Addressing the self-directed learning culture gap in Kenya's Junior School Science Curriculum

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Abstract
        This is a philosophical study and involves conceptual analysis of existing documents on Competency-Based Curriculum (CBC), Kenya's curriculum reforms and self-directed learning culture (SDLC). The study mainly focuses on how the curriculum reforms and curriculum for Kenyan CBC junior schools integrate science, and the current theoretical instructional model has promoted the development of SDLC. The data collected and analyzed is theoretical. This conceptual analysis applies the Kantian critical judgment theory model to analyses the data collected and assess findings using the reflective self-directed instructional model (RSIM). RSIM has standard sub-themes and learning strategies used in assessing SDLC. Key sub-themes and learning strategies used as standard are self-motivation, self-reflection, self-regulation, active learning, metacognition, and collaborative community of inquiry. Key theoretical premises and claims, co-premises, propositions, and supporting evidence are developed using the categories scrutinized and analyzed. According to the analysis, the study reveals a significant gap in the integration of SDLC within the CBC reforms and curriculum design. The study, therefore, proposes a novel instructional model to address this shortfall.

Keywords: Self-directed learning, Competency, Competency-based curriculum, Junior School, Integrated science

Introduction

This research aims to analyze the structure of the integrated science curriculum for ninth grade as outlined in the Kenyan Competency-Based Curriculum (CBC). A significant emphasis is placed on exploring the gaps in self-directed learning skills, particularly in the context of the COVID-19 school closures, which necessitated that students remain outside the conventional classroom environment where they usually received their educational support.

Rationale of the study

Self-directed learning plays a crucial role in cultivating a mindset geared towards lifelong education, as it enables individuals to assume responsibility for their own learning journeys. This approach not only allows learners to adapt to evolving demands but also enhances their critical thinking abilities, ultimately facilitating the attainment of both personal and professional aspirations. By granting individuals the autonomy to select their own pace, topics, and methods of study, self-directed learning aligns with their unique interests and circumstances. Particularly at basic educational levels, this form of learning significantly boosts motivation and engagement, promotes personalized and flexible study practices, and fosters the development of critical and creative skills, alongside an increase in self-efficacy. Essential components of self-directed learning across all educational levels include the establishment of clear objectives and attainable goals, self-evaluation, proactive exploration of relevant resources, effective time management, and reflective practices. Consequently, it is imperative to equip learners, especially those engaged in integrated science at the basic education level, with the necessary skills for self-directed learning.

Background of the Study

Various adaptations and innovations have emerged globally to facilitate educational access for all learners, whether in traditional classrooms, at home, or in alternative settings. This transformation has been largely prompted by the substantial disruptions to education resulting from the COVID-19 pandemic, which necessitated a departure from conventional learning environments. In response, numerous countries have embraced digital platforms, television, radio, and print media to sustain student engagement with educational materials. However, the implementation of these strategies exhibits considerable variation across nations, and their overall effectiveness

has yet to be comprehensively evaluated (Reimers, 2022). In contrast, lower and middle-income countries, such as Kenya, primarily rely on one-way communication channels like television and radio, with limited participation in online learning platforms such as YouTube, Zoom, Google Classroom, and Google Meet (Ng'ang'a, 2021). Conversely, more affluent nations, including the United States, have predominantly shifted to online classes via various digital learning platforms and have provided educational materials for home use.

The role of households is also crucial in the learning process during periods of school closure. In Kenya, approximately 30% of students from more privileged backgrounds have access to media, internet-enabled devices, books, sufficient time, and adequate study space (Ng'ang'a, 2021). However, according to Reimers (2022) and Punjani & Mahadevan (2021), these learners often lack essential 21st-century soft skills, knowledge, and the ability to study independently and remotely. Conversely, around 70% of learners in Kenya (Ng'ang'a, 2021; UNICEF, 2020) struggle to access such devices, and those who do often have only limited access to radio and television, frequently without adequate guidance from their families (Punjani & Mahadevan, 2021). In light of these challenges, this study aims to explore the potential for fostering a self-directed learning culture (SDLC) that would enable learners, particularly at the junior school levels of the Competency-Based Curriculum (CBC) in Kenya, to engage in learning anytime and anywhere.

Before the onset of COVID-19, secondary school students following the Kenyan 8-4-4 curriculum, which encompasses eight years of primary education, four years of secondary education, and an additional four years for post-secondary studies, were not exposed to essential critical thinking dispositions. The learning outcomes outlined in the Competency-Based Curriculum (CBC) for grades VII and VIII primarily require students to identify, recall, enumerate, and apply knowledge within a classroom setting, which aligns with lower-order thinking skills as categorized by Bloom's taxonomy. The CBC framework has predominantly focused on enumerating the skills and knowledge that students are expected to acquire, neglecting the teaching of dispositions that are fundamental to fostering critical thinking at the junior school level of the educational continuum.

In response to the challenges posed by COVID-19, the Ministry of Education (MOE) articulated nine objectives aimed at alleviating the pandemic's impact on the education sector. However, the development of critical thinking skills for students was conspicuously absent from the emergency response plan, indicating a significant oversight in addressing this vital area during the transition period. The instructional strategies implemented during this time, which included digital and online content as well as broadcasts via television and radio, were executed without adequately

training parents, teachers, and students on the importance of sustained learning amidst the pandemic. Furthermore, the limitations of remote learning in low- and middle-income countries, including Kenya, can be attributed to a lack of knowledge, skills, dispositions, and access to computer-based learning resources. This study aims to assess the impacts of factors such as awareness of the COVID-19 pandemic, computer-based self-efficacy, curiosity, and online teaching and learning on the perceived benefits for learners, which are essential for cultivating a culture of self-directed learning.

Research Gap

The obstacles encountered in the implementation of Kenya's new Competency-Based Curriculum (CBC) due to the COVID-19 pandemic are increasingly being perceived in a more favorable light. Although the expectation is for post-pandemic learning to foster self-directedness among students, the necessary skills, technologies, and information and communication technology (ICT) infrastructure remain insufficient. Current evidence suggests that Kenyan learners are not receiving adequate support in developing critical thinking skills, particularly in the context of limited learning management systems, insufficient digital devices, and a lack of computer literacy and digital infrastructure. This situation presents a significant challenge for a nation aiming to cultivate a culture of self-directed learning among its students. Consequently, there is a pressing need for research focused on the skills and dispositions that could facilitate the establishment of a self-directed learning culture, particularly in the context of integrated science for junior school students. This study aims to critically examine the feasibility of fostering a self-directed learning culture (SDLC) within the framework of Kenya's CBC for junior school learners.

Literature Related to Self-Directed Learning

In order to gain a comprehensive understanding of self-directed learning and the dynamics of teaching and learning within basic educational institutions during the COVID-19 pandemic, a broader study has been conducted. This investigation includes an assessment of pertinent theories and methodologies for analyzing and measuring data, utilizing a standardized self-directed learning model as a framework. While it has not been feasible to encompass the full spectrum of authors in the domain of self-directed learning, the research has successfully established a balanced representation of those whose contributions have significantly shaped the culture of self-directed learning. A substantial majority of educators, exceeding 70%, were found to be inadequately prepared for the transition to remote teaching during the school closures prompted by the pandemic (Wambaria, 2023; Willies, 2023). This lack of preparedness has implications for learners, who are similarly ill-

equipped to engage in self-directed study. Furthermore, the digital infrastructure, devices, and other essential resources for remote education were found to be unreliable throughout the COVID-19 period (Wambaria, 2023). Additionally, learners exhibited deficiencies in critical thinking dispositions (Wairimu & Chilufya, 2022) and the necessary competencies for independent study (Willies, 2023).

Assessing the current basic education theoretical teaching-learning approach

The curriculum for basic education in Kenya is primarily framed through a technical lens. The processes involved in curriculum development and design within this educational framework are predominantly characterized by technocratic and bureaucratic elements, as noted by Heto et al. (2020) and Nganga & Kambutu (2019). This management approach to curriculum preparation and execution, which aligns with the social-behavioral paradigm, typically follows a predetermined logical sequence, with specific objectives and activities designed to achieve these objectives. The communication framework is predominantly hierarchical, reflecting a top-down model. While the Kenyan Competency-Based Curriculum (CBC) for junior school education includes various overarching statements that emphasize the importance of skills development and address contemporary challenges in academia, there remains a scarcity of explicit examples of skills and competency development within the official documents, particularly in the syllabus, as highlighted by Kobiah (2020).

Decisions regarding the curriculum in Kenyan basic education, along with education policies and the necessity for curriculum reform, have traditionally been made by curriculum experts, supervisors at the Kenya Institute of Curriculum Development (KICD), and officials from the Ministry of Education (Akala, 2021). These decisions are then relayed through the bureaucratic hierarchy to essential stakeholders, including teachers, students, and parents (Kobiah, 2020). Within schools, the implementation of these decisions and teaching models is delegated to various departments by headteachers, who serve as curriculum managers. However, despite their pivotal role in the implementation process, headteachers do not possess complete authority over the change process within their institutions (Heto et al., 2020; Nganga & Kambutu, 2017). Their primary responsibility revolves around ensuring compliance with school routines, which includes tasks such as monitoring teacher attendance, maintaining registers, and overseeing examination procedures. In this context, teachers, students, and parents are often viewed as mere components of a rational system, despite the fact that a school functions as a community involving continuous interaction among learners, educators, and administrators (Syomwene, 2020). Unfortunately,

when curriculum specialists design the curriculum, they tend to overlook these vital interactions, leading to a curriculum that lacks evolution, authenticity, and a learner-centered approach, ultimately failing to foster personalized learning experiences for self-directed education.

The developers of the Competency-Based Curriculum (CBC) have integrated constructivism as a foundational learning model, a concept advocated by Dewey's contemporaries (1966) (Akala, 2021; Ongesa, 2020). This educational approach positions the learner at the heart of the knowledge acquisition process. However, Basweti (2019) and Ongesa et al. (2024) contend that the constructivist model is conspicuously absent from the teaching curriculum designed for students in grades V to IX within the new CBC framework. In constructivist theory, the educator's role is redefined as that of a facilitator rather than the primary source of knowledge. Furthermore, constructivism underscores the significant involvement of learners' guardians or parents, emphasizing their critical role in the educational process (Lumonya, 2020). The cultivation of critical thinking, particularly the development of essential critical thinking dispositions, empowers learners to express their thoughts freely and engage in the application, analysis, creation, and acceptance of diverse viewpoints and information, even when such perspectives may conflict with their previously held beliefs.

Ennis (2018) and Sande (2020) highlight in their observations that the absence of learner engagement in the processes of problem identification, content creation, and the formulation of solutions results in knowledge that lacks constructiveness, creativity, and criticality. Consequently, the recently implemented 2-6-6-3 curriculum, which allocates two years for pre-primary education, six years for primary, three years for junior school, and three years for post-secondary education, alongside the previous 8-4-4 curriculum—where students spend eight years in primary, four years in secondary, and four years in tertiary education—has not effectively addressed the cultivation of a self-directed learning culture. This shortcoming can be attributed to the reliance on social-behavioral or top-down management models in educational settings, which have not adequately engaged essential stakeholders in the processes of curriculum development and implementation. Such models prove inadequate in fostering the skills necessary for nurturing a self-directed learning environment within schools.

Critical thinking-based learning model for quality content delivery

Wambaria (2023) and Willies (2023) have identified a significant theoretical and methodological deficiency in the integration of critical thinking within the educational curricula of numerous developing nations, particularly in Kenya. Furthermore, Camilleri & Camilleri (2023) and Zhao & Watterston (2021) highlight that learners globally now have unprecedented

access to a diverse array of content, often at little or no cost, through the internet and digital devices. With the availability of tools such as video cameras and smartphones, students can easily gather and edit digital materials, which can then be incorporated into their academic work. This shift necessitates a transformation in instructional approaches, moving away from the traditional methods of delivering large volumes of information or relying solely on a single textbook for assignments. Instead, educators should facilitate learners in evaluating, applying, locating, and analyzing information pertinent to specific subject areas (Bozdağ & Gökler, 2023; Zhao & Watterston, 2021). The relevance of this information will increasingly be co-constructed between educators and students. A pedagogical model that emphasizes learner autonomy and choice is essential for effective assessment, support, and delivery within universities and primary educational institutions. This study aims to explore existing literature to identify a model that fosters a culture of self-directed learning within the Kenyan Competency-Based Curriculum (CBC) for junior schools and beyond. It has been determined that there is a gap in the current models, and the study intends to propose a robust framework for cultivating a self-directed learning culture in Kenyan CBC junior schools and beyond.

Methodology

The research conducted is a documentary analysis that leverages secondary data sourced from scholars, educational experts, policymakers, and governmental reports to investigate the gaps in the Kenyan Competency-Based Curriculum (CBC) for integrated science at the junior school level. The analysis employs speculative and reflective methodologies to critique and evaluate secondary documents pertinent to the CBC junior school education curriculum in Kenya. This examination encompasses various aspects, including reform reports, pedagogical models, curriculum design, and instructional materials utilized in Kenyan CBC junior schools. Additionally, the study reflects on and speculates about the integration of concepts such as self-efficacy, open-mindedness, a propensity for rational inquiry, inquisitiveness, self-reflection, self-monitoring, and self-control within the design of the CBC education curriculum for integrated science learners at the junior school level. Furthermore, the documents analyzed also address pedagogical strategies and theoretical frameworks that are either currently employed or recommended for fostering a culture of self-directed learning within the Kenyan CBC junior school education curriculum. The data for this analysis were drawn from key documents, including the Kenya Basic Education COVID-19 Emergency Response Plan Report (2020) and the Kenya Institute of Curriculum Development (KICD) curriculum for junior school grades VIII and IX in integrated science (2023). The categories

analyzed serve as a foundation for developing theoretical premises that inform the study's analysis and evaluation.

Study Findings and Analysis

The introduction of a competency-based curriculum (CBC) in 2017 aimed to integrate artificial intelligence (AI) into educational practices, emphasizing skill acquisition over traditional content delivery. However, the implementation of AI has encountered significant obstacles, including a lack of adequate information and communication technology (ICT) devices and infrastructure, compounded by slow and unreliable internet access. Furthermore, the CBC framework has established a system of summative evaluations at the end of each instructional cycle, designed to determine students' readiness to advance to subsequent levels of education.

In the context of Kenyan elementary education, only 120,000 out of 2 million pre-primary students have access to computers and iPads, with a mere 22.4% of this group having internet connectivity. By 2023, 82% of schools reported having power sources, including both mains electricity and solar energy. Notably, only 49,000 students, representing 5% of the 914,000 candidates who sat for the KCSE 2022 examination, participated in computer classes. This scenario indicates a concerningly low level of computer literacy within the Kenyan basic education system. The existing challenges related to ICT infrastructure and digital resources hinder effective management and learning processes. To successfully integrate digital content into educational practices, many teacher educators require access to digital devices, yet the prevailing issues surrounding device availability and internet infrastructure continue to impede progress, resulting in the underutilization of digital resources within educational institutions.

Addressing self-directed learning culture gap in Kenyan CBC Junior School Science

The primary educational goal for ninth-grade students in integrated science classes is to effectively utilize literacy, scientific knowledge, and principles to develop appropriate scientific skills and practices applicable to everyday life. To address scientific challenges encountered in daily situations, students are required to integrate their scientific knowledge, skills, values, and attitudes. Achieving specific learning outcomes is essential for junior high school students in integrated science, as it equips them with critical thinking and problem-solving capabilities. Students should enhance their skills in manipulation, management, conservation, hygiene, sanitation, and interpretation through a scientific approach that fosters creativity and effective problem-solving. Furthermore, it is imperative for students to apply scientific principles, knowledge, and foundational skills to resolve scientific issues

across various contexts. The integrated science curriculum is designed to impart knowledge of science, scientific skills, and principles; however, it does not adequately address the development of critical thinking dispositions and criticality within the ninth-grade curriculum for junior high school students.

The educational goals for integrated science encompass the acquisition of scientific knowledge, skills, and concepts aimed at environmental preservation, personal hygiene maintenance, and the establishment of effective scientific methodologies for environmental control. Students in junior school, particularly those in grade nine, are expected to develop specific scientific competencies, including manipulation, environmental management, conservation, sanitation, nutrition, and natural interpretation. However, the curriculum does not emphasize the cultivation of critical thinking dispositions or self-efficacy skills. The overarching objectives of the integrated science course fail to incorporate essential elements such as self-monitoring, self-management, self-reflection, open-mindedness, and curiosity, which are vital for fostering a self-directed learning culture and enhancing critical thinking, as highlighted by Roeniger (2023).

While self-efficacy is briefly mentioned in the context of force and energy and the study of curved mirrors, it plays a significant role in the learning process. For instance, when ninth-grade students engage in discussions about the characteristics of images produced by curved mirrors, they not only practice leadership but also enhance their self-efficacy. This term refers to the confidence learners possess when facing challenging tasks or questions during their educational journey. Although peer discussions are common, they do not equate to the development of self-efficacy. The assessment of self-efficacy levels reveals a notable gap in the critical thinking dispositions necessary for fostering a self-directed learning culture within integrated science curricula.

The design of the integrated science curriculum for junior school students is deficient in essential competencies necessary for the development of Systems Development Life Cycle (SDLC) and critical thinking, beyond merely imparting scientific knowledge, principles, and skills. Key abilities such as manipulation, environmental management, conservation, sanitation, nutrition, and nature interpretation are notably absent. According to the findings of the study and the Elder-Paul (2019) model for assessing SDLC, the integrated science curriculum outlined by KICD (2024) lacks several critical thinking dispositions, including role-playing, active learning, inquiry-based learning, modeling thought processes, utilizing tools to enhance cognitive engagement, collaborative learning, real-world application, visualization and prediction, as well as writing skills. This deficiency suggests that the integrated science curriculum for ninth-grade students not only fails to cover all critical thinking indicators but also does not equip students with

the necessary skills to effectively develop SDLC and critical thinking. Consequently, without these additional competencies, the teaching of manipulation, environmental management, conservation, sanitation, nutrition, and nature interpretation cannot adequately facilitate the comprehensive development of SDLC. Thus, it is clear that a significant gap exists in the promotion of SDLC among junior school learners engaged in integrated science education.

The primary inquiry topics within the integrated science curriculum, such as mixtures, elements, and compounds; living organisms and their environments; and force and energy, do not emphasize critical thinking. For example, when exploring the concepts of mixtures, elements, and compounds, students are prompted to engage with specific inquiries that may not foster a critical thinking approach.

What importance does the structure of an atom hold? Students are encouraged to create models of specific elemental atoms utilizing locally accessible materials. Given the complexity of real atoms and the advanced techniques required to manipulate them, they can only be observed through an electron microscope, which is typically found in national science centers. The act of modeling a hypothetical atom serves to stimulate creativity. However, according to Bloom's taxonomy, such imaginative tasks are considered lower-order skills and do not contribute significantly to the enhancement of critical thinking and the Software Development Life Cycle (SDLC) in students.

For ninth-grade learners in an integrated science curriculum, several inquiry questions pertinent to the theme of living organisms and their environment are proposed: Why is hard water preferred for consumption? What is the significance of photosynthesis in the ecosystem? How does the human body process food? To evaluate the conditions necessary for photosynthesis, students are expected to conduct experiments and share their findings in class. Engaging in experimental or manipulative activities fosters critical thinking and creativity. It is essential to assess the learner's understanding of photosynthesis, regardless of prior coverage of the topic. A reflective and analytical student can explore and verify the conditions for photosynthesis even without direct inquiry into the subject.

Students are encouraged to articulate their knowledge and understanding of the human digestive process while also engaging with the perspectives of their peers. Listening may occur primarily when students are prompted to recall previously learned information or when they acquire knowledge at an early stage, often in the absence of practical application. Within Bloom's taxonomy, the act of remembering is classified as a lower-order cognitive skill. The development of critical thinking and the Software Development Life Cycle (SDLC) cannot be effectively achieved through techniques that rely solely on lower-order thinking.

The inquiry questions proposed for the force and energy strand, which students are expected to address, include: what are curved mirrors and their applications in everyday life, and how are waves utilized in daily activities? These questions, along with other significant inquiries for ninth-grade integrated science, are structured to elicit specific responses from students. Such guided inquiries are typically closed-ended, which limits the potential for fostering open-mindedness a crucial component of critical thinking. The absence of open-ended questions in the proposed major inquiries indicates a shortfall in the development of critical thinking skills within the integrated science curriculum for junior school students in the Kenyan Competency-Based Curriculum (CBC).

A learner who successfully meets or surpasses assessment criteria should not only have a solid foundation in scientific knowledge but also demonstrate competencies in management, manipulation, conservation, experimentation, and nutrition. While the suggested inquiry questions for ninth-grade integrated science students may aid in fostering critical thinking skills, there is a noticeable deficiency in student curiosity. The predominant use of "how" and "what" as the initial prompts for most proposed inquiry questions suggests a lack of depth and engagement. Furthermore, it is essential that students generate inquiry questions driven by genuine curiosity rather than solely relying on the subject matter or the instructor. This reliance indicates a significant shortfall in the integrated science curriculum for ninth graders, particularly concerning the critical thinking components necessary for the Skills Development and Learning Competencies (SDLC). Consequently, there exists a notable gap in the integrated science and Competency-Based Curriculum (CBC) frameworks for junior schools.

Moreover, the integrated science curriculum for ninth-grade students does not address the development of self-efficacy, a vital aspect of critical thinking that encompasses self-confidence. The current CBC framework fails to incorporate essential critical thinking dispositions such as open-mindedness, inquisitiveness, truth-seeking, and self-efficacy. Given that these dispositions are integral to critical thinking indicators and the SDLC, the absence of such elements in junior school integrated science activities signifies a deficiency in fostering critical thinking skills. As a result, the integrated science curriculum for junior school students is inadequate in promoting critical thinking and SDLC. The lack of focus on critical thinking indicators within the curriculum may hinder a junior high integrated science student's ability to engage in critical thought, with discussions surrounding the development of these skills being only superficially addressed.

The lack of critical engagement among learners can be attributed to the absence of expectations for them to voluntarily participate in study projects that would benefit both themselves and society. Participation in integrated

science initiatives that promote learning and address societal challenges, such as hearing loss and vision impairment, exemplifies the critical engagement that is currently lacking among students. In the context of the integrated science curriculum for ninth-grade junior school students, critical engagement is notably absent. While the curriculum is a significant aspect of fostering critical thinking, it does not adequately address this deficiency. Ninth-grade students are tasked with developing community service projects, which require them to identify community issues and formulate solutions. Through this process, they are expected to acquire knowledge, skills, values, and attitudes pertinent to community service. However, the integrated science curriculum for these students is deficient in essential critical thinking skills, such as effective writing, collaborative inquiry, active learning, expert modeling, creativity, and practical skills. This shortfall suggests that the curriculum either overlooks or inadequately incorporates the fundamental elements of critical thinking. Furthermore, the community service assignments lack critical thinking attributes, including open-mindedness, curiosity, truth-seeking, and self-efficacy. Consequently, the absence of these critical thinking indicators hinders the potential for community service programs to enhance students' critical thinking abilities and foster sustainable development learning competencies (SDLC). Thus, there exists a significant gap in critical thinking dispositions among ninth-grade integrated science learners within the Kenyan Competency-Based Curriculum (CBC).

The curriculum report does not mandate that a ninth-grade student in integrated science must independently plan and execute their community service project. This suggests that any individual from the student's family or community may select the project, carry it out, or assist the student in its completion. If the individual who assigned the project also instructs the student on how to present it in class, the student may fail to achieve the intended goals of the project. Furthermore, the curriculum report lacks a clear framework for educators to assess the authenticity of the community service projects undertaken by students in integrated science courses. The evaluation process for these projects should provide guidance to instructors on how to verify the legitimacy of the completed work before making judgments about whether a student has met, exceeded, approached, or fallen short of the established expectations.

Addressing the self-directed learning culture gap in Kenyan CBC Junior school science curriculum using a standard model

In order to conduct a thorough evaluation of the analyzed documents, the research utilized a self-directed teaching-learning framework known as the Reflective Self-directed Instructional Model (RSIM), which is also referred to as the multiliteracies self-directed learning model. The authors Mentz,

Laubscher, and Olivier (2021) undertook a comprehensive review of existing self-directed teaching-learning models, identifying deficiencies in prior frameworks, which led to the development of RSIM. This model encompasses various themes, sub-themes, and essential components that are crucial for a self-directed learning curriculum, enabling learners to take charge of, manage, and oversee their educational experiences independently. The learning strategies of self-directed learners, as articulated within the RSIM framework proposed by Mentz, Laubscher, and Olivier (2021), are succinctly presented in Table 1 below.

Table 1: Reflective SDLC for a self-directed learning elements

Common themes	Common Sub-themes	Learning strategy (The role of the SDL learner)
Competency and commitment to self-directed learning	Self-motivation Self-monitoring Self-control Self-reflection	● Open-ended activities and assignments. ● Active learning ● Mind-mapping ● Formulating research or inquiry-based questions. ● The completion of projects, reports, and portfolios, allowing learners to exhibit their knowledge and skills effectively. ● Selection of medium to communicate their competencies: Writing, speaking, visual presentations, multimedia, or other formats. ● Collaborative communities of inquiry.

Mentz, Laubscher, and Olivier's (2021) Reflective Self-directed Instructional Model (RSIM) serve as a foundational framework in this research for evaluating the Self-Directed Learning Culture (SDLC) within junior school education curricula, with a particular focus on integrated science programs. The analysis of competency-based curriculum documents related to junior school integrated science, which includes reform reports on CBC, the integrated science curriculum, and the emergency response plan for education during the COVID-19 pandemic, is conducted through the lens of the RSIM. This examination reveals recurring themes and pedagogical strategies that are essential for fostering a self-directed teaching and learning environment, as detailed in Table 1.

The study further illustrates how these identified sub-themes and learning strategies pertinent to a self-directed learning culture are contextualized within the Kenyan CBC junior school integrated science curricula. Notably, a significant number of these sub-themes are either missing or insufficiently articulated in the Grade IX curricula of the Kenyan CBC, as previously analyzed. Key learning strategies that support a self-directed learning culture, such as digital literacy, goal setting, student-generated

inquiry questions, real-life experiences, and collaborative community studies, are notably absent. Additionally, strategies like modeling, role-playing, competency demonstrated through completed projects and portfolios, open-mindedness, self-monitoring, and real-life experiences are inadequately developed within the design of the Kenyan CBC junior school integrated science curriculum.

Research has indicated that students in Kenyan CBC junior schools face significant challenges in speaking, writing, and overall communication skills. The analysis presented earlier in this paper highlights the inadequate and uneven distribution of digital devices and infrastructure throughout the country, affecting schools and families alike. The educational objectives are predetermined for learners, which diminishes their ability to exercise self-regulation over the problems or projects assigned to them. Furthermore, the inquiry questions provided to students are fixed, leaving no opportunity for them to propose their own questions or enhance those already established. This situation restricts learners' curiosity and open-mindedness in both question formulation and response strategies. Additionally, the curriculum design lacks evidence of engaging students with real-world experiences or relevant issues. In the context of the grade IX curriculum, which includes topics such as mixtures, elements and compounds, and force and energy, students are not adequately exposed to practical experiences related to these concepts. While some aspects of mixtures and living organisms are addressed, the connection to real-life applications remains superficial, preventing learners from visualizing essential scientific principles. For instance, while students are required to memorize the symbols and atomic numbers of elements like iron, sodium, and chlorine, such abstract learning does not foster genuine curiosity or promote self-directed learning.

The absence of modeling self-control, self-reflection, and self-monitoring by instructors significantly undermines the effectiveness of completed projects, as students often lack these essential skills in managing their work. This deficiency leads to challenges in verifying the authenticity of students' outputs, particularly when poor language skills and dialectical issues hinder their ability to communicate effectively. Consequently, students who struggle with writing may exhibit a lack of curiosity, which in turn diminishes their capacity for self-directed learning during instructional activities. To address this issue, it is crucial to nurture and instill curiosity within students. Implementing Socratic questioning in small collaborative inquiry groups, where diverse perspectives and assumptions are explored, can effectively enhance students' curiosity. Such an approach encourages educators to transcend conventional understandings by clearly defining existing knowledge and promoting innovative concepts through creative learning experiences. It is advisable for educators to prioritize curiosity and an inquiry-based

methodology in their lesson planning and delivery, as this strategy fosters the generation of new ideas and encourages reflective thinking. When students engage in small, cooperative inquiry groups, they critically examine and evaluate the assumptions related to specific tasks, creating a supportive environment that bolsters self-efficacy. In these collaborative settings, students' creativity and self-efficacy are likely to flourish as they share and develop their ideas alongside peers with differing viewpoints.

Effective Self-directed Learning Culture Strategies

The focus of this discussion is on learner-centered, non-formal online learning, which is identified as a crucial and effective strategy for self-directed learning. The subsequent section will evaluate and elaborate on these learning strategies.

Learner-Centered, and Non-Formal Online Learning

Self-regulated instructional models should be embraced in the post-COVID-19 educational framework, moving away from traditional teacher-directed approaches. The essence of genuine self-motivated and self-regulated learning lies in the ability of learners to forge their own unique and thoughtful educational journeys, thereby fostering a culture of self-directed learning. This approach enables students to acquire knowledge that resonates with their personal interests and strengths. To facilitate this, the curriculum must not only incorporate essential critical thinking skills but also empower students to shape their own learning experiences without excessive constraints imposed by predetermined content or instructor directives.

Empowering students with ownership of the curriculum not only enhances their individuality but also affirms their rights as autonomous learners, thereby nurturing a self-directed learning environment. Such a curriculum allows students to propose innovative course materials, make informed choices, and accept the consequences of their decisions. Furthermore, it encourages students to take charge of their educational journey by engaging with the subject matter, exploring relevant issues, identifying potential solutions, and cultivating lifelong learning skills and habits.

Students have the opportunity to access a diverse array of free, multi-source, and site-specific educational resources relevant to their fields of study through various platforms, including the Internet, virtual laboratories, and traditional classroom environments. With the advent of technology, learners are equipped with devices such as video cameras, AI-enabled smartphones, tablets, and personal computers, which facilitate their engagement with virtual information and data that can be tailored for academic assignments. To enhance the effectiveness of learning, educators should move away from delivering content in large, unmanageable segments, such as extensive

chapters or singular textbooks, and instead foster a collaborative approach where both teachers and students assess the relevance and applicability of the materials.

In this context, it is crucial for students, particularly those in Kenya's CBC junior schools studying integrated science, to be allowed to bring portable internet-enabled devices into the classroom, including smartphones and video cameras, provided they have received adequate training in self-directed learning. Self-directed learners possess the ability to identify and utilize resources that are both beneficial and challenging, which are often not readily available through social media channels. Characteristics such as independence, self-awareness, and self-reliance define self-regulated learners. Research indicates that these devices serve as effective tools for tasks involving pattern recognition, repetition, and memorization, which are essential for information gathering, storage, and retrieval. However, it is important to note that these activities represent lower-order thinking skills and do not contribute significantly to the development of self-directed learning, as they do not necessitate rigorous classroom engagement.

Individual critical thinking, human values, and humanity will be the most important commodities that set humans apart from those lacking them in a world of artificial intelligence. Because of this, it's critical to foster in students a culture of self-directed learning from an early age in basic education settings (primary and secondary schools). Since the future is unpredictable, unclear, and ever-changing, it is crucial to foster traits like curiosity and self-efficacy. Learners will become critical thinkers if more time is allotted for more engaging activities that can foster the growth of a self-directed learning culture in them rather than just having them recollect and retrieve knowledge that can be done quickly by AI gadgets. In Kenyan CBC junior schools, curiosity and open-mindedness that foster self-directed persons should be promoted.

This study analysis and Roeniger's (2023) study on 'cultivating learning throughout life' which has observed that Massive Open Online Courses (MOOCs) and Online Education tools (OER) are two recent innovations in the field of education that provide learners with tools to enable and promote their independence during non-formal learning. Peer discussions, automated testing, and grading will give those students feedback and encouragement on their subject of study. This is also feasible if instructors have inspired students to consider ideas that are pertinent to their field of study. These chances for independent, non-formal online learning are anticipated to address any learning gaps that may have arisen during, particularly in the wake of, the COVID-19 pandemic and its aftermath. When we implement remote or online learning in our junior school and senior school

going forward, we also need to instill a strong self-regulated learning culture in those students so they can make informed material choices.

Discussion and summary of study findings

The thesis that there is a gap in SDLC revealed by the introduction of COVID-19 is strengthened by this study. To encourage the development of the SDLC, it implies that educators and students require support as well as a phrasing paradigm that makes use of important critical thinking dispositions as a unifying theme. The degree to which SDLC had been promoted during instructional delivery by Kenyan educators in schools, how key critical thinking dispositions (CTD) in the current instructional model in Kenya's CBC junior school integrated science curriculum design, and the suitable instructional model that promotes SDLC in junior schools are addressed.

The majority of common themes found in self-directed learning cultures, such as important dispositional aspects of critical thinking, competency and commitment, the development of conviction as a value, and the desire to foster such a culture, are either absent from the Kenyan CBC junior grade IX education curricula or are discussed in a way that is too general to foster the growth of a self-directed learning culture. The curriculum modifications examined also lack the majority of common sub-themes, such as truth-seeking, curiosity, open-mindedness, self-motivation, self-management, self-control, and small collaborative communities of inquiry. The examined categories also lack self-directed learning techniques like digital literacy, speaking, writing, and communicating, as well as experiences from real life, role-playing, modelling, active learning, community study or collaboration, and Socratic questioning. As a result, the current teaching-learning paradigm for the grade IX junior school integrated science curriculum has a self-directed learning culture gap.

The Kenyan CBC junior school grade IX curriculum does not yet include the problem-based learning (PBL) approach. Many elements must be in place for problem-based learning to occur, including students' self-determination, skillfully built teams or communities of inquiry, knowledgeable tutors, well-structured problems, activation of past knowledge, and group dynamics. The majority of these elements are absent from the Kenyan CBC junior school curriculum reports examined. A portion of the existing components has also not been implemented in the process of curriculum instruction delivery.

It is necessary to clarify how a self-directed learning culture and essential critical thinking dispositions are to be developed in Kenyan schools for students enrolled in the CBC junior school integrated science education curriculum, as well as other curriculum reform reports. To foster a culture of self-directed learning throughout all school curricula, the Kenyan curriculum

needs to be changed to incorporate common themes, sub-themes, and learning strategies that are covered early on. For instance, individual learning can be done when learners are placed in small learning communities of inquirers with a welcoming environment, instructions, and tasks that are somewhat challenging to solve on their own utilizing an inquiry-based strategy, using constructivism as a learner-centred epistemological approach.

According to the logical analysis, a school's culture of SDLC is established by its teachers' competence, commitment to advancing the development of SDLC, integration of SDLC into all programs, and school-wide practice. The qualities of educators who can support the development of SDLC in a school include being competent in key critical thinking dispositions (CTD) and having a commitment to creating SDLC. School-wide SDLC practice development and the advancement of SDLC in the majority of school programs are related to the creation of a school-wide practice of SDLC. Therefore, Kenyan CBC junior schools must create a school climate that values critical thinking abilities as well as self-monitoring, self-reflection, and self-motivation. All stakeholders in the school must participate in programs that foster a culture of self-monitoring, self-reflection, self-motivation, and critical thinking.

All students should be guided through thought-provoking activities that let their minds roam and grow so they may more easily deal with the challenges they encounter. This calls for a paradigm that makes use of essential dispositional elements of critical thinking to help students reflect on what they have learned and exercise self-control over how they study, explore, and deal with obstacles in life. To assist learners become self-directed, it is vital to foster an environment that supports and encourages self-motivation, self-reflection, self-monitoring, self-efficacy, open-mindedness, truth-seeking, and curiosity. An individual's critical thinking dispositions, knowledge, competency, and commitments, as well as their intended results and convictions, can all be used to establish a self-directed learning culture (SDLC). Additionally, this study's research reveals that teachers who are keen to promote a culture of self-directed learning should be curious, open-minded, truth-seeking, and self-assured. Content that stimulates readers' curiosity may aid them in becoming more independent learners throughout the teaching-learning process.

Several challenges might arise when attempting to establish a self-directed learning culture (SDLC) for students in Kenyan schools, particularly regarding classroom layout, scheduling, location, and even tenure for those tasked with fostering this kind of learning. To create a culture of self-directed learning throughout the school, time is needed to personalize the sessions and obtain pertinent materials. The responses, competency, and dedication of the learners should determine the direction of the discussions. It might take a bit

longer to generate competent, self-directed, critical-thinking students who are also devoted, but only if the educational system is less exam-focused.

Conclusion

Kenya's CBC junior school curriculum has not specified how to encourage the growth of a self-directed learning culture. The examined curriculum reports should include common themes, sub-themes, and learning practices that lead to the development of a self-directed learning culture in schools. According to the study analysis, the competency and commitment of all school stakeholders to SDLC, the formation of SDLC belief, the desired goals of SDLC learners, and important critical thinking dispositions are essential common themes to self-directed learning. Self-monitoring, self-reflection, self-motivation, self-control, self-regulation, and self-management are sub-themes that lead to competency and commitment. Curiosity, open-mindedness, self-efficacy, and truth-seeking are sub-themes to critical thinking dispositions that are underdeveloped in basic learning institutions, where the junior school is shelved. The Kenyan curriculum's current instructional approach includes a clear road map for fostering the creation of SDLC in classrooms. A new model is needed to guide this process.

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