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Switching from Knowledge to Competence-Based Teachings: Biology Teachers' Attitudes and Instructional Practices

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Abstract: The study investigated the attitudes of Biology teachers towards the Biology Competence-Based Curriculum (BCBC) and their instructional practices at the lower secondary school level in Nyamagabe district, Rwanda. A descriptive survey design was adopted. Also, a purposive sampling technique was used to select 26 (16 male and 10 female) teachers of Biology. Data were collected using a questionnaire addressed to Biology teachers in selected schools and analyzed and presented in terms of frequencies, percentages, mean, and standard deviation. A one-way ANOVA was employed in the hypothesis testing. The findings indicated that these teachers had positive attitudes towards the implementation of BCBC. As for female ones, they had more positive attitudes towards BCBC implementation than the male ones. Considering those from boarding schools, they had a more positive attitude than the ones from day schools. Additionally, teachers with less teaching experience had more favorable attitudes than those with long experience. Teachers' age did not have any effect on their attitudes. The study also revealed that teachers of Biology rarely applied competence-based approaches in their teaching and assessment processes of students' learning. It was inferred that the usage of CBC approaches differed significantly among teachers from boarding and day schools. The usage of CBC assessment methods did not differ significantly among teachers. From the findings, it was concluded that CBC seems not to be effectively implemented in the lower secondary schools under the study. Consequently, a recommendation was made to facilitate Biology teachers in schools with in-service training for professional development.

Keywords: *Biology teachers, competence-based teaching, competence, curriculum implementation, teaching approach.*

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Introduction

Following independence, many African counties inherited a colonial education system which needed to be adjusted to meet the requirements of the country's sociological and cultural diversity (Ruth & Ramadas, 2019). To this effect, most of them adopted the knowledge-based curriculum (KBC). Later, the KBC failed to satisfy the needs of these countries as its output was overly academic and lacked the skills and knowledge that modern workplaces demand (Mbarushimana & Allida, 2017; Ruth & Ramadas, 2019). Consequently, like other counties, Rwanda opted to choose a Competency-Based Curriculum (CBC), which emerges as a global trend in providing skills that align with employers' needs (Rwanda Education Board [REB], 2015; Tabaro, 2018). The aim was to guarantee learners being equipped with appropriate competences allowing them to integrate into society and exploit diverse employment opportunities at both national and global markets (REB, 2015).

In this above perspective, the CBC was launched in Rwanda since 2016 at all levels of general education schools. The development and the knowledge application achieved, skills, attitudes, abilities, and morals in practical contexts constitute the central focus of CBC. Learners should actively participate in the learning process to develop knowledge (REB, 2015). Besides, the acquisition, development, demonstration, and accomplishment of competences, serve as the foundation for learners' progression. Teachers now serve as facilitators, coaches, and guides in the cognitive process (Ruth & Ramadas, 2019; Tabaro, 2018).

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By adopting CBC, the main focus is building both basic and generic competences and addressing cross-cutting issues in the teaching and learning process (Tabaro, 2018). The basic competences include reading ability, expertise, citizenship plus a sense of belonging to a nation, being able to communicate in the languages officially recognized, free enterprise, and being capable to develop business. A point to note is that the CBC strongly emphasizes generic competencies, grouping transferable skills like inventiveness and innovation, being able to think critically, and even solving problems (Ndiokubwayo & Habiyaremye, 2018; REB, 2015). The other interconnected issues include studies on genocide, gender, and environment and how they can be sustained, without forgetting peace values and sexuality. It is also necessary to enhance finance and standardize cultural education (REB, 2015).

Although there is a close connection between basic and generic competences to innovation as well as learning of skills in the 21st century (Bellanca & Brandt, 2010), the interrelationship does not focus on one particular subject, but a number of them, which are the same as the curriculum based on outcomes (Kumar et al., 2022). Hence, the main purpose of the CBC is to enable learners to acquire knowledge as well as skills and to apply them in solving practical problems in their daily life experiences (Mulenga & Kabombwe, 2019). Therefore, it emphasizes knowledge acquisition and application.

Likewise, the CBC emphasizes principles of competence and learner-centeredness. Particularly, the CBC of Science focuses on societal challenges related to science as well as useful activities that can offer solutions to numerous issues that contemporary society faces. Students have to be exposed to scientific theories and phenomena to pick interest in becoming future scientists (REB, 2015). This may help the nation become a knowledge-based one hence enabling job creation thus reducing unemployment. Therefore, for it to succeed, requires a learning atmosphere that enables students to be resourceful and come up with solutions to different problems. To this effect, they become problem-solvers in society after getting their academic qualifications (T. Nsengimana et al., 2021).

To achieve the CBC demands, teachers ought to adopt learner-centered approaches which promote the development of learners' competences, by using activity-based interactive approaches and leave behind the traditional teaching approach and assessment. These can be in the form of oral questions, plays, assignments, field visits, projects, debates, discussions, tests, quizzes, group work, paired activities, individual work, investigations, problem-solving practical work, and presentations among others (REB, 2015). Moreover, the CBC implementation demands that collaborative learning should be used by learners to develop talents, information acquaintance, attitudes, and values (Ndiokubwayo & Habiyaremye, 2018).

Besides, the assessment practices are to focus on the students developed competences but not on the mastery of the concepts. Therefore, assessment must be carried out using authentic assessment methods such as oral presentations, assessments by peers, projects, portfolio, interviews, conferences, and classroom or field observations (REB, 2015). These types of assessments are more preferred by CBC than other forms because they involve learners in demonstrating the competencies mastered in real life (Mulenga & Kabombwe, 2019). In this regard, teachers are required to change from non-referenced to criterion-referenced judgments of learners' competences. At the same time, teachers are also required to provide continuous assessments timely and provide constructive feedback to inform learners about the strength and weaknesses of their performance (REB, 2015). Hence, CBC emphasizes the application of knowledge by helping learners to have the ability to use it appropriately, grasp concepts, skills, and principles needed in solving problems encountered in their daily life situations.

For successful implementation of CBC, the required training was put in place for teachers to be able to use the new curriculum. They were trained using a cascade strategy, with 300 of them trained in every district to encompass all schools across every district. This involved 100 teacher trainers for the whole country, and 3,000 master ones for the districts. In addition to that, 29,000 leaders of subjects from all schools were trained to teach the additional subjects included in the revised curriculum (REB, 2015). The purpose behind this was to get the teachers used to the CBC, and prepare them in mastering its new concepts and topics by showing them how to design and put into practice the CBC at the school level. Besides, the training intended to prepare teachers in the correct usage of classroom learning instructional approaches as well as the skills of how to develop learners' competencies. It would enable teachers to find solutions for students facing challenges in learning and the general problems involved in the process of classroom instructions (REB, 2015).

Despite the above-mentioned CBC requirements and interventions, studies on the implementation of CBC indicate that a lot is needed for teachers' improvement and adjustment. For instance, in the study by Nsengimana (2021), and Ukobizaba et al. (2020) it was revealed that teachers still need to implement learner-centered methods to enhance learners' abilities to solve problems, be innovative and creative. Moreover, Ndiokubwayo and Murasira (2019), Ndiokubwayo et al. (2020) showed lack of it if not inadequacy in teaching improvement although trainings and workshops about the implementation of CBC have been offered by the REB and other development partners (DPs). Besides, according to Byusa et al. (2020), the majority of science teachers still promote the old teaching practices such as the lecturing and the talk and chalk methods which are teacher-centered approaches. Moreover, the joint REB and Japan International Cooperation Agency (JICA) research noted with concern the teachers' lack of confidence in implementing CBC efficiently (REB, 2017).

Based on the above premises, one wonders why teachers are reluctant to comply with the CBC requirements like the learner-centered and assessment methods. In this regard, it was necessary to conduct a study on the teachers' attitudes

towards the implementation of CBC and their instructional practices among lower public secondary schools in Nyamagabe district of Rwanda taking Biology teachers as a case study. The purpose was to empirically assess the teachers' experiences and voices in implementing the CBC.

It is expected that investigating Biology teachers' attitudes towards the CBC in general and Biology Competence –Based Curriculum, particularly will help not only to highlight some of its aspects but also the teachers' instructional practices in its implementation process. Besides, knowing teachers' attitudes towards CBC may provide policymakers, curriculum designers as well as CBC trainers with the kind of correct methods to enable teachers directly implement the curriculum properly. Moreover, clear recommendations on necessary adjustments in further curriculum implementation will be made. Considering the discussion above, these were the principal research questions that guided this work:

- (1) What is the level of attitudes towards a Competence-Based Curriculum for teachers of Biology at lower secondary schools?
- (2) How far do teachers use competence-based teaching approaches in the learning process of Biology?
- (3) How far do teachers use competency-based assessment methods in Biology at lower secondary schools?

Literature Review

An Overview of Biology Competence-Based Curriculum Syllabus

Since 2016, the government of Rwanda introduced the Competence–Based Curriculum and left out the Knowledge-Based Curriculum (KBC). The purpose was to produce individuals with critical and creative thinking skills who could support themselves and compete successfully in the job market. The KBC was left behind because it was observed that it does not sufficiently reflect the necessary talents that the contemporary society and the market for employment need. Besides, it prioritizes information acquisition over talents, attitudes, and morals (REB, 2015).

By recognizing the value of CBC, the Government of Rwanda through its partners in education reviewed school curricula at all levels of basic education. In this regard, the Science curricula including Biology were also reviewed. The primary goal of the Biology curriculum review was to make sure that the content is appropriate for the learner's needs (REB, 2015). The emphasis was laid on building talents and capabilities as well as restructuring consistency within the prevailing material by benchmarking with other syllabuses elsewhere that are exemplary (T. Nsengimana et al., 2021).

The Biology Competence-Based Curriculum (BCBC), which is the outcome of the review's rearrangement of the existing contents and addition of new courses was created (Bizimana et al., 2022; REB, 2015). As review results, the BCBC was reorganized into eight Topic Areas including the following: organization and life maintenance, biodiversity and grouping, ecology and management, reproduction, health and disease, genetics and its uses, selection and evolution. Topic Areas are arranged into Sub-topics ones. Then, Sub-topics' areas are in turn arranged into 52 Units. In senior one, there are 14, while in senior two there are 16. As for senior three, there are 22. Furthermore, each unit has a given number of lessons associated with it plus a Key Unit Competence whose realization is a result of both the learners and the teachers who are involved. Also, every unit has content showing how far a teacher should teach and learners should follow within stated learning objectives. It indicates learning activities that are expected to engage learners actively and interactively as much as possible. Furthermore, each component is connected to other topics, in terms of its evaluation process during teaching and learning (Bizimana et al., 2022).

All along the review exercise, several topics from the previous curriculum were retained, and are now being redirected and reworked so that their value and importance are emphasized. Take for example, the topic of living things which formerly formed an autonomous unit is now infused into biodiversity and classification with two sub-topics (i.e., Biodiversity and classification of living things). The New topics that have been introduced include, amongst others, Ecology and conservation, gene technology, and selection and evolution for senior secondary three Students (Bizimana et al., 2022; REB, 2015).

Changes in how teachers teach and how students learn were imposed by the change in the curriculum. For instance, the CBC adopted learner-centered pedagogy, formative and authentic assessment methodologies, and prioritized competency development and knowledge application in practical contexts (Ndiokubwayo et al., 2020; REB, 2015). The main component of CBC, and consequently of BCBC, is that the learner must be actively involved in all aspects of acquiring the knowledge, skills, and professional behaviors. Equally, the same is required to demonstrate practice in a particular discipline. It is also essential to have a clear definition of the learning outcomes that must be shown in order to fulfill the professional role, one that is supported by evidence (REB, 2015). The observation here is that, in learning Biology, learners have to carry out experiments, go out in the field, are expected make study tours, work in groups, and at times individually, as well as doing work projects to boost acquisition of this subject.

The Teacher and the Competence-Based Curriculum Management

Moodley (2013), maintains that a teacher is important while dealing with education change, plus the theories of change that overlook an individual field that may not attain its objectives. Likewise, Smit (2001) stated that policy changes could not achieve the effect desired if they were not complemented with a process supporting the role reinforcement of teachers. According to Zheng and Borg (2014), for a competence-based curriculum to be accurately put into practice, teachers should follow instructions and guidelines given by the curriculum developers that are appropriate for competence-based strategies. For the strategies to succeed teachers need to be competent enough to let their learners participate in the learning process. This is because the former play a more significant role in curriculum implementation than the latter (Botha & Reddy, 2011). To provide focused products, teachers must also be experts in their particular fields (Moodley, 2013).

As the end users of the curriculum, teachers must be well informed of the curriculum objectives. Short of that, the implementation of a curriculum may be difficult (Mwanza, 2017). Consequently, teachers need to be aware of the theoretical sustenance of a curriculum to handle it well. Concurring with this view, Okechi and Asiachi (1992) agreed that teachers should handle the curriculum appropriately to ensure learners get the maximum benefit out of it. Additionally, Mwanza (2017) maintained that developers of the curriculum ought to get acquainted with the issues end-users face to create appropriate measures during revision. These studies indicate that teachers' full understanding of the CBC for its fruitful implementation is vital in the execution stage. Moreover, Komba and Mwandangi (2015), Mulenga and Kabombwe (2019) emphasize that in order to effectively and successfully implement the CBC in the classroom, teachers must possess the knowledge, abilities, and desirable attitudes necessary to teach utilizing the competency-based approaches appropriately.

The Nature of Curriculum Implementation

Several studies carried out have tried to explain the nature of curriculum implementation. According to Ornstein and Hunkins (2017), this exercise demands adjusting personal habits, behavior, program weights, learning periods, and existing prospectuses as well as schedules. Newton and Tarrant (1992) came up with two types of changes. These include reactive and proactive changes. Reactive change implies that those involved in school activities are applying the change to answer the demand from high educational offices if not the government. Given such a situation, the decision to implement a change is taken by administrators. When there is pressure to implement decisions, there is a tendency to abide by the directives or act in a given way. In contrast, practical change encompasses dynamically trying to create adjustments in the workplace and its culture.

Fullan (2015) maintained that change takes place in practice following three components for it to have a possibility of affecting the outcomes. They include newly reviewed resources, new instruction methods, and changes of opinions. The same scholar argued that all three components should be used practically to get positive results. However, the last component presents a bigger difficulty since it is connected with unspecified expectations of individuals about education, and changing their mindset is not easy. This implies that if teachers never comprehend why they are applying the new curriculum, the modification will be fake.

Considering teachers as crucial in change implementation, Sparkes (1990) argued that they should be exposed to the three levels of change. The first involves the learning of teaching aids (e.g. textbooks), without forgetting instructional assets and curriculum packages. The next one comes as a result of teachers upgrading their teaching abilities and methods, styles, and approaches. The final level includes the change in teachers' beliefs, values, and understandings. This scholar argued that once all the above-mentioned levels are not achieved, simply a shallow change takes place.

The successful implementation of the curriculum depends on several factors which should be taken into account by anyone trying to introduce any innovation in the educational context. These factors include among others the renewed learning materials, the application of innovative teaching abilities and strategies, and teachers' positive perception of syllabus change (Lynch, 2014). According to Lynch, all of these factors should be put into practice for change to be real and proactive. It is also crystal clear that change in the syllabus implementation happens as long as it occurs in class. This implies that the teacher's attitude is an important factor in the execution of the change. To this effect, there is a need for their attitudes to change. This is in line with Levitt (2002) who contended that if teachers' positions are incompatible with change, they are likely to be resistant to that change. Therefore, teachers' attitude has a significant effect on the implementation of a curriculum.

Implementation of Competence Based Curriculum and Teacher's Attitude

Various studies (Ngeno et al., 2021; V. Nsengimana et al., 2021; Ruth & Ramadas, 2019) indicated the fact that teachers' attitudes must be considered for the successful implementation of any educational program. According to the authors, because most teachers are accustomed to particular pedagogical practices, they are unwilling to accept new ones. They continued by stating that these teachers would rather stick to what they know than try anything new or make adjustments in their approach. This is also supported by Lynch (2014) who stated that the adoption of the competency-based curriculum is strongly correlated with the teacher's mindset, as the more productive teachers are those who

execute the CBC in the most efficient ways. Other researchers such as Ngeno et al.(2021), Waigera et al.(2020) found in their studies that teachers' attitudes influence the implementation of the CBC. They all came to the conclusion that the more optimistic teachers are, the more successful the CBC will be implemented. Therefore, any change in the curriculum and its practice is successful with the wholehearted cooperation of the teachers, who are supposed to implement the changes at the grass root level. Hence, the teachers' attitude and perception concerning the curriculum and its implementation is very significant.

Attitude refers to one's tendency to respond positively or negatively to something, a situation, or a person (Oghenevwe, 2019). It is also a person's predisposition to prefer something depending on their beliefs (Hacieminoglu, 2016). The negative or positive reaction will affect how one will deal with the object, situation, or person. Ngeno et al. (2021) maintained that student's learning is affected by the attitude and motivation of the teacher. They added that the teachers' attitude greatly affects the application of a given curriculum.

Scholars have come up with a lot of literature concerning teachers' attitudes and beliefs about curriculum implementation. Ornstein and Hunkins (2017) argue that the mindsets and personalities must change for them to implement the required change regarding curricula and their creation and delivery. This is supported by Fullan (2015) who asserted that as teaching is an ethical profession, teachers need to change their attitudes to accept new practices and apply them successfully. Thus, recognizing their role in curriculum implementation, there is a need to explore the attitudes of those handling Biology towards the BCBC and the extent to which they implement the curriculum in terms of teaching and assessment strategies among lower secondary schools in Nyamagabe district of Rwanda.

Methodology

Research Design

This study used a survey design that was descriptive and involved the investigation of Biology teachers' attitudes towards the implementation of lower Biology CBC. This research design proved useful because of the detailed information it provides. Besides, it was suitable as it allowed the use of several tools like questionnaires (Creswell, 2014).

Sample and Data Collection

The study used primary data collected from 26 Biology teachers at lower secondary schools from boarding and day public and subsidized institutions in the district of Nyamagabe, Rwanda. Also, sampling was purposively done to select only teachers from public boarding and day secondary schools who teach Biology at the lower secondary school level in the 2022 school academic year. The inclusion criteria were teachers with Biology experience of roughly seven years. The explanation is that those teachers have experienced in both KBC and CBC implementation.

Table 1. Demographic Characteristics of the Study Participants

Demographic characteristics	Variables	Frequency	Percentage
Gender	Male	16	61.5
	Female	10	38.5
Age	Below 35	7	26.9
	36-40	7	26.9
	Above 41	12	46.1
Teaching experience	7-10	14	53.8
	11-15	6	23.1
	Above 16	6	23.1
Type of school	Boarding	12	46.2
	Day	14	53.8

Table 1 shows the details of the demographic characteristics of the research sample. In the same Table, the sample was dominated by male respondents (61.5%) compared to 38.5% of females. Regarding age, the majority of respondents had more than 36 years old (68.0%) while the majority of the respondents (53.8%) had taught Biology between 7 and 10 years.

Biology Competency Based Curriculum in secondary schools was incepted in 2016 which implies that, up to now, it has been implemented for 7 years. Therefore, most of the teachers who were involved in the study had experience in implementing both the Biology Knowledge-Based Curriculum (BKBC) and BCBC. Thus, the study participants were experienced enough to share data related to the implementation of BCBC in lower secondary schools.

Teachers from both day and boarding schools in Nyamagabe district participated in this study. Table 1. Indicates that most of Biology teachers were from day schools which is 53.8.0% for the day and 46.2% from boarding schools. The observed difference can be accounted for by the difference in number of schools between boarding and day schools. In the study area, there were 46 secondary schools, 9 boarding, and 37 day schools.

Research Instrument

The research instrument used in this study was a structured survey questionnaire consisting of closed-ended items of a four-point Likert scale. Three parts made up the questionnaire. Part one consisted of questions on the demographic characteristics of respondents (type of school, sex, age, and length of school work experience). Part two aimed at determining the teachers' attitudes towards the implementation of BCBC and had 30 questions with closed-ends of four-point Likert-scale (i.e., attitudes towards the content-9 items; attitudes towards assessment-10 items; attitudes towards teachers' competence and workload-8 items; attitudes towards support-3 items). The items inquiring teachers' attitudes towards the BCBC were formulated based on the research instruments used in similar research (e.g., Potera & Shala, 2019; Suyundikova, 2019). Respondents were requested to show the degree to which they agreed or disagree with the statements on a Likert scale from 1=strongly disagree (SD) to 5=strongly agree (SA). Table 2. Indicates the examples of the items used in the second part of the questionnaire.

Table 2. Examples of Items Used in the Survey Questionnaire

Items	SA	A	D	SD
1. The scope of the Lower BCBC is too wide to be covered in three years.				
4. The Lower BCBC enhances student skills and competencies.				
8. The Lower BCBC develops more skills than BKBC.				
4. I know the application of criterion-based assessment.				
22. I am aware of what is required of me to teach the Lower BCBC.				
26. The Lower BCBC has increased teachers' workload.				
29. The school provides enough resources related to BCBC.				

SA: Strongly Agree; A: Agree; D: Disagree; SD: Strongly Disagree

The third part required teachers to rate their teaching approaches as well as their assessment techniques used in their biology lessons as very often, often, sometimes, rarely, and not used.

Validity and Reliability of the Research Instrument

Before utilization, the research instruments underwent validation by experts. The questionnaire employed in this study was given to the education specialist from the University of Rwanda for validation and correction who checked for grammatical errors, content coverage and wording. To further verify clarity, appropriate grammar, spelling errors, ambiguity, and question wording were all checked. Their corrections were incorporated in the final instrument. To ensure consistent findings from questionnaires, internal consistency as one of the reliability aspects was applied (Creswell, 2014). Thus, the questionnaire was pilot-tested and the Cronbach's alpha was used to estimate the reliability of the scale. In total, Cronbach's alpha coefficient was .91. This Cronbach's alpha coefficient indicated the instrument was reliable as evidenced by a Cronbach alpha exceeding .70 (Creswell, 2014).

Data Analysis

Descriptive statistics such as frequency, percentage, mean and standard deviation were used to analyze the collected data to answer the research questions. In this study, the attitude was regarded as the feeling of teachers regarding BCBC. Therefore, it was assessed from 30 items seeking respondents' agreement or disagreement with various attributes of BCBC including content, assessment, teachers' competence, workload and support. The mean score of each attribute was computed to assess the variations in the respondents' feelings. The teacher's attitudes towards BCBC were categorized into four different ranges of mean score levels including very high, high, neutral or mixed, and negative attitude. As such a mean above 4.51 expressed a very high positive attitude, a mean in the range of 3.51-4.50 described a high positive attitude, a mean in the range of 2.51-3.50 described feeling in the neutral or mixed, and mean scores below 2.51 denoted negative attitude towards BCBC (Zangmo, 2016). One-way ANOVA was used to test the study hypotheses formulated at a .05 significance level. The ANOVA test began with testing the normality of the data using the One-sample Kolmogorov-Smirnov. The results of the test showed that the data were normally distributed as p -value was $> .05$ (Landau & Everitt, 2004). Besides, for categorical variables, where the mean score differences were significant, Scheffe's test was used to ascertain the direction of the significant difference among the mean scores as a post-hoc measure (Holcomb & Cox, 2017). Furthermore, the effect size was used to measure the strength of a statistically significant difference between variables (Cohen, 1988). The following Cohen's rough were followed: small effect size ($d < 0.2$), medium ($0.2 < d < 0.8$), and large ($d > 0.8$).

Findings

General Attitude of Teachers of Biology towards Biology Competence-Based Curriculum (BCBC)

Table 3 depicts the distribution of teachers' attitudes towards the content, assessment, competence, workload, and support as well as the overall mean scores of the teachers' attitudes towards BCBC.

Table 3. Overall Mean Scores for the Teachers' Attitudes towards the BCBC

Attitude	N	Mean	SD	Interpretation
Attitudes towards BCBC content	26	3.81	.49	High Positive
Attitudes toward BCBC assessment	26	3.67	.56	High Positive
Attitudes towards competences and workload	26	3.38	.65	Moderate
Attitudes towards BCBC support	26	3.23	.77	Mixed
The overall attitude towards BCBC	26	3.52	.62	High Positive

The results in Table 3 revealed that the general attitude of 26 teachers of Biology towards BCBC as reported by the scale was high positively showing a mean score of 3.52, $SD = 0.62$. Likewise, the teachers reported the level of their attitude towards the BCBC content and assessment as highly positive and their competence and workload, and support as mixed levels with mean scores of 3.67, $SD = 0.56$; 3.38, $SD = 0.65$ and 3.23, $SD = 0.77$ respectively. The conclusions indicate that Biology teachers have positive attitudes towards BCBC.

Type of School, Gender, Age, and Teaching Experience Differences in Teachers' Attitudes towards BCBC

The study also determined whether the type of school (day and boarding), teachers' gender, age, and teaching experience play a role in teachers' attitudes towards the BCBC in Nyamagabe district, Rwanda. To achieve this, mean and standard deviation scores were computed separately for boarding and day schools, males and females, teachers' age, and teaching experience. The results are presented in Table 4 below.

Table 4. Results of Descriptive Statistics for Teachers' Attitude towards BCBC by Type of School, Gender, Age and Teaching Experience

Variables		N	Mean	Std. Deviation	Std. Error
Type of school	Boarding	12	39.66	9.58	2.7670
	Day	14	33.35	4.95	1.32436
Gender	Male	16	33.87	6.44	1.61213
	Female	10	40.10	8.97	2.83804
Age	Below 35	7	35.85	7.10	2.68531
	36-40	7	34.00	4.39	1.66190
	Above 41	12	37.8	10.00	2.88894
Teaching experience	7-10	14	35.14	6.49	1.73477
	11-15	6	43.16	10.28	4.19854
	Above 16	6	32.00	4.42	1.80739

Using descriptive statistics, the means and standard deviations for teachers from boarding and day schools, teachers' gender, age, and teaching experience were computed. As evident from Table 4, all teachers' attitude score means were different, which implies that teachers with different types of schools, ages, and teaching experiences differ in their attitudes towards BCBC. To test for the significance of the differences observed, a One-Way ANOVA test was run and the results are presented in Table 5.

Table 5. One-Way ANOVA Results of Teachers' Attitudes towards BCBC by their Type of School, Gender, Age and Teaching Experience

Variables	df	F	d	p-value
Type of school	1	4.64	.82	.041*
Gender	1	4.24	.80	.049*
Age	2	.504	.32	.611
Teaching experience	2	4.03	.20	.031*

*. The mean difference is significant at the .05 level.

The ANOVA results (Table 5) revealed that the school type is an important factor for teachers' attitudes towards BCBC ($F_{(1, 24)} = 4.64, p = 0.041$), indicating that there are statistically significant differences among teachers from boarding and day school teachers when their attitudes towards BCBC are considered. Teachers from boarding schools have more positive attitudes when mean scores are considered. In terms of demographic characteristics, gender, and teaching experience had a significant influence on the teacher's attitudes towards BCBC, $F_{(1, 24)} = 4.24, p = 0.049$; $F_{(2, 24)} = 4.039, p = 0.031$ respectively. As evident in Table 5, on average, female teachers have more favorable attitudes towards the BCBC than male ones. Also, the results indicated that the less experienced teachers embraced positively the BCBC more than the more experienced ones.

The effect size for the variables that were shown to have a statistically significant difference were all in the small to high range. Type of school ($d = .82$) was found to have high effect and thereby reflect a strong difference between the types of schools in the study area. Gender ($d = .80$) was found to have a moderate effect size. This suggests that the difference between genders was moderate in their strength. Teaching experience ($d = .32$) was found to be have a small effect which suggests that the difference among teachers' experience was small.

The teaching experience was a categorical variable consisting of the experience between 7 and 10, 11-15, and above 16 years. To find out the direction of the difference, the post-hoc analysis (Scheffe) was done and the findings are presented in Table 6.

Table 6. Post Hoc Analysis (Scheffe) of Biology Teachers' Attitudes towards BCBC according to their Teaching Experience

(I) Teaching Experience	(J) Teaching Experience	Mean Difference (I-J)	Std. Error	Sig.
7-10	11-15	-8.02381	3.48696	.092
	above 16	3.14286	3.48696	.671
11-15	7-10	8.02381	3.48696	.092
	above 16	11.16667*	4.12582	.042*
Above 16	7-10	-3.14286	3.48696	.671
	11-15	-11.16667*	4.12582	.042*

*. The mean difference is significant at the .05 level.

The pair-wise comparison in Table 6 indicated that although all groups of teaching experience showed positive attitudes towards BCBC, only the mean scores of the teachers with teaching experience between 11 and 15 years ($M = 43.16$, $SD = 10.28$) were significantly different from those with above 16 years of teaching experience ($M = 32.0$, $SD = 4.42$) in favor of less experienced teachers.

Teacher's Usage of Competence-Based Teaching and Learning Strategies

To determine the extent to which teachers use various BCBC strategies, they were asked to indicate whether they do not use (1), rarely (2), sometimes (3), often (4), and very often (5) BCBC teaching and learning strategies proposed by REB (2015) as guidelines. Findings are presented in Table 7.

Results from Table 7 show that about 68.2% of teachers indicated that they use group work very often as a teaching strategy while 85.4% of teachers showed that they used question-answer as the commonly used teaching strategy. Moreover, teachers indicated that they did not either or rarely use discussion (79.2), debate (80.8%), role play (92.3%), field trips (65.3%), problem-solving (53.9%), Brainstorming (69.1%) and experiment (53.9%). The findings suggested that teachers were continuing to implement a curriculum that was content-based through teacher-centered strategies.

Table 7. Frequency and Percentages Distribution of Teaching Methods Used by Biology Teachers

Teaching Method	1		2		3		4		5	
	f	%	f	%	f	%	f	%	f	%
Group work	0	0	0	0	2	7.7	6	23.1	18	68.2
Teacher exposition	0	0	12	46.2	9	34.6	5	19.2	0	0
Demonstration	4	15.4	6	23.1	8	30.8	5	19.2	3	11.5
Question-answer	0	0	0	0	0	0	9	34.6	17	85.4
Discussion	4	15.4	14	53.8	5	19.2	3	11.5	0	0
Debate	9	34.6	12	46.2	2	7.2	3	11.5	0	0
Roleplay	14	53.8	10	38.5	2	7.7	0	0	0	0
Field trips	3	11.5	14	53.8	9	34.6	0	0	0	0
Problem-solving	4	15.4	10	38.5	9	34.6	3	11.5	0	0
Brainstorming	12	46.1	6	23.1	8	30.8	0	0	0	0
Experiment	2	7.7	12	46.2	9	34.6	3	11.5	0	0

5: Very often, 4: Often, 3: Sometimes, 2: Rarely, 1: Not used

It appears that teachers do not actively engage students in the teaching and learning process by utilizing competency-based teaching strategies. To find out if there is a mean difference in the usage of BCBC teaching approaches among teachers from different types of schools, and with different gender, ages, and teaching experience, the mean scores of each group of teachers were calculated as shown in Table 8.

Table 8. Descriptive Statistics of Teacher's Usage of BCBC Teaching Approaches by Type of School, Gender, Age, and Teaching Experience

Variables		N	Mean	Std. Deviation	Std. Error
Type of school	Boarding	12	30.85	3.69	.98816
	Day	14	28.25	2.41	.69767
Gender	Male	16	29.87	3.98	.99530
	Female	10	29.30	2.26	.71570
Age	Below 35	7	30.14	2.34	.88448
	36-40	7	31.00	3.82	1.4474
	Above 41	12	28.58	3.52	1.0184
Teaching experience	7-10	14	30.21	3.44	.88448
	11-15	6	29.16	3.37	1.4474
	Above 16	6	28.83	3.60	1.0184

As results in Table 8, Biology teachers differ in their tendency of using BCBC teaching approaches by the variables such as their gender, type of school, age and teaching experience.

To find out if there were no significant mean score differences in using BCBC teaching and learning approaches based on the type of school, gender, age, and teaching experience, one-way ANOVA was used. Table 9 summarizes the One-Way ANOVA results.

Table 9. One Way ANOVA of Biology Teacher's Type of School, Gender, Age and Teaching Experience and the Usage of BCBC Teaching Approaches

Variables	df	F	d	p-value
Type of school	1	4.35	.85	.048*
Gender	1	.172	.20	.682
Age	2	1.25	.09	.304
Teaching experience	2	.411	.14	.668

*. The mean difference is significant at the .05 level.

The results in Table 8 show that there is only a significant mean score difference in the usage of BCBC teaching and learning strategies among teachers from boarding and day schools $F_{(1, 24)} = 4.35, p = .048$. The findings suggest that that, secondary school teacher's usage of various BCBC teaching and learning strategies depends on the type of school in which they work in favor of boarding schools. However, this usage does not depend on their gender, age as well as teaching experiences ($p > .05$). The effect size for the variable that was shown to have a statistically significant difference was in the high range. Type of school ($d = .85$) was found to have high effect size and thereby reflect a strong difference between the type of schools.

Teachers' Use of Competence-Based Assessment Methods

To determine the extent to which teachers use various BCBC assessment methods, teachers were asked to indicate whether they do not use (1), rarely (2), sometimes (3), often (4), and very often (5) BCBC assessment methods proposed by REB (2015) as guidelines. The findings are presented in Table 10.

Table 10. Teacher's Responses on their Usage of Various Competence-Based Assessment Methods

Assessment Methods	1		2		3		4		5	
	f	%	F	%	f	%	f	%	f	%
Tests or examination	0	0.0	0	0.0	2	7.7	6	23.1	18	69.2
Oral questions	10	38.5	6	23.1	7	26.9	3	11.5	0	0
Practical tasks	11	42.3	6	23.1	3	11.5	6	23.1	0	0
Class exercises	0	0	0	0	6	23.1	5	19.2	15	57.7
Projects	9	34.6	10	38.5	4	15.4	3	11.5	0	0
Portfolio	20	76.9	5	19.2	1	3.8	0	0	0	0
Oral Presentation	3	11.5	11	42.3	5	19.2	7	26.9	0	0

5: Very often, 4: Often, 3: Sometimes, 2: Rarely, 1: Not used; f = frequency; % = percentage

From data presented in Table 10, about 69.2% of the teachers indicated that they use tests or examinations very often as a method of assessment while 57.7% of them indicated that they used routine exercises in class very often as usual methods of evaluation. This implies that most teachers of Biology at the lower secondary school level are still using

assessment strategies that are not in line with the new CBC. In contrast, the majority of teachers revealed that they did not either or rarely use oral questions (61.5%), practical tasks (65.4%), projects (73.1%), and portfolios (96.1%).

To find out if there is a mean difference in the usage of BCBC assessment methods among teachers, the mean scores of each group of teachers were calculated as shown in Table 11.

Table 11. Descriptive Statistics of Teacher's Usage of BCBC Assessment Methods by Type of School, Gender, Age and Teaching Experience

Variables		N	Mean	Std. Deviation	Std. Error
Type of school	Boarding	12	18.91	3.08	.891
	Day	14	20.50	2.24	.599
Gender	Male	16	20.37	3.13	.784
	Female	10	18.80	1.61	.512
Age	Below 35	7	18.85	1.77	.670
	36-40	7	20.71	3.03	1.148
	Above 41	12	19.75	3.01	.871
Teaching experience	7-10	14	19.42	2.06	.551
	11-15	6	19.50	4.13	1.688
	Above 16	6	20.83	2.71	1.108

As results in Table 11 indicate that teachers differ in their tendency of using BCBC assessment methods by type of school, gender, age, and teaching experience.

To find out if there are no significant mean score differences in using BCBC assessment methods based on teacher's type of school, gender, age, and teaching experience, one-way ANOVA was used. Table 12 is the summary of the One-Way ANOVA results.

Table 12. One Way ANOVA of Biology Teacher's Type of School, Gender, Age and Teaching Experience and the Usage of BCBC Assessment Methods

Variables	Df	F	p-value
Type of school	1	2.28	0.144
Gender	1	2.14	0.157
Age	2	.796	0.463
Teaching experience	2	.573	0.572

Table 12 shows the results of One-Way ANOVA with p-values greater than .05 level of significance. Thus, there are no significant mean score differences in the usage of BCBC assessment methods among teachers from different types of schools, male and female teachers, and teachers with different ages and teaching experiences.

Discussion

Attitude of Teachers of Biology towards the Lower Biology Competence-Based Curriculum (BCBC)

The study assessed the attitudes of Biology teachers towards the lower secondary school BCBC in Nyamagabe district of Rwanda. The findings indicated that they embraced the curriculum positively. This implies that they appreciated the new curriculum. This finding is in agreement with that of Ruthand Ramadas (2019), Mbarushimana and Allida (2017), who reported in their separate studies that Rwandan teachers have a positive attitude towards CBC. They added that the teachers regarded the changes in the CBC as important. Besides, the study by Ngeno et al. (2021) showed that both head teachers and teachers in Erich County, Kenya have positive attitudes towards the implementation of CBC.

The findings also pointed out that the type of school (day and boarding) plays a role in teachers' attitudes towards the BCBC. According to the research findings, day school Biology teachers were less willing to adopt the new curriculum than their counterparts in boarding schools. This is in agreement with T. Nsengimana et al. (2021) who found that day schools lagged behind boarding schools in terms of Competence-Based Curriculum implementation.

Moreover, the outcomes of this study showed that the age of educators never significantly influenced teachers' attitudes towards the implementation of BCBC. The findings are at variance with that of Ngeno et al. (2021) who found that young teachers exhibited a more positive attitude towards CB implementation than old teachers.

The findings also revealed that female teachers showed significantly more favorable attitudes towards the implementation of the BCBC than male ones. The results of this study diverge from those of earlier research by Ndiokubwayo and Habiaryemye, 2018) who found no gender-significant difference in terms of teachers' perceptions of

competence-based curriculum. The findings are also at variance with that of Mbarushimana and Allida (2017) who found that teachers' adoption of a new curriculum implementation is not influenced by their gender.

Again, it was indicated that although all groups of teaching experience showed positive attitudes towards BCBC, only the mean scores of the teachers with teaching experience of between 11 and 15 years were significantly different from those with above 16 years of teaching experience in favor of less experienced teachers. This implies that less experienced teachers favor positively the new curriculum than more experienced ones. The findings do not match with the study done in Kazakhstan by Suyundikova (2019) which stressed that newly recruited educators have the same attitudes regarding the upgraded curriculum as senior experienced ones.

Teacher's Usage of Competence-Based Teaching and Learning Strategies

The study revealed that different new teaching approaches were adopted by the teachers during BCBC implementation. These include debates, role-plays, field trips, problem solving, and brain storming among others. This finding agrees with that of the study done in Tanzania by Ngeno et al. (2021) which revealed that teachers adopted new teaching approaches such as demonstration when carrying out lesson activities and question-answer when implementing CBC. However, despite the positive attitudes of teachers towards the CB, the study shows that most teachers continued using the old teaching approaches where lecturing and questions-answers are still dominating, which is contradictory to what the CBC is recommending. These study outcomes agree with that of Byusa et al. (2020), T. Nsengimana et al. (2021), and Nzeyimana and Ndiokubwayo (2019) who all found that in Rwanda, science teachers are still using teacher-centered related teaching strategies such as lecturing and writing on the blackboard. The findings of this study are also similar to that of various studies carried out in other countries showing that the implementation of CBC is still a knowledge transmission driven. For instance, Mulenga and Kabombwe (2019) in Zambia, Luambano (2014), Kafyulilo et al. (2013) in Tanzania respectively. One of the reasons they found was that the majority of teachers were committed to knowledge-based curricula and were resistant to change. Another researcher found the teachers' unpreparedness and the lack of sufficient knowledge about the CBC as majority were not involved in the CBC development (V. Nsengimana, 2021). The finding also corroborates with that of the study carried out in Tanzania by Komba and Mwandani (2015) which revealed that teachers were still using old approaches due to inadequate training about the CBC and the lack of inclusivity during CBC development, which resulted in lack of clear understanding of the CBC requirements.

Regarding whether there is a significant mean score difference in using BCBC teaching and learning strategies based on the type of school, gender, age, and teaching experience, it was indicated that the use of various BCBC teaching and learning strategies depends on the type of school in favor of boarding schools. The significant difference in the teachers' usage of BCBC teaching approaches observed only among boarding and day schools in favor of boarding may be explained by the fact that boarding schools attracted more qualified teachers and were more equipped than day ones (Mbonyumuvunyi, 2015). Besides, they are motivated to teach as they have top-up pay from parents of learners (Rubagiza et al., 2016).

Teachers 'Use of Competence-Based Assessment Methods

Regarding the assessment approaches, it was found that most teachers employ tests or examinations, and class exercises. This implies that the teachers are still using assessment strategies that are not in line with the CBC. The findings concur with the results by Ndalichako (2015) who found that class exercises, homework, quizzes, and tests were the most frequently used modes of evaluation by secondary school teachers. Likewise, the findings correlate with that of Luambano (2014), Komba and Mwandani (2015), Muneja (2015) whose overall findings revealed that despite the introduction of CBC, educators up to today favored small assessments and examinations because the school regulations specify them. These findings also correlate with the work done by Msonde (2011) in Tanzania which discovered that, despite the CBC requirements, the majority of assessments activities were conducted using the paper-and-pencil method, with exams serving as a means of classifying students. Also, Kissima (2015) in Tanzania found in his earlier research that written reports, projects, and portfolios were among the least assessment methods that secondary school instructors utilized.

Furthermore, many teachers showed that they don't or rarely use oral questions for practical tasks, projects, and portfolios. The findings are in contrast with the evaluation methods as specified in the CBC that a CBC uses evaluation methods such as portfolios, field observation, projects, oral presentations, and self-assessment (REB, 2015). Despite that these methods are provided in the syllabi of BCBC, most of the Biology teachers showed that they were indifferent to them. The findings collaborate with the findings by Luambano (2014) who observed that portfolios, projects, and written reports were among the least assessment strategies used by secondary school teachers while implementing the CBC in Tanzania.

Finally, it was indicated that there were no significant mean score differences in the usage of BCBC assessment methods by the type of school, gender, age, and teaching experiences. The findings concur with the study findings of Kissima (2015) which indicated that usage of CBA strategies did not differ significantly among teachers within different types of schools and demographic characteristics including gender, age, and working experiences.

Conclusion

The study investigated the attitudes of teachers of Biology towards the Biology Competence-Based Curriculum (BCBC) and their instructional practices at the lower secondary level in Nyamagabe district, Rwanda. This study's findings revealed that teachers of Biology had positive attitudes towards the BCBC. The Females had more positive attitudes towards BCBC than the male ones. Teachers from boarding schools showed more positive attitudes towards BCBC than those from day schools. Also, teachers with less teaching experience exhibited high positive attitudes than more experienced ones. Teachers' age did not have any effect on their implementation of BCBC.

The work also showed that the majority of educators of Biology were not using competence-based approaches in their routine work. They are still dominantly using old-fashioned approaches in teaching which do not match with CBC requirements. Therefore, there is a gap between the demand of BCBC in terms of teaching approaches and what is currently implemented by Biology teachers in both boarding and day schools.

Moreover, the study revealed that most Biology teachers neglected competence-based assessment. They were still using traditional methods of assessment and had no portfolios for learners to show the competences their students had acquired. Thus, the evaluation methods were not performance-based as requested by the CBC.

There was no significant difference in the usage of BCB assessment methods among teachers with different types of schools, gender, age, and teaching experiences. This suggests that appropriate knowledge and skills in the implementation of CBC remain one of the most important factors that have a huge effect on the application of the CBC assessment methods by Biology teachers. Therefore, more efforts should be made in making sure that necessary in-service training is in place for the effective implementation of BCBC to be realized.

Recommendations

In light of the findings from this study, special attention should be given to the teachers of Biology as follows: They need to be provided with requisite information and skills using additional training at work, workshops, and seminars to ensure effective implementation of the proposed teaching and learning approaches as well as assessment methods. These in-service trainings can assist them in being aware of the information, theoretical underpinning the curriculum and the needs of the students for CBC to be successful. Head teachers and deputy head teachers in charge of studies should be provided with in-service training on the effective ways of facilitating CB teaching and learning approaches and assessment methods of Biology teachers. Teachers training colleges and Universities which offer teacher education programs should revise their Biology teaching methods and assessment approaches so that the courses can sufficiently reflect the demands of the CBC teaching and learning approaches and assessment in Biology subject. Finally, the educational stakeholders should ensure enough availability of teaching and learning resources in secondary schools for enhancing the effective implementation of CBC in Biology.

Further evaluation studies can be conducted in secondary schools in Rwanda to assess the quality of teaching and assessment activities carried out in these schools to determine the extent to which they reflect the nature of teaching and assessment practices expected in the CBC. Another assessment study can be conducted in secondary schools to find out the extent to which students are involved in the implementation of the BCBC in terms of teaching and assessment approaches in Biology. Moreover, a similar study should be carried out to find out why Biology teachers' attitudes and implementation of the CBC are governed by the variables of influence such as age groups and gender as well as the type of school.

Limitations

It is important to keep in mind that some circumstances were out of the researchers' control and might have had an impact on the research findings. This study involved 26 Biology teachers from 6 boarding and 14-day secondary schools in Nyamagabe district of Rwanda. In reality, Rwanda has 30 districts, each with at least 4 boarding and 10-day schools, and none of the other 29 districts were used for the sample. Thus, when comparing the number of districts and secondary schools in Rwanda, the study sample's representativeness may be a limiting factor. Thus, the sample of this study can't be completely representative of Biology teachers in all secondary schools. Consequently, it is not possible to generalize the study findings to the entire population outside of the study population.

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Authorship Contribution Statement

Bizimana: Conceptualization, design, data collection, analysis and drafting manuscript. Mutangana: Reviewing, supervision. Mwesigye: Reviewing, supervision.

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