



Research Article

Assessment of Critical Thinking in Competency-Based Education in Kenya: Practices in Integrated Science Instruction in Public Junior Schools in Nairobi County

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Abstract

Critical thinking is one of the competencies learners are expected to develop under the Competency-Based Education in Kenya. This shift demands a paradigm shift from conventional assessment practices to inquiry-based Competency-Based Assessment practices. This study aimed to assess critical thinking assessment practices in Integrated Science instruction in public junior schools in Nairobi County. The study adopted a descriptive survey research design. The study used proportionate, convenience, and systematic sampling to select 382 respondents from a target population of 8,259. Structured questionnaires were used to collect information on critical thinking assessment practices in Integrated Science instruction from both teachers and learners. The reliability of the instruments was established through piloting in a neighboring county, Kajiado County. A Cronbach's alpha of 0.784 was obtained, thus making the tools suitable for data collection. The data were analyzed using descriptive statistics, and the study findings were presented using frequencies and percentage differences. The study findings show that teachers face challenges in assessing critical thinking in Integrated Science instruction, especially in interpreting the curriculum to incorporate inquiry, reflection, evidence-based reasoning, and application of knowledge in real-life situations. The gap was confirmed by learner responses, which consistently reported gaps in classroom practices that promote critical thinking. There is a gap in teachers' perception of competence in critical thinking assessment practices in Integrated Science instruction in comparison to learner perceptions. The findings inform education stakeholders of the need to invest in equipping teachers with pedagogical skills for Competency-Based Assessment, especially in assessing critical thinking.

Keywords

Critical Thinking, Competency-Based Assessment, Curriculum Interpretation, Integrated Science Instruction, Pedagogical Skills

1. Introduction

Critical thinking is a central educational goal of the 21st century. The United Nations Educational, Scientific and Cultural Organization (UNESCO) advocates for an education oriented to the development of critical thinking to prepare learners to

function effectively in complex and rapidly changing societies [18]. Additionally, critical thinking prepares learners to question existing knowledge, investigate phenomena, evaluate

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data, and interpret findings [6]. Education systems should incorporate critical thinking practices to equip learners with skills to examine information, interpret evidence, analyze ideas, evaluate claims, explain reasoning, draw inferences, and make justified decisions. Classroom instruction should focus not only on passing information but also on assessing how learners internalize, analyze, and apply it in authentic situations. Classroom instruction should, therefore, have credible evidence that learners are developing and demonstrating critical thinking as an intended learning outcome.

Kenya identifies critical thinking and problem-solving as one of the seven core competencies of the Competency-Based Education (CBE) introduced in the country in 2017. Additionally, the Kenya Institute of Curriculum Development (KICD) Curriculum Framework emphasizes a curriculum that is focused on applying knowledge and skills to real-life situations [11]. The Framework further recognizes assessment as a means of establishing the extent to which learners have acquired expected knowledge, skills, values, attitudes, abilities, and competencies. Similarly, the Kenya National Examinations Council (KNEC) describes competency-based assessment as focusing on learners' ability to apply knowledge and skills in real-world situations through formative and summative assessment [13]. Consequently, both formative and summative assessments should include practices that can evaluate learners' observable thinking skills.

Implementing critical thinking assessment practices requires teachers to use assessment tasks that provide evidence of learners' ability to analyze information, interpret evidence, explain ideas/observations, evaluate alternatives, justify conclusions, and apply knowledge to real-life situations. According to [19], the widespread recognition of critical thinking as a curriculum goal creates a corresponding need for teachers to understand how to translate it into observable dimensions and assess it through appropriate tasks, rubrics, and formative assessment practices. The assessment of critical thinking under CBE represents an important link between the intended outcomes and what learners demonstrate in classrooms. Therefore, the current paper sought to establish critical thinking assessment practices in Integrated Science instruction in Public junior schools in Nairobi County. Specifically, the study sought to assess critical thinking practices in Integrated Science instruction that facilitate linking concepts to other concepts, encourage broad-based thinking on scientific concepts, encourage investigation of scientific concepts through inquiry and evidence, facilitate reflection and reasoning in learning, and facilitate application of knowledge in real-life situations.

1.1. Statement of the Problem

Assessment is conducted to determine the extent to which learners acquire and demonstrate expected learning outcomes. Critical thinking assessment involves determining the extent to which learners can investigate phenomena, interpret evidence, explain observations, solve problems, and apply

knowledge to real-life situations. Consequently, critical-thinking assessment practices in Integrated Science should provide evidence not only of what learners know but also of how they reason with and apply scientific knowledge. The transition to CBE in Kenya has documented challenges with teacher preparedness, assessment tools, and the implementation of Competency-Based Assessment (CBA). The challenges include the use of assessment tools and the implementation of formative assessment practices in the learning process. The assessment of critical thinking is complicated by the fact that the competency cannot be inferred from learners' ability to recall facts. Teachers are required to use specific assessment practices to determine the extent of development of critical thinking skills. However, there is limited empirical evidence on the critical-thinking assessment practices teachers use in Integrated Science learning to conduct formative competency-oriented assessments. The absence of such evidence creates uncertainty about the extent to which critical-thinking assessment in public junior schools aligns with CBE expectations. Therefore, the current study sought to determine critical-thinking assessment practices in Integrated Science instruction in public junior schools in Nairobi County.

1.2. Purpose of the Study

The purpose of the study was to find out critical thinking assessment practices in Integrated Science instruction in public junior schools in Nairobi County.

1.3. Research Objective

The objectives of the study were to assess critical thinking practices in Integrated Science instruction that:

- 1) Facilitate linking concepts with previous related concepts.
- 2) Encourage broad-based thinking on scientific concepts.
- 3) Encourage investigation of scientific concepts through inquiry and evidence.
- 4) Facilitate reflection and reasoning on concepts.
- 5) Facilitate application of knowledge in real-life situations.

1.4. Significance of the Study

The findings of the study provide insights into the implementation of critical thinking assessment in Kenya's CBE system by revealing practices employed by teachers in Integrated Science instruction to facilitate linking concepts, encourage broad-based thinking on scientific concepts, encourage investigation of scientific concepts through inquiry and evidence, facilitate reflection and reasoning on concepts, and facilitate application of knowledge in real-life situations.

2. Literature Review

Critical thinking is a multidimensional construct involving

the purposeful use of cognitive processes to examine information and arrive at reasoned judgments. According to [5], critical thinking involves higher-order thinking processes such as interpretation, analysis, evaluation, inference, explanation, and self-regulation. However, critical thinking should not be reduced to higher levels of a cognitive taxonomy. [19] states that critical thinking involves the quality and purpose of thinking. Critical thinking processes encompass day-to-day competencies for examining evidence, recognizing relationships, questioning assumptions, evaluating arguments, and justifying conclusions. This perception has increased the importance of critical thinking alongside the global movement towards Competency-Based Curriculum (CBC). According to KICD, the CBC approach emphasizes learners' capacity to mobilize knowledge, skills, attitudes, and values to perform meaningful tasks rather than merely reproduce information [11]. As such, critical thinking and problem-solving are among the seven core competencies learners are expected to acquire through the CBE framework in Kenya. When designing classroom instruction, teachers should outline how critical thinking assessment will be conducted. Additionally, the KICD curriculum designs, including the Integrated Science curriculum design, focus on critical thinking across all learning areas [12]. Therefore, Integrated Science instruction should explicitly outline how critical thinking is assessed as learners think critically about observations and patterns and use the knowledge to address problems.

The positioning of critical thinking as a core competency in the modern labor market places a new dimension in assessment practices. Teachers should change assessment approaches from "What knowledge can the learner remember?" to "What evidence demonstrates that the learner can use acquired knowledge to reason, judge, and solve problems?" [19]. This shift has direct implications for the types of classroom assessments teachers can utilize. According to [13], assessment should not be used only to determine whether intended learning outcomes have been achieved (summative assessment) but also to help teachers adjust teaching approaches for effective learning (assessment for learning) as well as help learners think about their own work and set personal goals (assessment as learning). Teachers should use both formative and summative assessments to diagnose learning needs, monitor progress, and provide feedback. Therefore, classroom instruction should provide evidence of formative assessment practices teachers use to assess learners' ability to apply knowledge and skills in day-to-day classroom activities.

Formative assessment of critical thinking is more demanding than assessment of factual knowledge. This is because critical thinking is not directly observable like the recall of factual knowledge. Teachers infer the quality of learners' thinking from what they say, write, make, or do [19]. Consequently, assessment tasks need to elicit observable evidence of cognitive processes such as analysis, evaluation, inference, expla-

nation, and justification. This has presented significant challenges in assessing critical thinking as teachers operationalize a complex and multidimensional construct into observable assessment criteria. [3] Observe that although critical thinking is widely emphasized in curricula, teachers find it difficult to determine what developing and assessing it entails in classroom practice. Teachers lack clarity about the specific learner behaviors or products that constitute evidence of the development of critical thinking skills. These findings, therefore, highlight the need to determine how teachers in public junior schools in Nairobi County align Integrated Science instructional practices with critical thinking assessment.

Assessment practices intended to capture complex competencies require teachers to move beyond familiar forms of testing towards tasks and criteria that reveal higher-order thinking. [3] Suggest that teachers should differentiate active learning from critical-thinking assessment. There should be clearly stated parameters for assessing critical thinking in a lesson that involves activities such as group work, discussion, experimentation, or questioning. The rubric should show how learners are assessed in examining evidence, making judgments, explaining their reasoning, or justifying conclusions. Such assessment may face challenges under CBE due to inadequate training on Inquiry-Based Learning (IBL) approaches. [9] states that junior school teachers in Kenya lack training in IBL approaches. This may influence the extent to which they utilize CBA tools and approaches. Additionally, [20] found that Kenya's assessment framework was insufficiently elaborate to provide clear guidance to teachers and identified weaknesses in the assessment culture and teachers' preparation for formative assessment. Teachers relied extensively on outcome-oriented assessment approaches with minimal evidence of activities that fostered higher-order thinking. Assessment activities such as rating scales, constructed-response questions, and multiple-choice questions were more common. In contrast, [4] found that teachers in Kenyan public schools frequently relied on class exercises, oral questions, and observations as the main assessment practices. The study found that although teachers demonstrated awareness of assessment principles, more varied, integrated, and authentic CBA approaches such as observation schedules, learner profiles, rubrics, journals, portfolios, and project work were used less consistently and were sometimes unstandardized or unrecorded. If classroom pedagogy and assessment practices remain largely content-focused, there will be no evidence of competency achievement of specific CBE core competencies. The status necessitates an assessment of instructional practices to determine how formative assessment accounts for the development of specific CBE core competencies in the day-to-day teaching and learning process. Therefore, the current study focused on determining critical thinking assessment practices employed by teachers in public junior schools in Nairobi County during Integrated Science learning.

3. Methodology

3.1. Location of the Study

The study was conducted in public junior schools in Nairobi County, Kenya. The location was considered appropriate for the study because the teachers and learners in this county come from diverse socio-economic and cultural backgrounds, providing opportunities for divergent practices for critical thinking assessment.

3.2. Research Design

The study employed a descriptive survey research design to analyze teachers' practices for assessing critical thinking in Integrated Science instruction. The teachers and learners completed a questionnaire to identify instructional practices for assessment of critical thinking in Integrated Science learning.

3.3. Study Population

The target population for the original study from which the current article was extracted comprised 7598 Grade Eight learners and 643 junior schoolteachers drawn from the 142 junior schools in Nairobi County, and 18 Curriculum Support Officers (CSOs), making a total of 8,259 respondents.

3.4. Sampling Technique

The sampling process was implemented in stages to ensure geographical representation and identification of participants who met the study criteria. Nairobi County had 17 sub-counties and 195 public schools, of which 142 had operational junior schools. To ensure geographical representation, the 17 sub-counties were purposefully grouped into eight regions: Dagoretti, Embakasi, Kamukunji, Kasarani, Kibra/Lang'ata, Makadara/Mathare, Roysambu/Ruaraka, and Starehe/Westlands. The schools were purposefully grouped into the eight regions using the list obtained from the Regional Education Office. The grouping ensured representation of junior schools across the study area. The number of schools required from each region was conveniently selected based on

familiarity with the school location and willingness of the teachers to participate in the study. Using this procedure, 46 public junior schools were selected across the eight regions, and one Integrated Science teacher was purposively selected from each participating school. The number of learners from each region was determined from the learner allocation assigned to the respective region and the number of participating schools in that region. Simple random sampling was used to select participating learners from class lists provided by the teacher in each school, resulting in a total sample size of 328 learners.

3.5. Sample Size

The sample size was calculated using Yamane's formula, where:

$$n = N / [1 + N(e^2)]$$

n = Required sample size

N = Target population

e = Sampling error at 5% (0.05)

Substituting the figures in the formula gave n as:

$$\begin{aligned} n &= 8259 / [1 + 8259(0.05)^2] \\ &= 8259 / (1 + 20.6475) \\ &= 8259 / 21.6475 \\ &= 381.522 \\ &\approx 382 \end{aligned}$$

The CSOs were not engaged in the critical thinking assessment segment. Therefore, the sample size for the assessment segment was 374 respondents. Table 1 presents the distribution of the sample size among survey participants.

Table 1. Sample Size of the Survey Respondents.

Region	Schools	Survey Sample Size		Total
		Teachers	Learners	
Dagoretti	6	6	46	52
Embakasi	6	6	57	63
Kamukunji	5	5	46	51
Kasarani	6	6	29	35

Region	Schools	Survey Sample Size		Total
		Teachers	Learners	
Kibra/Langata	7	7	47	54
Makadara/Mathare	6	6	49	55
Roysambu/Ruaraka	5	5	35	40
Starehe/Westlands	5	5	19	24
Total		46	328	374

3.6. Research Instruments

The data were collected using teacher and learner questionnaires, which were used to collect qualitative data to explore the extent to which Integrated Science instructional practices enhance the development of critical thinking among junior school learners. The teachers' questionnaire gathered information on Integrated Science instructional practices that enhance the development of critical thinking among junior school learners. The instrument focused on instructional practices for assessing critical thinking with the aim of identifying the difficulties teachers face in creating Integrated Science instruction that assesses learners' critical thinking, as well as teachers' perceptions of critical thinking assessment among Grade Eight learners. The learners' questionnaire focused on establishing the learners' perceptions of teacher practices during Integrated Science lessons. The statements in the learner questionnaire were aligned with those in the teachers' questionnaire. The learner responses were used to determine the extent to which the learners experienced what the teachers indicated in the corresponding responses.

3.7. Validity of Research Instruments

An instrument may be designed to measure multiple aspects; therefore, the validity must be established [16]. The researcher, along with the supervisors, assessed the face and content validity of the research instruments by comparing the topic, objectives, literature review, conceptual framework, and instrument items to ensure alignment and consistency. Curriculum experts were consulted for content validity. The experts verified the cognitive level of the items concerning their ability to promote critical thinking.

3.8. Piloting

Piloting of the research instruments was conducted in public junior schools in Kajiado County, which neighbors Nairobi County in the South. A total of 40 respondents, representing 10% of the study sample, took part in piloting the instruments.

The piloting aimed to test the clarity, feasibility, and preliminary validity of the research instruments. Analysis of the pilot data yielded a Cronbach's alpha of 0.784; therefore, the instruments were deemed sufficiently reliable for use in the main study.

4. Results and Discussions

4.1. Response Rate

Teachers and learner questionnaires were filled out by 296 learners and 44 teachers, respectively, translating to a response rate of 90.2% and 95.7%, respectively. According to [8], the minimum acceptable threshold for analysis is 70%; thus, the response rate was considered adequate.

4.2. Demographic Information

The proportion of boys who participated in the study was 40.5%, while 59.5% were girls. Among the teacher respondents, more than half (52.3%) were male, while 47.7% were female. Most (81.8%) teacher respondents held a Bachelor of Education degree, and all (100%) had trained in a science-related field (Chemistry, Biology, or Physics). A study by [9] found that teacher specialization challenged the transition of the first cohort of Grade 7 learners to junior school. These findings, therefore, indicate an improvement in the professional qualifications of science teachers in public junior schools.

4.3. Instructional Practices for Assessing Critical Thinking in Integrated Science Instruction

The study aimed to determine CBA practices used by teachers to evaluate learners' critical thinking skills during Integrated Science learning. The teacher respondents completed Likert-scale statements to indicate the frequency with which they considered practices for assessing critical thinking in Integrated Science instruction. Although the questionnaire had

a five-point scale: 'Never Considers', 'Rarely Considers', 'Sometimes Considers', 'Often Considers', and 'Always Considers', the points were categorized as either 'Never Uses' or 'Always Uses' for analysis purposes. The substantial data reduction was because critical thinking assessment cannot be

partial; therefore, 'Never Considers', 'Rarely Considers', 'Sometimes Considers', and 'Often Considers' were categorized as indicators of absence of assessment. The results obtained are shown in Table 2.

Table 2. Practices for assessing critical thinking in Integrated Science instruction. (Teacher responses, N= 44).

Assessing critical thinking in Integrated Science instruction, to	Never Uses%	Always Uses%	Total%
Facilitate linking concepts with previous related concepts, I:			
Ask learners to state concept relationships.	75.0	25.0	100
Encourage learners to clarify concept misconceptions	65.9	34.1	100
Guide learners to clarify concept misconceptions.	72.7	27.3	100
Allow learners to restate concepts using their own words.	72.7	27.3	100
Encourage learners to comment on responses from others	61.4	38.6	100
Encourage learners to explain how concepts build.	68.2	31.8	100
Assess learners on related concepts.	56.9	43.1	100
Encourage broad-based thinking on scientific concepts, I:			
Ask questions that encourage inquiry into scientific phenomena.	47.7	52.3	100
Incorporate questions that stimulate learner curiosity.	50.0	50.0	100
Ask questions from real-life contexts.	47.7	52.3	100
Prepare answers with anticipated possible responses.	43.1	56.9	100
Formulate scaffolding prompts to challenge responses.	40.9	59.1	100
Ensure exams have open-ended questions.	25.0	75.0	100
Think through the would-be out-of-context responses.	56.8	43.2	100
Encourage investigation through inquiry and evidence, I:			
Allow learners to justify their scientific investigations.	18.2	81.8	100
Research on observations that are not in the course books.	13.6	86.3	100
Consider data analysis supported by scientific facts.	27.3	72.7	100
Do not penalize responses justified by scientific explanations.	18.2	81.8	100
Allow learners to justify how scientific concepts connect.	11.4	88.6	100
Facilitate reflection and reasoning, I:			
Use tasks that require explanations, not just answers.	11.4	88.6	100
Encourage learners to reflect on how they get answers.	9.1	90.9	100
Provide feedback focusing on the reasoning processes.	9.1	90.9	100
Allow learners to revise explanations based on feedback.	11.4	88.6	100
Create room to justify the concept connection in real life.	11.4	88.6	100
Create time for learners who are contemptuous of activities.	18.2	81.8	100
Allow random questions based on provided instructions.	11.4	88.6	100
Facilitate application of knowledge, I:			
Assess learners' knowledge application to new situations.	15.9	84.1	100

Assessing critical thinking in Integrated Science instruction, to	Never Uses%	Always Uses%	Total%
Guide learners who can analyze and create solutions.	18.2	81.8	100
Assess learners' ability to connect concepts to real-life situations.	15.9	84.1	100
Use responses and reflections to adjust subsequent lessons.	15.9	84.1	100

Findings on assessment practices for facilitating learners' ability to connect scientific concepts with previously learned concepts indicate moderate implementation of critical thinking-oriented assessment practices in Integrated Science learning. The majority (75.0%) of teacher respondents indicated that they do not use assessment practices that require learners to state relationships between scientific concepts, with a further 65.9% indicating that they do not use practices that encourage clarification of misconceptions of scientific concepts. Almost three-quarters (72.7%) of teacher respondents indicated that they do not use practices that guide learners in clarifying conceptual misunderstandings or allow learners to restate concepts in their own words. A further almost two-thirds (61.4%) of teacher respondents indicated that they do not encourage learners to comment on responses from others, with slightly more than two-thirds (68.2%) indicating they do not encourage learners to explain how concepts build, and slightly more than half (56.9%) indicating that they do not assess learners on related concepts. These findings suggest that assessment practices for evaluating learners' ability to identify conceptual links remain weak in Integrated Science instruction in public junior schools in Nairobi County. The classroom instruction fails to consistently challenge learners to engage in deeper reasoning, conceptual integration, and reflective evaluation, which are the core focus of assessment under CBE. The findings are consistent with [14], who reported that teachers often struggle to translate competency-based assessment principles into classroom practice, particularly when assessing higher-order cognitive skills such as analysis, synthesis, and evaluation.

The findings on teachers' use of assessment practices that promote broad-based thinking about scientific concepts suggest that, on average, teachers demonstrate a moderate implementation of practices that support inquiry, curiosity, and deeper reasoning. Three-quarters (75.0%) always ensure that exams contain open-ended questions, while the other practices were, on average, used as follows: always ask questions that encourage inquiry into scientific phenomena (52.3%), incorporating questions that stimulate learner curiosity (50.0%), asking questions from real-life contexts (52.3%), preparing answers with anticipated learner responses (56.9%), and formulating scaffolding prompts to challenge learner responses (59.1%). Notably, the proportion of teacher respondents who indicate they always ensure exams include open-ended questions is a positive indicator, as open-ended questions enable learners to explain their reasoning, justify their responses, and

demonstrate conceptual understanding. These findings suggest that teachers in public junior schools in Nairobi County are gradually appreciating the value of assessments that move beyond factual recall toward evaluating analytical and reasoning skills. However, the finding that more than half (56.8%) of teacher respondents do not consistently consider possible out-of-context learner responses in Integrated Science assessment is concerning. According to [2], out-of-context responses often signal deeper curiosity, creative thinking, or alternative reasoning pathways. The practice suggests a limitation in teacher preparedness to manage spontaneous learner thinking and exploratory questioning, which may restrict opportunities for creativity and scientific inquiry.

Regarding critical thinking evaluation practices that encourage scientific investigation through higher-order cognitive skills, the findings suggest relatively strong implementation in Integrated Science instruction in public junior schools in Nairobi County. The proportion of teacher respondents who indicated a moderate to high use of practices was above three-quarters in most of the mentioned practices: allowing learners to justify scientific investigations (81.8%), researching observations beyond course book content (86.3%), not penalizing responses justified by scientific explanations (81.8%), with the strongest practice emerging in allowing learners to justify how scientific concepts connect (88.6%). This is a strong indication of growing emphasis on relational thinking and conceptual understanding. However, notably less than three-quarters (72.7%) of teacher respondents indicate that they consistently consider data analysis supported by scientific evidence. These findings suggest inconsistency in the integration of evidence-based reasoning into assessment practices. Although teachers in public junior schools in Nairobi County are increasingly incorporating evidence-based assessment practices in Integrated Science learning, less than a third (27.3%) of teachers do not allow learners to analyze data differently, supported by scientific evidence, which may indicate continued reliance on assessment approaches centered on predetermined responses and available data. Such practices may limit learners' opportunities to challenge existing knowledge, generate alternative explanations, and engage in deeper scientific inquiry. This observation aligns with [2], who argue that assessment practices focused primarily on correct answers often restrict learner autonomy and critical reasoning. Therefore, if teachers do not intentionally create opportunities for questioning, exploration, and scientific argumentation, learners in public junior schools in Nairobi County may remain confined to

duplicating known facts rather than innovating new knowledge.

An effective implementation of critical thinking evaluation practices that facilitate reflection and reasoning in Integrated Science learning was also observed among the teachers. The majority of respondents reported they always use key critical thinking evaluation practices: use of tasks requiring explanations rather than merely correct answers (88.6%), encouraging learners to reflect on how they arrived at answers (90.9%), providing feedback focused on reasoning processes (90.9%), and allowing learners to revise their explanations based on feedback (88.6%). Similarly, a high proportion of teachers reported creating opportunities for learners to justify the connection of scientific concepts to real-life situations (88.6%) and allowing random questions based on given instructions (88.6%). However, there was a decrease in the proportion of teachers who provide time for learners who express contempt during activities (81.8%). A similar observation was noted in critical thinking practices that facilitate the application of

knowledge, where most of the teacher respondents indicated they always use the mentioned practices: assessing learners' ability to apply knowledge to new situations (84.1%), giving guidance to learners who can analyze and create solutions (81.8%), assessing learners to find how they connect concepts in real life (84.1%), and using responses and reflections to adjust subsequent lessons (84.1%). These findings confirm that teachers in public junior schools in Nairobi County are increasingly adopting CBA practices in Integrated Science. Such practices are essential for developing higher-order thinking because they allow assessment beyond factual recall toward explanation, justification, and metacognitive reflection.

The teacher respondents were asked to specify any other challenge(s) they encountered in assessing critical thinking in Integrated Science learning among the Grade Eight learners. The responses were thematically grouped into time availability, pedagogical challenges, resource availability, workload, or curriculum interpretation. Table 3 summarizes the results.

Table 3. Other challenges that prevent teachers from considering practices for assessing critical thinking in Integrated Science instruction. (N= 44).

Challenge related to	Response (%)	Cumulative (%)
Time.	9.1	9.1
Pedagogy.	-	9.1
Resources.	-	9.1
Workload.	2.3	11.4
Curriculum Interpretation.	27.3	38.7
No other challenge.	61.3	100

Regarding other reasons why teachers do not consider CBA practices in Integrated Science instruction, nearly a third (27.3%) of the respondents reported challenges in curriculum interpretation. A study by [10] found that curriculum interpretation was a challenge among teachers during the preparation and presentation of Integrated Science instruction. These findings suggest that teachers also encounter challenges in interpreting curriculum during CBA. Although teachers reported other challenges related to time (9.1%) and workload (2.3%), the percentages were negligible. Notably, none of the teacher respondents identified pedagogy- or resource-related challenges in evaluating critical thinking in Integrated Science learning. Workload-related challenges remained minimal (2.3%). These findings suggest that CBA challenges are related to instruction design practices rather than instructional administration. [2] states that formative assessment of higher-

order thinking demands substantial teacher time for interpreting the curriculum and learners' responses. Although higher-order thinking evaluation requires open-ended tasks, individualized observation schedules, learner explanation, and individualized feedback, which may be time-consuming, the teacher respondents do not perceive time constraints as a limitation to CBA practices.

The study sought to investigate how Grade Eight learners perceive the teacher's CBA practices in Integrated Science learning. The learner respondents were given Likert scale statements, which were assigned numerical values: 'Never Uses (1)', 'Rarely Uses (2)', 'Sometimes Uses (3)', 'Often Uses (4)', and 'Always Uses (5)'. The statements were re-grouped as 'Never Uses' or 'Always Uses' for analysis purposes. The responses obtained are presented in Table 4.

Table 4. *Critical Thinking Evaluation Practices during Integrated Science Learning (Learner responses, N=296).*

Evaluation of Integrated Science instruction	Never Uses%	Always Uses%	Total%
To facilitate linking concepts with previous related concepts			
During Integrated Science instruction, my teacher:			
Ask learners to state concept relationships.	77.0	23.0	100.0
Encourage learners to clarify concept misconceptions	81.1	18.9	100.0
Engage learners in activities to clarify conceptions.	74.3	25.7	100.0
Allow learners to restate concepts in their own words.	56.8	43.2	100.0
Encourage learners to comment on given responses.	74.0	26.0	100.0
Encourage learners to clarify how concepts build up.	64.9	35.1	100.0
To encourage broad-based thinking on scientific concepts			
During Integrated Science instruction, my teacher:			
Ask questions that encourage learner curiosity	48.3	51.7	100.0
Ask questions from real-life contexts.	60.8	39.2	100.0
Give learners exams with open-ended questions.	42.0	58.0	100.0
To encourage investigation through inquiry and evidence			
During Integrated Science instruction, my teacher:			
Allow learners to justify scientific investigations.	23.0	77.0	100.0
Discuss learner observations not in the course books.	32.3	67.7	100.0
Consider data analysis supported by scientific facts.	48.2	51.8	100.0
Do not punish learners for random responses.	21.4	78.6	100.0
Allow learners to justify the connection of concepts.	19.1	80.9	100.0
To facilitate reflection and reasoning			
During Integrated Science instruction, my teacher:			
Use tasks that require explanation, not just answers.	8.4	91.6	100.0
Encourage learners to reflect on how they got answers.	20.9	79.1	100.0
Provide feedback focusing on scientific reasoning.	34.5	65.5	100.0
Allow learners to revise explanations based on feedback.	11.1	88.9	100.0
Create room to justify the connection of concepts.	14.9	85.1	100.0
Has time for learners with contempt for activities.	14.3	85.7	100.0
Allow learners to ask random questions from the provided instructions.	6.9	93.1	100.0

The items in the learner questionnaire aligned with those in the teacher questionnaire. The alignment was because the learner responses were used to assess the extent to which learners experienced the teachers' perceived implementation

of critical thinking assessment practices in the classroom. An analysis showing the percentage difference between the learner and teacher responses on 'Always Use' is shown in [Table 5](#).

Table 5. Analysis of Percentage Difference Between Learner and Teacher Responses.

Evaluation of Integrated Science instruction	Learner Responses %	Teacher Responses %	Percentage Difference
To facilitate linking concepts with previous related concepts			
During Integrated Science instruction, my teacher:			
Ask learners to state concept relationships.	33.0	25.9	+7.1
Encourage learners to clarify concept misconceptions	18.9	34.1	-15.2
Engage learners in activities to clarify conceptions.	25.7	27.3	-1.6
Allow learners to restate concepts in their own words.	43.2	27.3	+15.9
Encourage learners to comment on given responses.	26.0	38.6	-12.6
Encourage learners to clarify how concepts build up.	35.1	31.8	+3.3
To encourage broad-based thinking on scientific concepts			
During Integrated Science instruction, my teacher:			
Asks questions that encourage learner curiosity	51.7	52.3	-0.6
Ask questions from real-life contexts.	39.2	50.0	-10.8
Give learners exams with open-ended questions.	58.0	52.3	+5.7
To encourage investigation through inquiry and evidence			
During Integrated Science instruction, my teacher:			
Allows learners to justify scientific investigations.	77.0	81.8	-4.8
Discuss learner observations not in the course books.	67.7	86.3	-18.6
Consider data analysis supported by scientific facts.	51.8	72.7	-20.9
Do not punish learners for random responses.	78.6	81.8	-3.2
Allow learners to justify the connection of concepts.	80.9	88.6	-7.7
To facilitate reflection and reasoning			
During Integrated Science instruction, my teacher:			
Uses tasks that require explanation, not just correct answers.	91.6	88.6	+3.0
Encourage learners to reflect on how they got answers.	79.1	90.9	-11.8
Provide feedback focusing on scientific reasoning.	65.5	90.9	-25.4
Allow learners to revise explanations based on feedback.	88.9	88.6	+0.3
Create room to justify the connection of concepts.	85.1	88.6	-3.5
Has time for learners with contempt for activities.	85.7	81.8	+3.9
Allow learners to ask random questions from the provided instructions.	93.1	88.6	+4.5

The comparison of learner and teacher responses revealed both negative and positive percentage differences between how both perceive the implementation of CBA practices in Integrated Science learning. The degree of agreement across categories was similar, though the magnitudes varied. The percentage differences were below average for practices that fa-

cilitate linking concepts to related ones, and average for practices that encourage broad-based thinking about scientific concepts. The values rose to the third quartile for practices that encourage investigations through inquiry and evidence, and mainly in the eighth and ninth deciles for practices that facilitate reflection and reasoning. The findings suggest a degree of agreement on how critical thinking is assessed in Integrated

Science Instruction. Critical thinking assessment practices are implemented to varying degrees in Integrated Science learning in junior schools in Nairobi County, with links between concepts and related prior concepts largely missing, and most indicators for facilitating reflection and reasoning well implemented. The percentage-difference analysis further indicated partial agreement between teacher and learner perceptions. Regarding facilitating linking concepts to related ones, learners agreed with teachers on practices such as asking learners to state relationships between scientific concepts (+7.1), allowing learners to restate concepts in their own words (+15.9), and encouraging learners to clarify how concepts build on each other (+3.3). These findings suggest that teachers are relatively effective at implementing evaluation practices that help learners identify relationships between concepts and reconstruct understanding in their own language. According to [1, 15], such practices are consistent with constructivist learning principles, which emphasize active learner engagement in meaning-making through linking prior and new knowledge. However, such evaluation practices do not support conceptual understanding at the Relational and Extended Abstract levels of the SOLO Taxonomy.

Learners disagreed with teachers on practices related to encouraging clarification of misconceptions about scientific concepts (-15.2), encouraging learners to comment on others' responses (-12.6), and engaging learners in activities to clarify previous misconceptions (-1.6). While teachers in public junior schools in Nairobi County believe they provide sufficient opportunities for conceptual correction and collaborative critique, learners reported not consistently experiencing these practices in Integrated Science learning. Teachers overestimate their effectiveness in supporting learners, while learners are not experiencing the support. According to [2], the notable learner perception of weak teacher support is significant because addressing misconceptions and evaluating peer reasoning are critical aspects of deeper critical thinking, especially in science learning, where conceptual change often occurs through questioning, discussion, and evidence-based reasoning.

Teachers in public junior schools in Nairobi County are more successful at evaluating critical thinking in Integrated Science learning at the Pre-structural and Uni-structural levels of the SOLO Taxonomy than at facilitating deeper evaluative practices at the Mult-structural, Relational, and Extended Abstract levels. According to [17], at the Mult-structural level, learners develop a comprehensive understanding of the subject matter and learn to connect multiple facts from prior learning and current knowledge. At the Relational level, learners integrate various aspects of knowledge into a unified whole by analyzing the importance of each part and its role in the overall system. This occurs when the teacher provides instruction that helps learners synthesize and evaluate information, justify conclusions, and engage in evidence-based reasoning. Such instruction should gradually move learners toward Extended Abstract thinking, the current highest level

of the Revised Bloom's Taxonomy (RBT). At Extended Abstract thinking, [7] avers that at this level, learners can generalize, transfer, and creatively apply knowledge to new concepts as they make connections within the provided tasks and generalize concepts and principles from one subject area to a specific domain. Higher-order independent learning is taking place because the learner has deeply mastered a concept, pulling the core principles from one lesson and seamlessly applying them to solve entirely new, unfamiliar problems across different subjects or real-world situations.

Regarding broad-based thinking about scientific facts, there is a near-zero (-0.6) negative deviation between learner and teacher responses on the consistent use of critical-thinking evaluation practices, as reflected in questions that encourage learner curiosity. Although the practice is on average implemented, with (51.7%) of learner and (52.3%) of teacher respondents indicating consistent use, the teachers' perception closely matches what learners experience in classroom practice. However, these findings also exposed a major weakness in Integrated Science learning in public junior schools in Nairobi County. [10] found that teachers do not prepare for anticipated possible learner curiosity responses when preparing Integrated Science instruction. The study further established that teachers do not prepare for possible out-of-context learner responses when presenting Integrated Science instruction. Additionally, more than half (55.4%) of learner respondents disagree with the statement 'the teacher does not reprimand learners who ask out-of-context questions. Out-of-context responses often signal deeper curiosity, creative thinking, or alternative reasoning pathways. Therefore, although teachers and learners agree on consistent use of critical thinking assessment practices that encourage learner curiosity, teachers may be more comfortable managing structured questioning than spontaneous exploratory thinking.

The percentage difference analysis further indicated a larger negative difference (-10.8) in asking questions from real-life contexts. These findings reveal a notable gap between teachers' perceptions and learners' experiences. Teachers appear to believe they frequently use real-life contextual questions to assess learners' thinking, but learners report experiencing this less often. These findings confirm previous results from instructional practices for presenting Integrated Science instruction, where almost all (97.7%) of the teacher respondents reported helping learners connect instruction to real-life situations, with slightly more than three-quarters (79.4%) of learners agreeing that such practice exists. The less consistent and authentic real-world application of scientific knowledge may weaken learners' ability to transfer classroom knowledge to practical problem-solving, a core expectation of CBE [11]. A positive percentage difference (+5.7) was observed when learners were given exams with open-ended questions. This is a positive finding because open-ended assessments create opportunities for learners to explain their reasoning, justify their responses, and demonstrate conceptual understanding, rather

than simply duplicating what exists in written media. Although teachers in public junior schools in Nairobi County appear less effective at consistently embedding assessment within authentic, real-life contexts, they are relatively effective in implementing structured, broad-thinking evaluation practices, particularly those involving open-ended questioning.

Regarding investigation through inquiry and evidence, the findings reveal a major discrepancy between teacher and learner perceptions of critical thinking evaluation practices in Integrated Science learning. Learners disagreed with teachers on all the evaluated practices, including allowing learners to justify scientific investigations (-4.8), not punishing learners for random responses (-3.2), and allowing learners to justify how scientific concepts connect (-7.7). The greatest perception gaps were observed in discussing learner observations beyond course books (-18.6) and considering learner data analysis supported by scientific facts (-20.9), suggesting that learners experience significantly fewer opportunities for authentic inquiry and evidence-based reasoning than teachers perceive. Therefore, although teachers in public junior schools in Nairobi County report moderate use of inquiry-based evaluation practices in Integrated Science learning, classroom assessment remains largely content-bound and teacher-directed. Such practices deny learners the opportunity to investigate beyond textbook knowledge, interpret evidence independently, and generate scientifically justified conclusions.

Concerning facilitating reflection and reasoning, the findings revealed partial alignment between teacher and learner perceptions. However, where the findings aligned was at a lower magnitude, such as using tasks that require explanation, not just correct answers (+3.0), allowing learners to revise their explanations based on feedback (+0.3), the teacher allocating time for learners who express contempt for the given activity (+3.9), and allowing learners to ask random questions based on provided instructions (+4.5). On the contrary, the magnitude was high for practices with which the learners disagreed with the teachers, such as encouraging learners to reflect on how they arrived at their answers (-11.8) and providing feedback that focuses on the quality of reasoning (-25.4). These wide teacher-learner perception gaps justify previous findings where teachers tend to believe they provide learning environments that encourage meaningful reasoning, which learners do not explicitly experience. Teachers in public junior schools in Nairobi County believe they consistently (90.9%) support deeper metacognitive reflection and reasoning during Integrated Science instruction, which learners indicate they experience to a two-thirds (65.5%) extent. Such practices may hinder learners' ability to critically examine their thought processes, justify conclusions, and apply scientific reasoning to real-life situations.

5. Conclusion and Recommendations

The findings established that CBA remains a challenge in

Integrated Science learning. Although teachers in public junior schools in Nairobi County are gradually appreciating the value of assessments that move beyond factual recall toward evaluating analytical and reasoning skills, many do not consistently consider possible out-of-context learner responses in Integrated Science assessment. However, implementation of critical thinking evaluation practices that encourage scientific investigation through higher-order cognitive skills was relatively strong. Notably, although teachers in public junior schools in Nairobi County are increasingly incorporating evidence-based assessment practices in Integrated Science learning, some teachers do not allow learners to analyze data differently, supported by scientific evidence. This indicates continued reliance on assessment approaches centered on predetermined responses and available data, limiting learners' opportunities to challenge existing knowledge, generate alternative explanations, and engage in deeper scientific inquiry.

An effective implementation of critical thinking evaluation practices that facilitate reflection and reasoning in Integrated Science learning was observed among the teachers, with a high proportion of teachers reporting creating opportunities for learners to justify the connection of scientific concepts to real-life situations and allowing random questions based on given instructions. The teacher further reported that they provide time for learners who express contempt during activities as well as facilitate the application of knowledge to real-life situations. When teachers were asked about any challenges they encounter in implementing CBA practices in Integrated Science instruction, many indicated challenges in curriculum interpretation.

The comparison of learner and teacher responses revealed both negative and positive percentage differences between how both perceive the implementation of CBA practices in Integrated Science learning. The degree of agreement across categories was similar, though the magnitudes varied. The percentages were below average for practices that facilitate linking concepts to related ones, and average for practices that encourage broad-based thinking about scientific concepts. Learners disagreed with teachers on practices related to encouraging clarification of misconceptions about scientific concepts, encouraging learners to comment on others' responses, and engaging learners in activities to clarify previous misconceptions. These wide teacher-learner perceptions indicate a gap between what teachers tend to believe about CBA and what learners experience in the classroom.

Based on these findings, the study recommends that teacher education institutions include structured instructional design models for competency-based teaching in both pre-service and in-service programs to equip teachers with skills for assessing critical thinking in learners through inquiry, conceptual connections, reflection, and the real-world application of knowledge. The study also suggests future research to develop assessment frameworks that help teachers reliably evaluate critical thinking skills across different areas of the CBE.

Abbreviations

CBA	Competency-Based Assessment
CBE	Competency-Based Education
IBL	Inquiry-Based Learning
KICD	Kenya Institute of Curriculum Development
KNEC	Kenya National Examination Council
UNESCO	United Nations Educational, Scientific, and Cultural Organization

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Conflicts of Interest

The authors declare no conflict of interest.

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