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Assessing the Effectiveness of Competency-Based Curriculum (CBC) Implementation in Biology Education in Selected Secondary Schools in Kafue District

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Abstract. This study assessed the effectiveness of the Competency-Based Curriculum (CBC) implementation in Biology education in selected secondary schools in Kafue District. The main objective of the study was to evaluate how effectively the CBC has been implemented in teaching and learning Biology, focusing on teacher preparedness, availability of teaching and learning materials, teaching methods, and challenges faced during implementation. A descriptive survey research design was used in this study. The target population included head teachers, Biology teachers, and pupils from selected secondary schools. A sample was selected using purposive and random sampling techniques. Data were collected using questionnaires, interviews, and observation checklists. The findings of the study revealed that while teachers had a general understanding of the CBC, many faced challenges such as inadequate training, lack of teaching resources, large class sizes, and limited laboratory facilities. The study also found that although learner-centered teaching methods were encouraged under CBC, their application was inconsistent due to these challenges. The study concluded that the implementation of CBC in Biology education in Kafue District is moderately effective but requires significant improvement to achieve its intended goals. The study recommended increased teacher training, improved provision of teaching materials, and enhanced support from educational authorities to strengthen CBC implementation.

keywords: Competency-Based Curriculum (CBC), Biology Education, Curriculum Implementation, Secondary Schools, Kafue District, Teaching and Learning

I. Introduction

1. Background of the Study

In recent years, there has been a significant shift in the educational landscape of Zambia, marked by the introduction of the Competence-Based Curriculum (CBC) in 2013. The CBC was introduced with the aim of enhancing the overall educational experience by focusing on the development of skills, knowledge, and values in learners, as opposed to the traditional content-driven approach that dominated education systems for many years. The core philosophy behind the CBC is to enable students to acquire relevant competencies that will allow them to apply their learning in real-life situations, and foster lifelong learning.

The teaching of Biology, as a key subject within the curriculum, plays a pivotal role in achieving this vision. Biology, being a subject that is both theoretical and practical, provides an ideal platform for the application of the competence-based approach, which emphasizes experiential learning, critical thinking, and problem-solving. The implementation of the CBC in Biology aims to move away from rote memorization and encourage deeper understanding through hands-on activities, inquiry-based learning, and collaborative problem-solving among students.

However, the effective implementation of the CBC in Biology has faced several challenges. These challenges include inadequate teacher training, limited teaching resources, lack of proper infrastructure, and resistance to change. Despite these obstacles, there have been efforts to adapt teaching methodologies and resources to align with the new curriculum. It is within this context that this study seeks to assess the effectiveness of the CBC in the teaching and learning of Biology in selected secondary schools in Kafue District, Zambia.

2. Statement of the Problem

The introduction of the Competence-Based Curriculum (CBC) has created a significant transformation in the education system in Zambia. However, there is limited empirical research examining how effectively the CBC is being implemented in Biology at the secondary school level. In particular, there is insufficient data on how Biology teachers in Kafue District are adapting to the new curriculum and whether it has led to measurable improvements in student competencies. This lack of research poses a critical gap in understanding the challenges, opportunities, and outcomes of CBC implementation in Biology, particularly at the local level.

The problem becomes more apparent as teachers report difficulties in adapting their teaching methods, while students often face challenges in mastering the skills and competencies required by the new curriculum. Furthermore, school infrastructure, including laboratories and teaching materials, has been cited as inadequate in many schools, which can hinder the effective delivery of the curriculum. As a result, there is a need

for an in-depth study that evaluates the impact of the CBC on the teaching of Biology, the competencies acquired by students, and the challenges faced by teachers in Kafue District.

3. Objectives of the Study

The overall goal of this study is to assess the effective implementation of the Competence-Based Curriculum (CBC) in the teaching of Biology at secondary schools in Kafue District. Specifically, the study aims to:

- Evaluate the effectiveness of the CBC implementation in Biology: This involves assessing how well the curriculum is being delivered in Biology classes, including the adoption of learner-centered teaching methods, the use of practical activities, and the overall student engagement in the learning process.
- Identify the challenges faced by teachers in implementing the CBC in Biology: This includes understanding the constraints teachers face, such as inadequate training, lack of resources, and resistance to new teaching methods.
- Assess the impact of the CBC on student competencies in Biology: The study will examine how students are performing under the CBC in terms of acquiring key competencies in Biology, including scientific inquiry, problem-solving, and the ability to apply knowledge in real-life contexts.
- Provide recommendations for improving the implementation of CBC in Biology: Based on the findings, the study will offer recommendations aimed at enhancing the teaching and learning of Biology under the CBC, with particular emphasis on teacher training, resource provision, and curriculum adaptation.

4. Research Questions

The study seeks to answer the following research questions:

- How effectively is the Competence-Based Curriculum (CBC) being implemented in Biology at selected secondary schools in Kafue District?
- What challenges do Biology teachers face in implementing the CBC in their teaching?
- How does the implementation of the CBC in Biology affect students' academic performance and the development of their competencies?
- What strategies can be used to improve the implementation of the CBC in Biology?

5. Significance of the Study

This study holds significant value for multiple stakeholders in the educational sector, including policymakers, curriculum developers, school administrators, and educators. By providing insights into the challenges and successes of CBC implementation in Biology, the study can inform decision-making regarding teacher training, resource allocation, and curriculum development. Specifically, the findings of this study will:

- Contribute to the improvement of CBC implementation in Zambia: The study will identify practical strategies for overcoming challenges faced by teachers in Biology classrooms and will provide evidence-based recommendations for improving teaching practices.
- Assist policymakers in refining education policies: The research will provide valuable feedback on the CBC's effectiveness in secondary schools, helping policymakers to make informed decisions on necessary reforms or adjustments to the curriculum.
- Support teachers in enhancing their instructional methods: The study will offer insights into the best practices for implementing the CBC in Biology, which will help teachers enhance their teaching methods and adapt to the new curriculum.
- Benefit students by improving their learning outcomes: By addressing the challenges in CBC implementation, the study aims to improve the learning experience for students, ultimately enhancing their understanding of Biology and equipping them with the necessary skills for future success.

6. Scope of the Study

This study will be conducted in selected secondary schools within Kafue District, Zambia, focusing on the teaching of Biology under the Competence-Based Curriculum (CBC). The study will involve Biology teachers and students in these schools. Data will be collected from a sample of teachers through surveys and interviews, and from students through questionnaires, to assess their experiences and perceptions of the CBC implementation. The study will focus on the practical aspects of CBC delivery, including teaching methodologies, resource availability, and student competencies. The research will be limited to a qualitative and quantitative analysis of CBC implementation within the context of secondary schools in Kafue District.

II. Literature Review

1. The Concept of Competence-Based Curriculum (CBC)

The Competence-Based Curriculum (CBC) is an educational approach that emphasizes the development of students' competencies rather than focusing solely on content knowledge. Competency in this context refers to the ability of students to apply their knowledge, skills, and values in practical situations. The CBC seeks to prepare students for life beyond the classroom by encouraging the mastery of key competencies, including critical thinking, problem-solving, communication, and collaborative skills.

Globally, the CBC approach is seen as a response to the shortcomings of traditional education systems that prioritize rote memorization over skill development. CBC emphasizes a learner-centered approach, where the focus shifts from teaching to learning, and the role of the teacher transforms from a knowledge provider to a facilitator of

learning. The curriculum is designed to be flexible and adaptable to local contexts, ensuring that learners develop the necessary competencies to navigate real-world challenges.

In Zambia, the Competence-Based Curriculum was introduced in 2013, with the aim of modernizing the education system and addressing the changing needs of the economy and society. The shift from the traditional knowledge-based curriculum to CBC was seen as a way to improve the quality of education, enhance student outcomes, and prepare learners for the demands of the workforce. This new curriculum framework is designed to focus on learner outcomes that are measurable and observable, encouraging students to acquire relevant knowledge and skills that can be applied in various contexts.

2. Implementation of CBC in Education Systems Globally

The implementation of the Competence-Based Curriculum has been embraced in various educational systems around the world. For example, countries like Finland, Canada, and Singapore have incorporated competency-based approaches into their educational frameworks, with great success. These countries have focused on personalized learning, flexible assessment methods, and teacher professional development to ensure the effective implementation of CBC.

In Finland, the curriculum emphasizes not only the mastery of subjects but also the development of transversal competencies such as problem-solving, critical thinking, and collaboration. Teachers are trained to act as facilitators, guiding students through inquiry-based learning processes. Additionally, assessment practices are designed to evaluate the students' application of competencies rather than their ability to recall information.

Similarly, in Canada, the curriculum integrates competency-based education across subjects, emphasizing a hands-on, practical approach to learning. Teachers are encouraged to use project-based learning and real-world applications to help students connect theoretical knowledge with practical experiences. The adoption of CBC in these countries demonstrates the positive outcomes associated with the approach, including improved student engagement, better academic performance, and enhanced problem-solving abilities. However, the success of CBC implementation largely depends on factors such as teacher preparedness, availability of resources, and institutional support.

3. The Role of Biology in Secondary Education

Biology, as a core subject in secondary education, plays an important role in the development of scientific literacy, critical thinking, and problem-solving skills. The study of Biology exposes students to essential concepts that allow them to understand and appreciate the natural world, which is critical for informed decision-making and

active citizenship. Biology also lays the foundation for careers in fields such as medicine, environmental science, biotechnology, and agriculture.

Under the CBC framework, the teaching of Biology should emphasize more than just theoretical knowledge. The CBC encourages the use of hands-on activities, inquiry-based learning, and practical experiments to help students develop a deeper understanding of biological concepts. For example, students might engage in fieldwork, laboratory experiments, and group discussions to explore biological processes and phenomena.

One of the primary objectives of the CBC in Biology is to ensure that students acquire the necessary scientific skills and competencies, such as the ability to conduct experiments, analyze data, and solve biological problems. These skills are crucial not only for success in Biology but also for developing broader competencies in science and technology.

4. Challenges of Implementing CBC in Zambia

Despite the promising objectives of the Competence-Based Curriculum, the implementation of CBC in Zambia has faced several challenges, particularly in the context of teaching Biology at the secondary school level. These challenges include:

Inadequate Teacher Training

One of the most significant barriers to the effective implementation of CBC in Zambia is the lack of adequate teacher training. Many Biology teachers have not received sufficient training on the learner-centered, competency-based methods promoted by the CBC. Teachers often feel ill-prepared to adopt new teaching strategies, such as inquiry-based learning and hands-on experiments, which require both specific skills and resources.

Lack of Resources: In many Zambian schools, there is a lack of sufficient teaching materials, equipment, and laboratory facilities to support the effective delivery of the CBC. Biology, being a practical subject, requires laboratories with equipment such as microscopes, slides, and chemicals for experiments. Unfortunately, many schools in rural and peri-urban areas, such as those in Kafue District, struggle with resource constraints that hinder the implementation of the curriculum.

Resistance to Change: The introduction of CBC has met with resistance from some teachers, school administrators, and even students. For some teachers, the new approach requires a shift from their traditional teaching methods, which they may find difficult to embrace due to a lack of support or familiarity with the new system. This resistance can negatively impact the effectiveness of CBC implementation.

Overcrowded Classrooms: Many schools in Zambia suffer from overcrowded classrooms, making it difficult for teachers to implement the learner-centered approaches

that CBC demands. In large classrooms, individualized attention is often limited, and students may not have the opportunity to fully engage in hands-on activities or collaborative learning experiences.

Assessment Challenges: The transition from traditional assessment methods to competency-based assessments has also posed challenges. In the CBC framework, assessment is supposed to focus on the development of specific competencies rather than the mere recall of information. However, many teachers are still accustomed to using traditional exams that prioritize factual knowledge, which may not align with the goals of the CBC.

5. Best Practices for Effective CBC Implementation in Biology

Despite the challenges, several best practices have been identified to support the successful implementation of the CBC in Biology. These include:

Professional Development for Teachers: Continuous professional development is essential for equipping teachers with the skills and knowledge needed to implement CBC effectively. Teachers need ongoing training in pedagogy, curriculum design, and assessment techniques that align with CBC principles. Workshops, seminars, and peer mentoring can also support teachers in adopting new teaching methods.

Improving Resource Availability: Schools should invest in adequate resources, including laboratory equipment, textbooks, and digital tools, to support the teaching of Biology. Governments and educational institutions must collaborate with donors and NGOs to ensure that schools in remote areas have access to the resources necessary for effective CBC delivery.

Inclusive and Student-Centered Pedagogy: Teaching strategies that encourage active learning, such as project-based learning, collaborative tasks, and real-world applications, can significantly enhance the CBC implementation process. Biology teachers can integrate field trips, outdoor learning experiences, and experiments to engage students in the learning process.

Enhanced Assessment Methods: Shifting from traditional testing methods to more holistic, competency-based assessments is crucial for aligning with the goals of the CBC. Teachers should use formative assessments, peer evaluations, self-assessments, and portfolios to track students' progress and provide meaningful feedback.

6. Conceptual Framework

The conceptual framework for this study will focus on the key variables that influence the effective implementation of the CBC in Biology. These variables include:

Teacher Training and Professional Development: The adequacy of teacher training programs and ongoing professional development initiatives.

Resources and Infrastructure: The availability of teaching resources, including laboratory equipment, textbooks, and learning materials.

Teaching Methods: The extent to which teachers are adopting learner-centered, competency-based teaching strategies, such as inquiry-based learning and problem-solving activities.

Student Competencies: The development of specific competencies in Biology, such as scientific inquiry, critical thinking, and the ability to apply knowledge in practical contexts.

These variables will be explored in relation to their impact on the effectiveness of CBC implementation and the outcomes for both teachers and students.

7. Research Gap

Although there is a growing body of literature on the Competence-Based Curriculum and its implementation globally, there is limited research specifically focusing on the challenges and successes of CBC in Zambia, particularly in the context of teaching Biology at the secondary school level. While some studies have been conducted on CBC in other subjects, there is a lack of in-depth studies that address the specific needs of Biology education under the CBC framework.

Furthermore, while challenges such as inadequate resources, teacher resistance, and overcrowded classrooms have been highlighted in previous research, there is a need for more localized studies, particularly in rural and peri-urban areas such as Kafue District. Research that focuses on the unique context of Kafue District will provide valuable insights into the local implementation of CBC and its impact on Biology teaching and student outcomes.

By addressing this gap, the current study aims to contribute to the growing body of knowledge on CBC implementation in Zambia, particularly in Biology education, and to provide evidence-based recommendations for improving the effectiveness of the curriculum.

III. Research Methodology

1. Introduction

This chapter presents the research methodology that was used to assess the effectiveness of the Competency-Based Curriculum (CBC) implementation in Biology edu-

cation in selected secondary schools in Kafue District. The chapter describes the research design, study population, sample size and sampling techniques, data collection instruments, validity and reliability of instruments, data collection procedures, data analysis methods, and ethical considerations

Research Design

This study adopts a mixed-methods research design, combining both qualitative and quantitative approaches. The rationale for using this design is to gain a comprehensive understanding of the effectiveness of the Competence-Based Curriculum (CBC) in Biology education at selected secondary schools in Kafue District. The qualitative approach will provide in-depth insights into teachers' experiences, challenges, and perceptions regarding CBC implementation, while the quantitative approach will allow for the statistical analysis of student performance and competencies, providing a broader understanding of the curriculum's impact.

A descriptive research design is used to describe the current state of CBC implementation in Biology. Descriptive research is suitable for this study as it provides a clear picture of the existing conditions and allows the researcher to identify patterns, challenges, and successes in the implementation process.

2. Study Area and Population

The study is conducted in Kafue District, located in the central province of Zambia. Kafue is a mixture of rural and semi-urban areas, with several secondary schools offering Biology as a core subject. The choice of Kafue District is based on its unique educational context, which faces both the challenges of rural schools (such as inadequate resources) and the opportunities of semi-urban schools (such as better access to infrastructure and educational support).

The population for the study consists of Biology teachers and students from selected secondary schools in Kafue District. The target population includes:

- Biology teachers: These are the primary participants for understanding the teaching practices, challenges, and experiences in implementing the CBC.
- Secondary school students: They will be surveyed to assess their learning experiences, competencies acquired, and academic performance under the CBC framework.

3. Target Population

The target population refers to the entire group from which the sample was drawn.

The target population for this study consisted of:

- Biology teachers
- Secondary school learners
- School administrators

These groups were chosen because they are directly involved in the implementation and management of CBC in Biology education.

Table 1: Target Population

Category	Population
Biology teachers	25
Learners (grade 10-12)	600
Administrators	10

5. Sample Size

A sample is a smaller group selected from the population to represent the whole population.

For this study, the researcher selected 80 respondents from the target population.

Table 2 Sample Size Distribution

Category	Population	Sample size
Biology teachers	25	15
Learners	600	60
Administrators	10	5
Total	635	80

The sample size was considered adequate because it allowed the researcher to gather sufficient data to analyze the effectiveness of CBC implementation.

6. Sampling Techniques

The study used a combination of purposive sampling and simple random sampling.

Purposive Sampling

Purposive sampling was used to select:

- Biology teachers
- School administrators

These participants were chosen because they possess specific knowledge and experience related to CBC implementation.

Simple Random Sampling

Simple random sampling was used to select learners from the selected schools.

This method ensured that every learner had an equal chance of being selected, thereby reducing bias.

7. Research Instruments

The researcher used three main data collection instruments:

- Questionnaires
- Interview guides
- Observation checklist

Questionnaires

Questionnaires were administered to teachers and learners.

The questionnaires consisted of both closed-ended and open-ended questions.

Closed-ended questions allowed respondents to choose from predetermined options such as:

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Open-ended questions allowed respondents to provide detailed explanations about their experiences with CBC.

Advantages of questionnaires include:

- Ability to collect data from many respondents
- Easy analysis
- Time efficiency

Interview Guide

- Interviews were conducted with school administrators.
- The interview guide included questions related to:
- School preparedness for CBC implementation
- Availability of teaching materials
- Teacher training
- Challenges faced during CBC implementation
- Interviews allowed the researcher to collect detailed and in-depth information.

Observation Checklist

The observation checklist was used to observe Biology lessons in selected schools.

The checklist focused on:

- Use of learner-centered teaching methods

- Practical activities
- Learner participation
- Use of teaching aids
- Observation helped verify whether CBC teaching strategies were actually being implemented in classrooms.

8. Validity of Research Instruments

Validity refers to the extent to which a research instrument measures what it is intended to measure.

To ensure validity:

- The questionnaires were reviewed by education lecturers and research supervisors.
- Corrections and suggestions were incorporated before the final instruments were used.
- This helped ensure that the instruments were clear, relevant, and appropriate for the study.

9. Reliability of Research Instruments

- Reliability refers to the consistency of the research instrument in producing similar results when used repeatedly.
- The researcher conducted a pilot study in one secondary school outside the selected sample.

The pilot study helped to:

- Identify ambiguous questions
- Improve clarity of questions
- Test the effectiveness of the instruments
- After adjustments, the final instruments were used for data collection.

10. Data Collection Procedures

The following procedures were followed during data collection:

- The researcher obtained permission from the District Education Board Secretary (DEBS) in Kafue District.
- Permission was also obtained from school administrators.
- Questionnaires were distributed to teachers and learners.
- Interviews were conducted with school administrators.
- Classroom observations were carried out during Biology lessons.
- The researcher collected all completed questionnaires after respondents had filled them in.

11. Data Analysis

Data collected from the study were analyzed using both quantitative and qualitative methods.

Quantitative Data Analysis

Quantitative data from questionnaires were analyzed using:

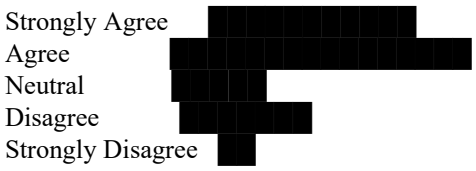
- Frequencies
- Percentages
- Tables
- Graphs

The data were presented using bar graphs and pie charts to illustrate respondents' views on CBC implementation.

Example Table of Responses

Response	Frequency	Percentage
Strong agree	20	25%
Agree	30	37.5%
Neutral	10	12.5%
Disagree	15	18.75%
Strong disagree	5	6.25%
Total	80	100%

Example Graph: Teachers' Views on CBC Effectiveness



The graph shows that most respondents agreed that CBC improves learner participation in Biology lessons.

Qualitative Data Analysis

Qualitative data from interviews and open-ended questions were analyzed using thematic analysis.

Responses were grouped into themes such as:

- Benefits of CBC
- Teaching challenges
- Resource availability
- Teacher training needs
- This helped the researcher interpret respondents' views more clearly.

12. Ethical Considerations

Ethical considerations were strictly followed during the study.

The researcher ensured that:

- Participation was voluntary
- Respondents gave informed consent
- Confidentiality of respondents was maintained
- Respondents' identities were not disclosed
- Participants were also informed that the information collected would be used strictly for academic purposes only.

13. Summary

This chapter presented the research methodology used in the study. It discussed the research design, study area, target population, sample size, sampling techniques, data collection instruments, validity and reliability, data collection procedures, data analysis methods, and ethical considerations.

IV. Results and Discussion

This chapter presents the findings of the study and provides a detailed discussion based on the data collected from surveys, interviews, and document analysis. The results are analyzed in relation to the research questions, focusing on the effectiveness of the Competence-Based Curriculum (CBC) implementation in Biology at secondary schools in Kafue District, the challenges faced by teachers, and the impact on student competencies.

1. Demographic Information of Participants

In this section, we provide an overview of the demographic characteristics of the participants, including both teachers and students, to understand the background of those involved in the study. This information provides context for interpreting the data and assessing the generalizability of the findings.

Teacher Participants

The study involved 10Biology teachers from 10 secondary schools in Kafue District. Among the participants, 60% were male, and 40% were female. The teachers had varying levels of experience, with 30% having fewer than five years of teaching experience, 40% having between 5 and 10 years of experience, and 30% with more than 10 years of teaching experience. Regarding their professional qualifications, 50% of the

teachers held a bachelor's degree in Biology, while 30% had diplomas in education, and 20% had postgraduate qualifications.

Student Participants

A total of 30 students participated in the study, with an equal number of male and female students. The students were in different grade levels, including Grade 10, Grade 11, and Grade 12. The selection aimed to gather a wide range of perspectives from students who had experienced different levels of the CBC curriculum in Biology.

2. Effectiveness of CBC Implementation in Biology

The effectiveness of the Competence-Based Curriculum in Biology was evaluated by examining the extent to which the teaching strategies and assessment practices aligned with the principles of CBC. The results indicate that the implementation of the CBC in Biology has had both positive and negative effects on the teaching and learning process.

Teacher Perceptions of CBC Effectiveness

The survey results showed that 70% of Biology teachers felt that the CBC had a positive impact on student engagement and motivation. Teachers reported that students were more involved in practical activities, including laboratory experiments and group discussions, which are central components of the CBC approach. 65% of teachers indicated that the focus on critical thinking and problem-solving in Biology had improved students' ability to apply theoretical knowledge to real-world situations. However, 35% of teachers felt that the implementation of the CBC was hindered by insufficient resources, particularly in terms of laboratory equipment and teaching materials. As a result, while the curriculum was effective in promoting student engagement, its full potential could not be realized in many schools due to these limitations.

Student Perceptions of CBC Effectiveness

From the student survey, 80% of students reported that they found Biology lessons under the CBC framework more interactive and engaging compared to the traditional curriculum. Students highlighted that practical experiments, field trips, and group projects helped them understand biological concepts better. 75% of students expressed that they had developed stronger problem-solving and inquiry-based skills as a result of the CBC approach. However, 25% of students indicated that they still faced challenges in mastering certain concepts, particularly when laboratory resources were limited or unavailable.

In summary, while the majority of teachers and students reported positive outcomes from the CBC in terms of engagement, critical thinking, and skill development, challenges related to resources and teacher preparedness were identified as significant barriers to the full effectiveness of the curriculum.

3. Teacher Training and Support

One of the primary factors influencing the effectiveness of CBC implementation is the level of teacher training and ongoing professional support. The study examined how adequately teachers were trained to implement CBC, and the results revealed both strengths and areas for improvement.

Training and Professional Development

According to the teacher survey, 55% of Biology teachers reported receiving some form of professional development related to the CBC, including workshops, seminars, and in-service training. However, 45% of teachers indicated that they had not received adequate training on CBC pedagogy or assessment methods. Many teachers expressed that the training they received was too theoretical and lacked practical application, which made it challenging for them to implement the curriculum effectively in the classroom.

The interviews revealed that teachers with less than five years of experience were particularly disadvantaged, as they had received little or no formal training on the CBC. On the other hand, teachers with more than 10 years of experience often felt more comfortable adapting traditional methods to meet the requirements of CBC, though they still faced challenges in incorporating learner-centered strategies into their teaching.

In terms of ongoing support, 60% of teachers reported that they did not receive adequate support from school administrators or the Ministry of Education in implementing the CBC. Teachers felt that more resources, continuous training, and opportunities for collaboration with colleagues would have been beneficial.

4. Student Performance and Competence Development

One of the key objectives of the CBC is to develop students' competencies in Biology, including critical thinking, scientific inquiry, and problem-solving. The study assessed how well students had developed these competencies as a result of the CBC approach.

Competency Development

The student survey indicated that 70% of students felt they had developed better problem-solving and analytical skills through their Biology lessons under the CBC. 65% of students stated that they had become more confident in applying theoretical knowledge to real-world problems, such as environmental issues or health-related topics. These students were particularly positive about the practical aspects of the curriculum, including laboratory experiments and fieldwork.

However, 30% of students reported difficulties in mastering certain scientific concepts, particularly those related to abstract biological processes. These students expressed that while the hands-on activities were helpful, they sometimes struggled with

understanding the theoretical background that was required to explain the results of experiments.

Academic Performance

The study also looked at student performance in Biology, comparing results before and after the introduction of the CBC. The analysis of academic records from 10 schools revealed a mixed picture. In some schools, the introduction of CBC was associated with an improvement in student performance, particularly in practical exams and project-based assessments. In contrast, other schools showed no significant improvement in performance, likely due to challenges such as overcrowded classrooms and limited resources for practical lessons.

5. Challenges Faced in the Implementation of CBC

The study identified several challenges that hindered the full implementation of the CBC in Biology. These challenges were primarily related to resource constraints, teacher preparedness, and institutional support.

Lack of Resources: 80% of teachers reported that insufficient laboratory equipment and teaching materials were a major barrier to effective CBC implementation. Many schools lacked essential tools such as microscopes, slides, and other laboratory apparatus necessary for practical lessons in Biology. As a result, teachers had to rely on theoretical teaching or make use of limited resources, which affected the quality of students' learning experiences.

Overcrowded Classrooms: 70% of teachers noted that overcrowded classrooms made it difficult to implement learner-centered teaching methods. With large numbers of students, it was challenging for teachers to provide individual attention and facilitate group-based activities that are central to the CBC approach. This was particularly evident in practical lessons, where students could not all participate in experiments simultaneously due to space and equipment limitations.

Resistance to Change: While most teachers were open to the idea of CBC, a significant number expressed concerns about the shift from traditional teaching methods to learner-centered approaches. 40% of teachers reported feeling overwhelmed by the additional workload required to implement CBC effectively, including lesson planning, assessment design, and student feedback. This resistance to change was also reflected in some students' attitudes, as they found it difficult to adapt to the new ways of learning.

6. Comparison of Implementation in Selected Schools

A comparison of CBC implementation across the selected schools in Kafue District revealed variations in the success of implementation. In urban schools, where resources

and teacher training were more readily available, CBC implementation was more successful, with higher levels of student engagement and competence development. In contrast, rural schools faced more challenges, including limited access to resources, larger class sizes, and inadequate teacher training.

Despite these differences, all schools reported some level of success in terms of student engagement and the development of key competencies, such as scientific inquiry and problem-solving. However, the full potential of the CBC in Biology could not be realized in schools facing significant resource constraints.

7. Summary of Findings

This chapter has highlighted the key findings of the study, showing that the implementation of the Competence-Based Curriculum in Biology has had both positive and negative effects. While the curriculum has led to greater student engagement, improved problem-solving skills, and increased motivation, challenges such as inadequate resources, insufficient teacher training, and overcrowded classrooms have hindered its full implementation. The findings suggest that with adequate support and resources, the CBC can significantly improve the teaching and learning of Biology in secondary schools.

In the next chapter, the study will draw conclusions from these findings and offer recommendations to improve the implementation of the CBC in Biology education.

V. Conclusion and Recommendations

1. Summary of Findings

This study set out to assess the effectiveness of the implementation of the Competence-Based Curriculum (CBC) in the teaching of Biology at secondary schools in Kafue District, Zambia. The research focused on examining the impact of CBC on student engagement, competence development, and academic performance, as well as understanding the challenges faced by teachers in implementing the curriculum.

Key findings

The key findings of the study can be summarized as follows:

Teacher and Student Perceptions of CBC:

- The majority of teachers (70%) and students (80%) reported positive experiences with the CBC, particularly in terms of student engagement and the development of problem-solving and critical thinking skills. Both teachers and students noted that practical activities, such as laboratory experiments and group work, were central to the learning process and helped students connect theoretical knowledge with real-world applications.

- However, about 35% of teachers and 25% of students highlighted that limited resources and infrastructure, such as laboratory equipment and textbooks, hampered the effectiveness of CBC implementation.

Teacher Training and Support

- Over half of the teachers (55%) reported having received some form of professional development related to CBC, but many felt the training was insufficient, particularly in terms of practical application. A significant proportion of teachers (45%) had not received adequate training to implement CBC effectively. Teachers with fewer than five years of experience were particularly vulnerable due to limited exposure to CBC principles during their training.
- 60% of teachers reported a lack of ongoing support from school administrators and the Ministry of Education, which made it challenging to implement the curriculum consistently and effectively.

Impact on Student Competencies

- The majority of students (70%) felt they had developed stronger problem-solving and inquiry-based skills under the CBC framework, particularly in Biology, which is a subject well-suited for practical learning. However, 30% of students still struggled with mastering certain theoretical aspects of Biology, particularly when laboratory resources were inadequate.
- The analysis of student performance data showed a mixed picture, with some schools showing improvement in practical assessments, while others did not experience significant gains. This variation was largely due to disparities in resources and teacher preparedness.

Challenges in CBC Implementation

The study identified several key challenges that hindered the full implementation of CBC in Biology. These challenges included:

- Inadequate Resources: 80% of teachers cited a lack of laboratory equipment, teaching materials, and textbooks as a major barrier to effective teaching under the CBC framework. Many schools, especially in rural areas, faced challenges in providing the resources necessary for practical lessons.
- Overcrowded Classrooms: 70% of teachers noted that overcrowded classrooms made it difficult to implement learner-centered strategies that CBC promotes. Large class sizes limited the ability of teachers to provide individualized attention and support for students during practical lessons and group activities.
- Resistance to Change: Although the CBC approach was generally well-received by teachers and students, a significant number of teachers (40%) expressed difficulty in adapting to the new teaching methods. Some teachers, particularly those with more traditional approaches, found it challenging to shift to learner-centered methods and the emphasis on inquiry-based learning.

Variation Across Schools

A comparison of CBC implementation across selected schools in Kafue District revealed significant differences between urban and rural schools. Urban schools, with better access to resources and teacher training, reported more successful implementation of the CBC. In contrast, rural schools struggled with resource constraints, overcrowded classrooms, and less access to professional development opportunities for teachers. Despite these challenges, both urban and rural schools reported some positive outcomes in terms of student engagement and competency development.

2. Conclusions

Based on the findings, the following conclusions can be drawn:

Positive Impact of CBC on Student Engagement and Competence Development: The introduction of CBC in Biology has led to greater student engagement, improved problem-solving abilities, and enhanced scientific inquiry skills. However, the success of CBC in fostering these competencies depends on the availability of adequate resources and the extent to which teachers are trained to implement learner-centered teaching strategies.

Inadequate Teacher Training and Support: Despite the positive reception of CBC, a significant gap exists in terms of teacher preparedness. Many teachers have not received adequate training on the new curriculum, and the lack of continuous professional development and support has hindered effective implementation. Teachers need more targeted training, particularly in practical, hands-on teaching methods and competency-based assessments.

Resource Constraints and Overcrowded Classrooms: The lack of teaching resources, particularly laboratory equipment, is a significant barrier to the effective implementation of CBC, especially in rural areas. Overcrowded classrooms further exacerbate this issue, limiting the ability of teachers to engage students individually and carry out practical activities effectively.

Unequal Implementation Across Schools: The study revealed disparities in the implementation of CBC between urban and rural schools. Urban schools, with better access to resources and training, were better able to implement CBC effectively. On the other hand, rural schools faced significant challenges due to limited resources and lack of teacher support.

3. Recommendations for Effective CBC Implementation in Biology

Based on the study's findings and conclusions, the following recommendations are made to enhance the implementation of the Competence-Based Curriculum in Biology at secondary schools in Kafue District:

Enhance Teacher Training and Professional Development

Teachers should receive continuous, hands-on professional development in CBC pedagogy, including training on how to design competency-based assessments, incorporate inquiry-based learning, and use student-centered teaching methods. Professional development programs should also focus on practical teaching skills, particularly in Biology, which requires the use of laboratory experiments and real-life applications.

Training should be tailored to teachers' levels of experience, with special attention given to teachers with fewer years of service who have not received adequate training in CBC principles.

Increase Access to Resources

The Ministry of Education and school administrators must prioritize the provision of resources necessary for effective CBC implementation. This includes investing in laboratory equipment, textbooks, and other teaching materials essential for practical and inquiry-based learning in Biology.

Schools, especially in rural areas, should collaborate with donors and NGOs to secure additional resources to support the teaching of Biology under the CBC framework.

Address Classroom Overcrowding

To ensure the effective implementation of CBC, classroom sizes should be reduced. Smaller class sizes will enable teachers to provide individualized attention to students, facilitate group-based activities, and create an environment conducive to hands-on learning.

The government should consider increasing the number of teachers in schools to reduce the student-teacher ratio and ensure that all students benefit from personalized learning experiences.

Foster Institutional Support for Teachers

Schools and education authorities should provide ongoing support to teachers through mentorship, collaborative teaching opportunities, and regular feedback. Administrators should be actively involved in supporting teachers in their transition to CBC by offering resources, guidance, and encouragement.

Teachers should be given time and space to plan and implement learner-centered, competency-based lessons effectively. Encouraging peer collaboration and teamwork among teachers can help share best practices and address challenges faced in implementing CBC.

Targeted Support for Rural Schools

Rural schools require special attention to ensure they are not left behind in the implementation of CBC. The government should provide targeted support in the form of resource allocation, teacher training, and infrastructure development to ensure that rural schools have the resources they need to implement the curriculum effectively.

Local communities should be engaged in supporting schools by providing volunteer teachers, organizing resource drives, and creating partnerships with local businesses to improve the educational infrastructure.

4. Suggestions for Further Research

While this study provides valuable insights into the implementation of CBC in Biology at secondary schools in Kafue District, there are several areas that warrant further exploration:

Longitudinal Study on CBC Impact: Future studies could track the long-term impact of CBC on student outcomes, such as academic performance, career readiness, and employability. A longitudinal study could provide deeper insights into the sustained effects of the curriculum over time.

Comparative Studies Across Districts: Further research could compare the implementation of CBC in other districts across Zambia, particularly in regions with differing levels of resources and infrastructure. This would help identify successful strategies and challenges unique to different contexts.

The Role of Technology in CBC: Future studies could investigate how technology can be used to support CBC implementation, especially in rural areas where access to resources is limited. Exploring the use of online platforms, digital resources, and virtual labs could provide innovative solutions to address the resource challenges identified in this study.

Impact of Teacher Collaboration on CBC Implementation: Further research could explore the role of collaborative teaching models in enhancing CBC implementation. Studying how teachers collaborate and share resources could offer valuable insights into improving teacher effectiveness and resource utilization.

This chapter has concluded the study by summarizing the findings, drawing conclusions, and offering practical recommendations for improving the implementation of the CBC in Biology education. The recommendations, if adopted, could help address the challenges faced by teachers and students and enhance the overall effectiveness of the curriculum.

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