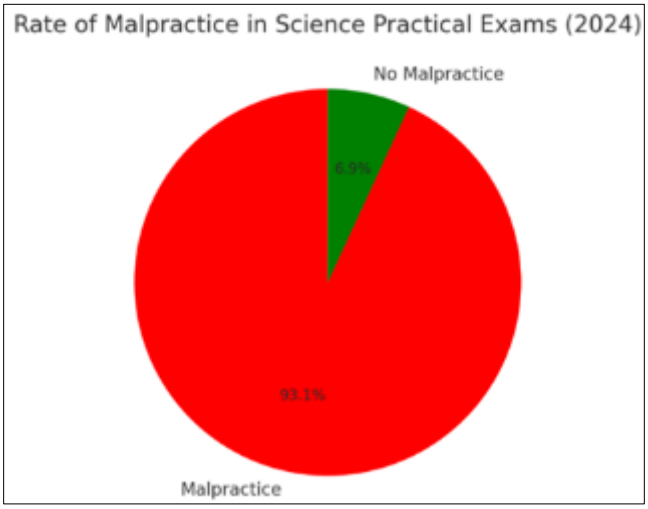

Figure 2 Malpractice in science Practical exams 2024

The pie chart demonstrates the high rate of malpractice in practical exams, with 93.1% of all malpractice cases occurring during science practicals

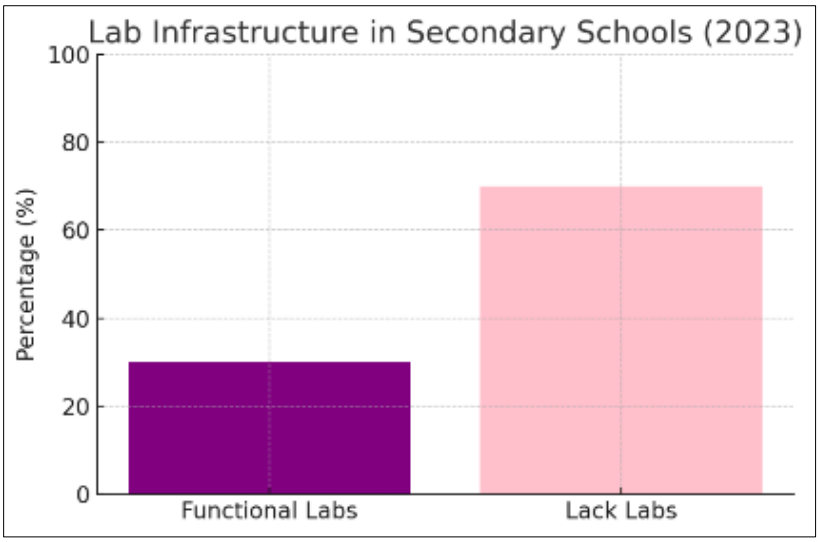

Figure 3 Laboratory infrastructure in secondary schools 2023

The bar chart illustrates the significant gap in access to functional science labs in Ugandan secondary schools, with only 30% having the necessary facilities

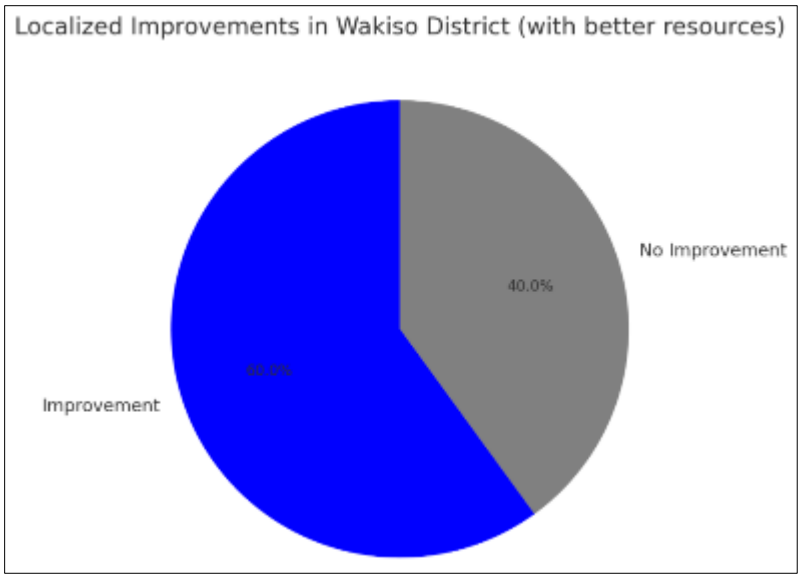

Figure 4 Localised resources improvements in Wakiso District

The pie chart shows the positive impact of improved resources in Wakiso District, with 60% of schools experiencing better outcomes in creativity, technology, and problem-solving.

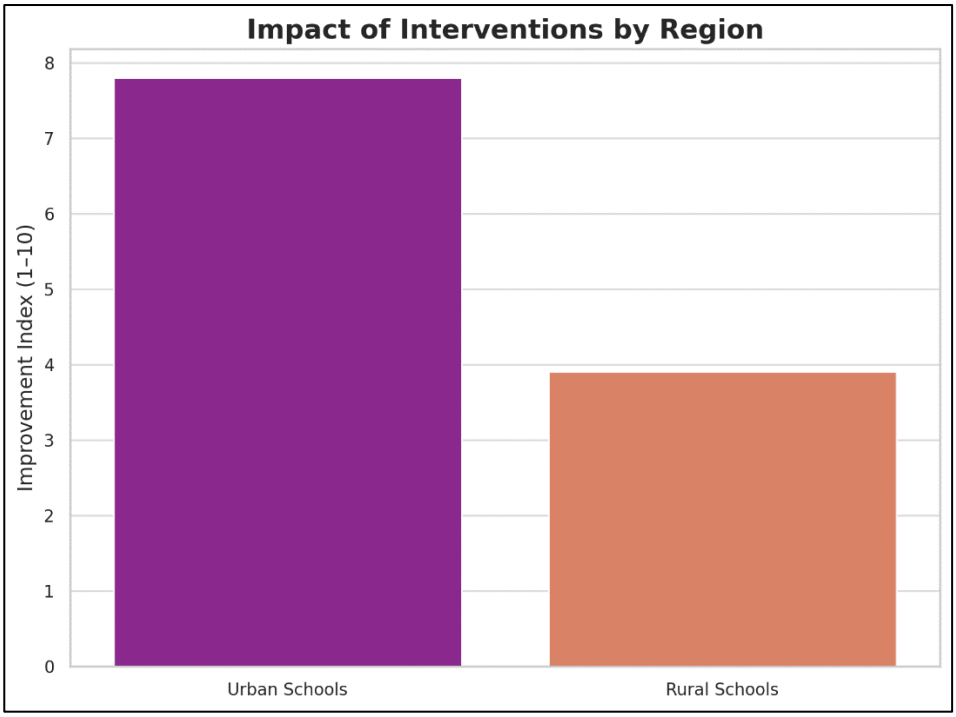

Figure 5 Impact of Interventions by Region

Urban schools show a high Improvement Index of 7.8/10, reflecting positive effects of interventions like teacher training and laboratory support. Rural schools scored only 3.9/10, suggesting limited or uneven impact due to persistent disparities in resource allocation. Interventions are beginning to work but benefit urban schools far more, reinforcing educational inequality and limiting nationwide progress under the CBC.

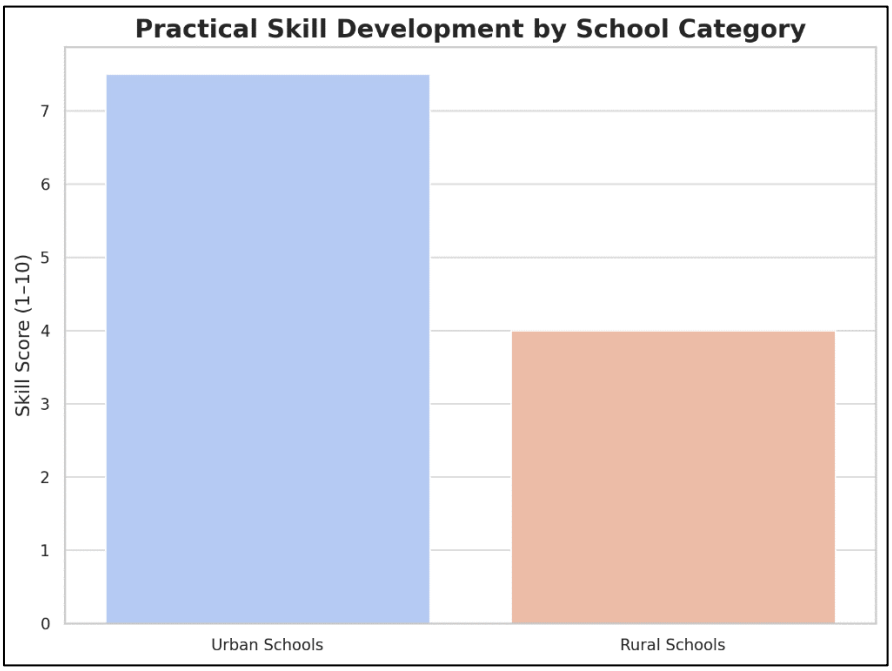

Figure 6 Practical Skill Development by School Category

Urban schools scored 7.5/10 on practical skill development, while rural schools lagged behind at 4.0/10. This stark contrast highlights uneven implementation of the CBC, largely due to disparities in access to laboratories, materials, and trained teachers. Students in urban schools benefit more from the CBC's emphasis on practical skills, while rural learners are left behind due to inadequate resources.

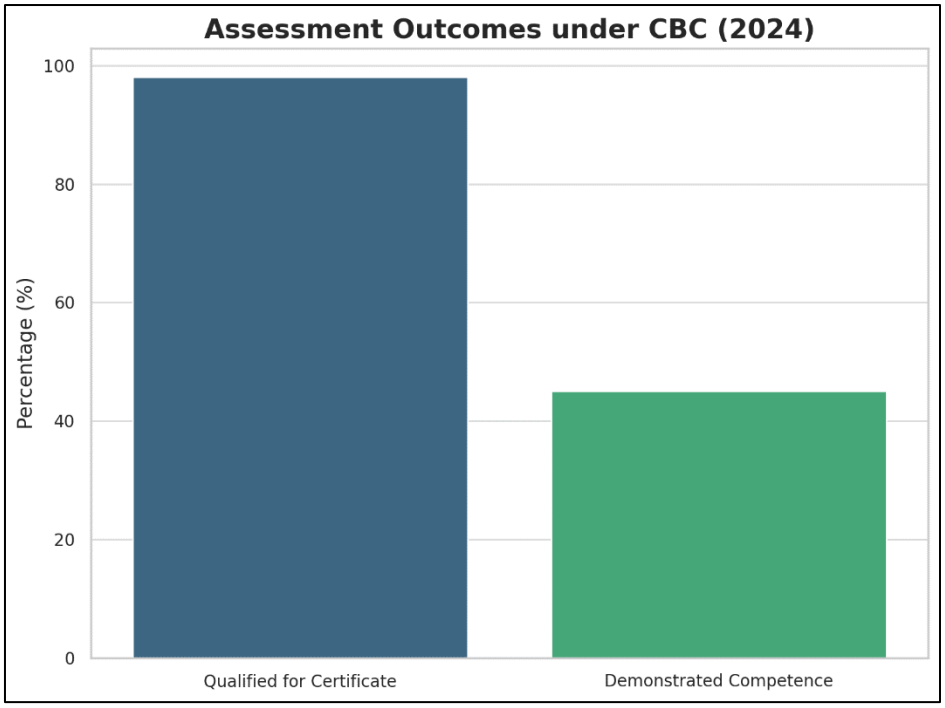

Figure 7 Assessment Outcomes under CBC (2024)

98.05% of students qualified for certificates, suggesting high pass rates. However, only about 45% demonstrated real competence, especially in science application and practical assessments. This implies a gap between formal certification and actual learning outcomes, likely due to weak integration of assessment reforms into everyday teaching. Certification rates are high, but they mask deep-seated competency gaps, especially in applying scientific knowledge practically.

5. Conclusion

This study set out to examine the learning outcomes in Biology, Chemistry, and Physics under Uganda's newly introduced Competence-Based Curriculum (CBC) in secondary education. Drawing from secondary data sources including UNEB reports, NCDC publications, Ministry of Education documents, and academic studies from 2020 to 2024 the findings reveal a complex picture of both progress and persistent challenges in science education. While the CBC represents a progressive shift toward practical skills, critical thinking, and learner-centered approaches, its implementation in science subjects has not yet achieved its full potential. Performance in Chemistry and Physics remains notably low, with the majority of students failing to meet basic proficiency levels. Though Biology shows marginal improvement, the broader pattern suggests that many learners are struggling to grasp scientific concepts and apply them effectively. A central concern is the weak acquisition of practical science skills, largely due to limited access to laboratories, equipment, and qualified science teachers. The high incidence of malpractice during practical exams further illustrates systemic issues undermining the integrity and effectiveness of competency-based assessments. Assessment reforms have introduced more holistic approaches to evaluating student performance, but these remain misaligned with classroom realities due to gaps in teacher preparedness and infrastructural support. However, stakeholder interventions including teacher salary enhancements, infrastructure upgrades, and professional development initiatives have shown promise. Notably, positive outcomes have been recorded in schools with adequate resources and trained personnel, affirming the potential of the CBC when appropriately supported.

Recommendations

To enhance the effectiveness of the Competence-Based Curriculum (CBC) in improving science education outcomes in Uganda, several key recommendations emerge from the findings of this study. First, it is essential to strengthen the professional development of science teachers. The Ministry of Education and Sports, in collaboration with the National Curriculum Development Centre (NCDC), should scale up in-service teacher training programs focused on competency-based pedagogy. These trainings should not only address curriculum content delivery but also emphasize hands-on teaching approaches, practical experimentation, and authentic assessment practices aligned with the CBC framework. Continuous professional development will empower teachers to shift from traditional content delivery methods to learner-centered, inquiry-based instruction.

Secondly, improving science infrastructure in schools is crucial. The practical nature of the CBC requires that schools have fully functional laboratories with sufficient equipment and materials. Many secondary schools, particularly in rural areas, lack these essential facilities, severely limiting students' ability to engage with the curriculum meaningfully. The government should initiate a nationwide program to refurbish and equip science laboratories in under-resourced schools, supported by targeted funding and partnerships with development agencies and the private sector.

Another important recommendation is the alignment of classroom instruction with assessment reforms. As UNEB transitions toward competency-based assessments, it is vital that classroom practices prepare learners to demonstrate the required skills and competencies. Teachers need training and support to develop and administer formative and summative assessments that mirror national examination standards under the CBC. This will help bridge the gap between curriculum expectations and learner performance.

Furthermore, there is a need for stronger monitoring and supervision mechanisms to support effective CBC implementation. District education offices and school inspectors should conduct regular visits to assess curriculum delivery, provide pedagogical support, and track progress in science teaching. This will ensure accountability and help identify challenges early for timely intervention.

Addressing examination malpractice is also critical, particularly in science practical assessments. The high incidence of malpractice, as noted in the 2024 UCE results, undermines the credibility of science education under the CBC. UNEB and school administrators must introduce stricter monitoring protocols during exams, train invigilators, and promote academic integrity through school-wide sensitization programs.

To reduce disparities in science education outcomes, the government should promote equity in resource distribution. This entails prioritizing support for underperforming and under-resourced schools through targeted recruitment of qualified science teachers, provision of science kits, and implementation of infrastructure improvement programs. Resource equity will help ensure that all learners, regardless of location or school type, benefit equally from CBC reforms.

Stakeholder engagement is another area requiring attention. Collaboration with organizations such as Innovation for Poverty Action (IPA), NGOs, and the private sector can bring innovative solutions and mobilize additional resources. Expanding successful pilot programs and using data to inform decisions will foster evidence-based improvements in science education.

Finally, the integration of information and communication technology (ICT) in science instruction should be expanded. In schools lacking adequate laboratory resources, digital tools and simulations can provide alternative means for students to experience practical science learning. The Ministry of Education should invest in ICT infrastructure, digital learning platforms, and teacher training in educational technology to support blended science instruction under the CBC.

5.1. What this Study Contributes

This study makes a significant contribution to research on educational reform in Uganda by critically reviewing the implementation and outcomes of the Competence-Based Curriculum (CBC) in secondary school science education. Using secondary data from the Uganda National Examinations Board (UNEB), National Curriculum Development Centre (NCDC), Ministry of Education and Sports (MoES), and academic studies, it synthesizes trends in student performance, practical skills, and challenges in Biology, Chemistry, and Physics. This fills a crucial gap by providing a comprehensive assessment of how CBC is reshaping science education outcomes.

The study highlights a major mismatch between CBC's curriculum goals and classroom realities. Limited access to well-equipped laboratories, inadequate teacher preparation, and widespread examination malpractice undermine the CBC's focus on hands-on learning and inquiry-based science. These findings support calls for targeted interventions to improve science education infrastructure and uphold assessment integrity.

Systemic barriers hindering CBC implementation in science subjects are also identified, including shortages of trained teachers skilled in competency-based methods, insufficient instructional materials, and resource disparities between urban and rural schools. The study underscores the need for teacher professional development, consistent policy, and curriculum support systems to fully realize CBC objectives.

Additionally, the research evaluates government and stakeholder efforts such as improved teacher pay and initiatives led by partners like Innovation for Poverty Action (IPA). While acknowledging progress, it critically examines the scope and sustainability of these interventions, offering a balanced view of successes and ongoing challenges to inform better policy decisions.

By focusing on equity and inclusion, the study stresses that CBC's success depends on bridging the urban-rural divide and ensuring fair resource distribution. Its practical recommendations provide a roadmap for educators, policymakers, and development partners aiming to enhance the quality and relevance of science education in Uganda.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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