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Developing Instructional Processes for Competency Based Learning of Integrated Science at Junior Secondary School in Kenya

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Abstract
Curriculum reforms world over indicate an overwhelming acceptance of Competency Based Learning in basic education. The curriculum reform in Kenya from the content based learning in the 8-4-4 system of education to Competency Based Curriculum (CBC) entails a paradigm shift in pedagogical approaches from content-based approaches to learner-based approaches. Competence-based learning approach is an integrated and holistic understanding of what we want the young people to learn, be able to do, and to become. This is demonstrated in competencies developed by learners. Such a change in the curriculum require that teachers be adequately trained and supported for its successful implementation. It is however notable that as the first CBC class enters junior secondary school level at Grade 7, many teachers are not adequately prepared for competence-based teaching/learning. This situation informs the need to develop a guide that can be used to assist teachers in implementing competence-based learning. This paper therefore seeks to answer the question 'How should teachers design competence-based learning of Integrated Science for junior secondary school?'. Research work has been done over time to unveil the best processes that help learners acquire competencies in learning. This paper consolidates from literature views on the best practices that help teachers implement heuristic teaching strategies required in the competence-based learning of integrated science. An elaboration on the importance of teacher preparedness for competence-based learning of science at junior secondary school is discussed. The teacher is then guided through designing appropriate competence-based learning environment which involves: (i) Adequate understanding of integrated science curriculum design and competence-based teaching and learning situation; (ii) Creating the learning environment and preparation of resources; (iii) Planning for competence-based learning; (iv) an understanding different heuristic teaching strategies, approaches and methods; (v) Appropriate interaction with learners and (vi) Appropriate assessment of learning. The paper consolidates the characteristics of approaches and methods of teaching science in competence-based learning with a focus on their application by the teacher in a face-to-face classroom situation.
Keywords: Competence-Based Learning, Developing Competency, Heuristic Teaching Methods, Junior Secondary School, Integrated Science Learning, Teacher Preparedness for Competency Based Curriculum.
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1. Introduction

Competency Based Curriculum (CBC) is geared towards improving education by making it more relevant to the needs of the society. The main aim of change of the curriculum in Kenya is to prepare learners for the requirements of a highly dynamic society as well as for the global community. There was need to overcome the weaknesses of the 8-4-4 system of education noted in the summative evaluation of its curriculum. The curriculum was found to have an overload in content, lacked adequate resources for implementation, failed to equip learners with adequate self-reliance skills and was highly academic and examination oriented (KIE, 2009). In turn CBC envisioned development of every learners' potential to enable every Kenyan to become an engaged, empowered and an ethical citizen (The Basic Education Curriculum Framework BECF, 2019). The change has been received with a mixture of excitement as well as criticism. In Kenya, Competency based curriculum was first implemented in 2017 at pre-primary school and grade 1 level. The first class in CBC joins junior secondary in the year 2023. Though teachers have gone through trainings to adapt to the change in the curriculum, some of them have indicated lack of preparedness and a feeling of inadequacy in handling CBC classes at Junior secondary school level (Mohamed, Ondigi & Kiio, 2022). It is important to note that the quality of curriculum implementation is highly dependent on the abilities of the teachers in terms of knowledge, skills and attitudes towards the curriculum. Whether teaching a CBC class or otherwise, the science teacher should focus on effective heuristic methods of teaching that are mostly learner centred. Such teaching strategies are difficult to implement and thus teachers need adequate guidance and facilitation. Based on theoretical analysis of best practices, this paper focuses on guiding teachers on how to design science learning situations for heuristic learning set-up such as required in the CBC classes.

Competency based curriculum is systems of instructions, assessment, grading, and academic reporting that are based on students demonstrating acquisition of competence. The focus is on the set of specific competence (knowledge, skills, values, attitudes) associated with successful academic performance. Competence-Based Learning (CBL) is an approach to learning that mainly focuses on the demonstration of desired learning outcomes by the learners as central to the overall learning process. This is achieved through application of various abilities such as knowledge, skills and attitudes (referred to as competencies). CBC emphasizes the various complex outcomes of a learning process rather than just focusing on what learners are expected to learn in terms of traditionally defined subject content (Preeti, 2021). This involves developing learners' individual capabilities of knowledge, skills, and attitudes that would help them effectively perform real world tasks. Mastery of such capabilities is determined by demonstration of proficiency in a role in measurable/ observable way. The learning process is based on the premise that the learner progresses through the curriculum at their own pace which includes speed, pace, depth, and other similar parameters, usually working with a mentor. The learners engage and interact with the learning content taking responsibility for their learning through direct exploration of knowledge which will result in desired experiences. This type of learning attempts to bridge the gap between industry and academia by emphasizing on the application of knowledge in order to integrate theory and practice in real life context. This learning design shows a definite improvement in job-oriented skills for students. It ensures that students are better prepared to face work-related challenges later in life.

2. TEACHER PREPAREDNESS FOR CBC IMPLEMENTATION

Most secondary school teachers in Kenya have no experience in facilitation of competence-based learning and studies indicate that they feel unprepared for the implementation of CBC at junior secondary school. A study by Rutere and Njeru (2019) on teachers' preparedness in effective implementation of Competence Based Curriculum in primary Schools in Nairobi County found that poor teacher's knowledge on the CBC competencies significantly affected the effective implementation of the curriculum. The study recommended improved teacher training and enhancing awareness on their involvement in decision making to enhance effective implementation of the curriculum. The study also highlights that a number of teachers were not trained on implementation of the curriculum and that the trainings were short in duration, overcrowded, and the trainers had little understanding of the concepts of CBC. Teachers also lacked confidence about their ability to use ICT in teaching. On studying Early Grade primary teacher's implementation of CBC in Kenya, Momanyi and Rop (2019) identified capacity gaps in pedagogy, preparation of teaching documents and assessment. Equally a study on teacher preparedness and implementation of the CBC in public pre-primary schools in Nairobi City County by Isaboke, Mweru & Wambiri (2021), further revealed that the pre-school teachers are were ill-equipped and lacked computer skills to implement the new curriculum despite being trained. The study recommended that the Ministry of Education in collaboration with the Nairobi City County government should adequately create a regular in-service training program. At secondary school level, Mohamed, Ondigi, and Kiio (2022) studied teachers' pedagogical preparedness for the implementation of the Competency-Based Curriculum and found that many teachers had not attended in-service training and therefore, were not conversant with the concept of the CBC. The findings of these studies point to the fact that teachers need more support including training and research based support materials to assist them develop abilities to implement the curriculum.

The problem of teacher preparedness is not a preserve of Kenya. Other developing countries experience similar problems while trying to adapt to curriculum changes. The findings of a study by Nsengimana, Mugabo, Hiroaki & Nkundabakura (2020), reveal that even though CBC has been introduced in different Sub-Saharan African countries to enhance the quality of education, the science curriculum is still implemented in traditional ways thus not effectively addressing socio-economic needs as intended. Paulo (2014) carried out a study on pre-service teacher's preparedness to implement CBC in secondary schools in Tanzania. Findings showed that despite the fact that the curriculum demands changes, and pre-service teachers' awareness of the teaching and assessment methods stipulated to be used for its implementation, teachers were not adopting the envisaged methods in their classroom practices. They were found to continue using the traditional teacher centred teaching methods as well as the usual assessment methods. This indicates need to further support teachers for the implementation of competency based learning in junior secondary beyond the usual pre-service and in-service training.

Other studies cited inadequate teaching and learning materials, inappropriate learning environment and overcrowded classrooms with inadequate teachers for delivery of competence-based curriculum (Atikiya, 2021; Isaboke, Mweru & Wambiri, 2021). Many questions have been therefore raised on how teachers put Competency-Based Curricula into practice (Harris, 2017). The need to review literature on the suggested principles embraced by adopters of CBC and methodologies that can help teachers in designing the competence based learning may therefore not be undermined.

2.1. Importance of Teacher Preparedness for CBL of Integrated Science at Junior Secondary School

In order for science teachers to learn new teaching methods suitable for competence based learning (CBL) situations and be flexible enough to apply them, they need to be familiar with the concept of competence-based teaching and learning (Mkonongwa 2018). They need to appreciate that CBL takes care of individual differences of learners because it is flexible as learners can learn at their own pace. It also supports learners with diverse learning abilities, language literacy variations, knowledge backgrounds, and other related aptitudes. With application of skills to real life environment, learners appreciate the learning of science and thus take responsibility for their education. It focuses on the holistic development of an individual learner, on mastery, ownership, and accountability and therefore equips learners with skills that help them prepare to succeed as adults in the society. Science learning in CBC is relevant to each learner and to real-life problems and the content is and should be tailored to their unique needs which leads to better learner engagement as well as better learning outcomes (Abuga, 2019). According to Strugies (2015), in Competence based learning:

i. Learners receive timely, differentiated support based on their individual learning needs.
ii. Learners advance upon demonstrated mastery.
iii. Competencies include explicit, measurable and transferable learning objectives that empower students.
iv. Learning outcomes emphasize competencies that include application and creation of knowledge along with the development of important skills and dispositions.
v. Assessment is a meaningful and positive learning experience.

This description provides for the type of learning the teacher is required to facilitate in CBC. The role of teachers in competency based learning is therefore immense. Akala (2021) refers to teachers as the heartbeat of the CBC innovation which calls for them to be engaged substantively, and thus the need to be adequately trained and skilled on CBL. A proper understanding of how to design and implement learning activities should help teachers put Competency-Based Curricula into practice.

3. DESIGNING CBL FOR INTEGRATED SCIENCE AT JUNIOR SECONDARY

Designing a competency based learning involves creating varied opportunities for students that allows them to demonstrate important skills in authentic contexts. This is basically important in the learning of science considering the applicable nature of science concepts and the ease with which these concepts can be demonstrated in real life contexts. Designing appropriate competence based learning environment involves:

a. Understanding the curriculum design.
b. Understanding competency based learning situation.
c. Creating a learning environment and preparing resources.
d. Proper planning.
e. Use of varied heuristic teaching strategies.
f. Proper interaction with learners.
g. Appropriate assessment of learning.

These form the areas of focus that guide teachers in appropriate implementation of competence based teaching and learning. The following sub-sections provide an elaborate explanation of each of these areas.

3.1. Understanding the Junior Secondary Integrated Science Curriculum Design

Science learning at junior secondary school is guided by the Basic Education Curriculum Framework (BECF, 2019). Integrated science in CBC can be defined as an effort to organize or integrate science curriculum content into a meaningful whole by a constructive and context-based approach that crosses subject boundaries and links learning to real world (Haatainen, Outi & Aksela, 2021). In order to appropriately implement the integrated science education curricular, it's important to understand how it is embedded in the Basic Education Curriculum Framework (BECF) provided by the Kenyan government through Kenya Institute of Curriculum Development (KICD). The vision of the basic education curriculum is 'To enable every Kenyan to become an engaged, empowered and ethical citizen' and the mission is 'Nurturing every learner's potential' (BECF, 2019). The curriculum implementation should therefore equip every Kenyan learner with world-class standards in skills and knowledge, as well as provide opportunities to identify the potential that every learner brings to school and nurture the potential to its fullness.

The curriculum is based on three important pillars: the guiding principles, theoretical approaches and values. The guiding principles are: Opportunity, Excellence, Diversity and Inclusion, Differentiated Curriculum and Learning, Parental Empowerment and Engagement as well as Community Service Learning. These indicate a curriculum design that takes into consideration diverse needs of learners, engagement of all stakeholders in the learning process and use of authentic learning contexts. The theoretical approaches on which the curriculum is founded include; Instructional Design Theory, Visible Learning Theory and Constructivism Theories. These theories guide the design and development of CBL on creative, contextual and practical learning which allows

learners to develop/construct knowledge and thus be able to apply it in real life situations. The core values that learners should develop during the learning of science include love, responsibility, respect, unity, peace, patriotism, social justice and integrity (BECF, 2019).

An essence statement which gives a general overview and summarizes the fundamental ideas of the integrated science learning area offered in junior secondary is provided by BECF (2019). It explains the rationale of inclusion of integrated science in the curriculum. The statements also provide a brief overview of the subject and the subject expectations. According to (BECF, 2019), the essence statement for integrated science indicates that integrated science is a subject that combines concepts of physics, chemistry, biology and environmental studies. It provides the learner with an opportunity to gauge his or her ability in science in preparation for specialization in applied sciences, as well as pure sciences (physics, chemistry and biology), in Careers and Technology Studies (CTS) offered in the Science Technology Engineering and Mathematics (STEM) pathway at senior school level and even choosing it as a career. This is in tandem with the dictates of Kenya Vision 2030 that emphasize Science, Technology and Innovation (STI) as one of the key drivers of the economy towards industrialization of the country by the year 2030. It is also in tandem with the aspirations of the country's constitution that emphasizes the promotion of science, indigenous technology and innovation. Concepts are presented as units within which there are specific topics that build on the competencies acquired in science and technology at upper primary level which provides the learner with the requisite skills, knowledge and attitudes necessary for integrated science. Integrated science is taught through inquiry based learning approaches with emphasis on hands-on teaching and learning activities. The content for this area is hinged on social constructivism as well as Piaget's cognitive development theories. The learning of science at junior secondary should seek to develop competencies as described in BECF which include: Communication and Collaboration; Self-efficacy; Critical Thinking and Problem Solving; Creativity and Imagination; Citizenship; Digital Literacy and Learning to Learn.

The vision, mission, key pillars, guiding principles, essence statement as well as the competencies required for Junior secondary integrated science learning act as a basis that guide the teacher during the formulation of competence based teaching and learning. In order to develop appropriate classroom activities, the teacher needs to appropriately interpret the curriculum designs provided by KICD. This involves an understanding of all the components of the curriculum design which include:

i. The goals, aims and objectives of learning; these are rigorous, common expectations for learning (knowledge, skills, and dispositions) that are explicit, transparent, measurable, and transferable. They include, National goals of education, Level learning outcomes (in this case the objectives of junior secondary learning), Learning area general outcomes (objectives for learning Integrated Science), the essence statement for Integrated Science and specific learning outcomes for each content area.
ii. The content (subject matter); strands and sub-strands within the Integrated Science guided by the Key Inquiry Question(s)
iii. Learning experiences suggested which includes core competences to be developed, pertinent and contemporary issues to be considered, values, link to other learning areas, inclusion of community service learning and non-formal activities to support learning.
iv. Resources for learning and teaching.
v. Suggested assessment methods and assessment rubrics.

3.2. CBC Teaching and Learning Situation

In order to create an appropriate learning environment, the teacher should understand the change in the teaching situation. Competency based learning is an approach used in learning concrete skills rather than abstract learning. This calls for a lot of learner interaction with materials and use of practical work. Learners often find different individual skills more difficult than others. CBL allows a learner to learn those individual skills they find challenging at their own pace, practicing and refining as much as they like before moving on to learn a new skill. In addition, the teachers are on hand to provide personalized, one-on-one learning support when it's needed. CBL measures learning rather than time. Learners progress through learning as soon as they can prove they've mastered the skill or content, rather than advancing only when the year or term ends. Once a learner has acquired a particular competency or skill, they may be allowed to move to the next level of competency without having to wait for the others. CBL involves making learning personal and thus, values learners' existing knowledge, and incorporates their choice in curriculum decisions. It attempts to break away from the regularly scheduled classroom model, where students study the same subject matter at the same speed in a cohort of fellow students (Abuga, 2019).

For promotion of competency based learning of science, the creation of teaching and learning situation should include the following;

i. Improved methods of teaching- the commonly used methods of teaching in Kenya are highly teacher-centred with limited learner involvement. In CBL, there is need for increased learner engagement through

searching for information, exploring and problem solving. Learners in a CBL environment are considered as active participants in the construction of knowledge thus an emphasis on experiential learning where the learner takes control of the learning process while the teacher becomes a facilitator of the learning process (Mkonongwa, 2018). The teachers' role changes from the communicator and provider of knowledge to the facilitator of learning. The teacher should maintain an appropriate pace of study and step in to guide the learners when need be. The teachers' focus shifts from content requirements to the skills learners need to build. Strategies used should ensure equity for all students embedded in the culture, structure, and curriculum design.

ii. Flexibility; The flexibility in CBL situation allows students to progress as they demonstrate mastery of academic content and skills, regardless of time, place, or pace of learning. It also involves differentiated learning according to learners' needs, abilities and interests.

iii. Practical learning; Active learning is a basic characteristic of CBL. Learners gain competencies by being involved in practical activities both inside and outside the classroom or laboratory. Use of practical work gives learners an opportunity to apply their knowledge and skills to solve problems. The current secondary school practical work involves learners strictly following outlined practical procedures. In CBL, teachers should involve learners in planning and organizing their own practical activities rather than following cookbook design of activities. This translates to what Ituma (2015) calls 'minds-on activities' rather than simple 'hands-on activities'.

iv. Enhanced teacher-student interaction; teachers must create a friendly and interactive learning environment. The learning environment should encourage learners' freedom to learn from each other and to contribute their ideas and perceptions regarding the subject matter. In the course of this interaction, teachers need to motivate and respect the contributions learners make in the lesson. This calls for an appropriate class size that enhances maximum teacher/learner interaction. Mkonongwa (2018), argues that teachers find it easier to teach when an appropriate class size is maintained. Teachers in crowded classrooms may find it difficult to identify each individual's needs and help all students in the classroom.

v. Motivated teachers and learners; Both teachers and learners need to be motivated in order to implement competence–based teaching and learning. A good working environment with adequate facilities and resources eases the teachers' ability to facilitate CBL. Capacity building for teachers equips them with skills that enable them perform their duties with ease and confidence. Teachers' knowledge on competence based teaching and learning should be continually improved. This helps develop and thus apply skills and knowledge learnt in the classroom. Learners should be intrinsically motivated in order to pursue their goals with vigour and persistence. Intrinsic motivation also helps learners develop a high level of confidence and self-efficacy. The teacher can help learners attain intrinsic motivation by providing a supportive learning environment, setting goals with an appropriate level of challenge, appreciating performance and maintaining success expectation thus reducing anxiety and worry as well as informing them about the value and application of skills in their lives. Adequate support for learning increases learner interest in learning.

vi. Having well-structured and detailed curriculum design; In Kenya, a detailed curriculum design is provided by the curriculum developer Kenya Institute of Curriculum Development (KICD). Proper interpretation of all the components of the curriculum as discussed earlier eases the development and utilization of appropriate classroom activities for competency acquisition.

vii. Varied learning contexts; variation in learner characteristics require that learners be provided with personalized learning opportunities. CBC also focuses on contextualized learning and thus the teacher should consider the school set-up that facilitates learning. The school environment may determine he learning activities. Field excursions, community based learning and inquiry based learning are determined by whether the school is in urban or rural set-up and facilities available in the school. The learning may include online and blended learning, project-based and community-based learning, among others. Finding creative ways of teaching and interested partners for community service learning is one way to support learners (BECF, 2019).

viii. Provide adequate resources; Learning and teaching infrastructure are crucial in building learning competences among learners. This means that the presence and the conditions of classrooms, laboratories, workshops, libraries, sports fields and power and water supply. For CBL of science at junior secondary school, learners require well equipped and functional laboratories, books, and wall maps, technological tools (such as computers and machineries), and other real objects. Other resources for teaching include open educational resources and online sources such as e-textbooks through publishers approved by KICD. These resources help learners gain practical skills rather than only abstract knowledge. Teachers should make adequate use of locally available resources.

ix. Collaborative learning; Provide and utilize a team environment where learners develop together. This should apply in physical as well as online learning. Utilization of group activities, practical work, project work and group discussions in the teaching of science can fulfil this need.

x. Enhanced use of technology; improved technological infrastructure as well as enhanced teacher skills in the use of technology would improve the use of technology in the teaching of science. Teachers should utilize

the many options of technology in teaching of science which include simple power point displays, word and spreadsheets, use of video clips, simulations, use of interactive smartboards, educational puzzles and games, virtual laboratory and technology supported laboratory tools.

xi. Improved assessment procedures; Learning includes tracking and managing student progress. It involves formative and summative assessment to track learner acquisition of competencies. Well-designed formative assessment tools will help the teachers in assessing science learning. Assessment should be a meaningful, positive, and empowering learning experience for students that yields timely, relevant, and actionable evidence. Student's progress is based on evidence of mastery of competencies.

xii. Value-based learning; The teacher should train to develop in the learners the right character, values and attitude to become an ethical and empowered citizen. The teacher therefore need to display appropriate values and thus act as a role model.

3.3. Creating Learning Environment and Preparation of Resources

Designing competency-based learning is a process which according to (Preeti, 2021) involves a number of steps. The first step is developing learning or identification and development of general competencies. The general competency areas can be identified using a wide range of sources of information such as subject matter experts, students, educators, online textbooks, articles and other resources. Techniques of collecting information may include focus groups, surveys, readings, and observations. Observing and interviewing top-performing students help the curriculum developer identify and map out knowledge and abilities that learners are able to acquire and thus develop a list of core competencies. Identifying the skills, knowledge, and abilities necessary for achieving success in any industry or occupation the students choose to pursue, can be used to develop and evaluate a competency-based curriculum. Competencies should be progressive and coherent. In Kenya the curriculum design is developed by subject matter experts at KICD and provided to teachers in schools. The curriculum design offers a guideline of competencies applicable at junior secondary education which include; communication and collaboration, critical thinking and problem solving, creativity and imagination, self-efficacy, citizenship, digital literacy and learning to learn. These competencies offer a framework based on specific performance outcomes to develop a curriculum and measure performance. The junior secondary science teacher therefore, need to adequately understand these competencies in order to design learning towards their development and demonstration by the learners.

The second step involves organizing competencies into specific themes. Defining a competency fully, involves reflecting thoroughly on its composing elements. For instance, to develop collaboration and communication during the teaching of science considers the learner's ability to work together, share resources, agree on results of a practical experience and describe their experience appropriately. In order to develop the expected learning outcomes around the competencies, the teacher should consider the content required to support the development of the specific competency in the curriculum, and the instructional strategies and methods that are most effective in developing the competency. This can be facilitated by the curriculum design provided by KICD that guides on strands and sub-strands that can be used to develop particular competencies.

The third step involves establishing criteria for performance. For each of the competencies, create the standards or rubrics (criteria for outcomes) which can be used to measure the competence. Several levels that define positive and negative competence should be defined at this step. This helps to find out what works best for the learners as well as gauge the effectiveness of the curriculum. The indicator of the expected competency should be well outlined and what is to be observed for each rubric level (such as Exceeds expectation; Meets expectation; Approaches expectation or Below expectation) adequately described.

Creating the learning experiences is the fourth step. Develop ways in which learners will demonstrate the skills outlined in the criteria for outcomes through learning experiences. There are multiple ways to in which the competencies can be demonstrated, the learning experiences should be varied and interesting. Recognizing a competency-based learning experience and outcome involves a thorough look at the work the students produce and the learning environment in which they produce it. For this reason, therefore, learners should engage in regular practical work and open reflection on their learning. This empowers learners to be the real learning designers. The teacher should allow them to use the rubric to design a learning experience where they can demonstrate the learning outcomes and give them the responsibility of the planning, execution, and presentation of their work for assessment.

The next step involves assessing the competencies attained by learners. The ability of learners to apply knowledge, skills, attitudes and abilities desired by the industry is the key purpose of a successful competency-based learning. It is therefore important to assess how the learning process achieves these. When assessing competencies, it is important to consider whether the competencies have been achieved, the extent of competency achievement, and to determine whether the acquisition of the competencies a result the teaching learning process. The rubrics created in step three are used in this step. Formative and summative assessments are useful. Opportunities for self-assessment should always be availed.

The last step involves Evaluating the effectiveness of the curriculum It is important to evaluate the efficacy of the curriculum to deliver competence, refine it to better meet the desired goals and then repeat the process to ensure ongoing effectiveness.

3.3.1. Use of Media and Technologies in CBL

Media in form of written materials, realia, graphics, audio, video, visual materials and computing (including animation, simulations and virtual reality) should be integrated within experiential learning of science. Teaching integrated science also require the constant use of technological tools. In order to provide for differentiated science learning through varied contextual settings, the teacher should use a variety of media, both digital and non- digital types. With increased need for digital literacy, knowledge explosion and improved technologies, the learning of science is very dynamic. The same technology can be applied in different ways through the teaching/learning methods and approaches discussed in this paper. ICT can be utilized in science learning for accessing information, communicating and applying knowledge. According to BECF (2019) ICTs have the potential to enhance teaching and learning through:

- Enriching the subject matter.
- Improving delivery and extending methods of presenting information as a teaching aid.
- Overcoming teacher isolation by connecting them to colleagues, mentors, curriculum experts, and the global teachers' community.
- Providing teachers with the opportunity to disseminate and share good practice via communities of practice and the internet; access reliable facilities and resources, and receive support on pedagogical issues and the latest curriculum developments.
- Offering opportunities for quick, easy and near real time reports and communication to and from the different sectors.

3.4. Planning for CBL

Adequate planning for teaching provides an opportunity to assess and determine teaching approach and methods, allows selection of appropriate resources and helps the teacher familiarize with the content. Generally, planning for teaching a science lesson involves;

- Preparation of teaching documents-schemes of work, lesson plan, lesson notes,
- Identification of competencies, content and lesson objectives.
- Preparation of teaching resources.
- Preview of experimental procedures.
- Choice of teaching methods.

Planning for CBL is however a complex process because it requires the general structure shaped around essential skills with provision of opportunity for personalization. Personalized instruction also requires multiple ways of representation to address different learning interests and modalities. In competency-based learning, there is need to shift focus from content to the skills learners need to build. Due to the flexibility of CBL no two schools implementing CBL have exactly the same program, however they do share some common features. Borrowing from Jordan (2020), some steps that would guide sketching out the CBL for science learning can be suggested. These include;

i. List out the competencies that learners may be required to acquire through the learning of integrated science. The competencies outlined by BECF in Kenya are; Communication and Collaboration; Self-efficacy; Critical Thinking and Problem Solving; Creativity and Imagination; Citizenship; Digital Literacy and Learning to Learn.

ii. Create a progression of the selected competencies-the teacher should consider the skills that may need to be addressed first, those that need to be developed throughout the learning session, those that can be developed together as well as how the development of skills fit into each other. The skill addressed first establishes a foundation for other skills to build on. For example, for practical learning, the bases of proper communication and collaboration is required. This skill is also developed throughout the learning. Problem solving and critical thinking fits into collaborative activities and can be developed together with creativity and imagination. Development of digital literacy can go together with self-efficacy which helps build citizenship and learning to learn.

iii. Link the competency to the curriculum content and the strategies and methods used. During this stage, consider the content needed to support the development of the competency in the curriculum and the instructional strategies and methods that are most effective in developing the competency. Note that KICD has developed a detailed curriculum design that guide through these links.

iv. List the skills learners should master in order to develop specific competencies. According to Bates (2019) it is important to first identify different types of skills needed which include:

- Conceptual skills such as knowledge management, critical thinking, analysis, synthesis, problem-solving, creativity/innovation, experimental design and mathematical skills.

- Developmental or personal skills, such as independent learning, communications skills, ethics, networking, responsibility and teamwork.
- Digital skills, embedded within and related to a particular subject or professional domain.
- Manual and practical skills, these include manipulative skills (such as machine or equipment operation- arranging, fixing, pouring) and science process skills (such as observing inferring, measuring, classifying, predicting, analyzing patterns and experimenting), non-linear interpretation and recognition of data, safety procedures, and spatial factors.

v. Describe how each competency will be demonstrated by the learner guided by the performance-based formative and summative assessments and what learners will do to demonstrate the competency.

vi. Develop practical activities that should be carried out for the development of each skill. This includes identification, selection, design and development of resources required for the practice of the skill.

vii. Identify the duration of learning in terms of weeks and lessons allocated in each week. Prepare a grid of how these activities will be carried out considering incremental development of skills.

viii. Ensure skills acquired in a specific content are transferred to other areas of learning within the interest of the learner.

KICD curriculum design guides the teacher through planning by providing detailed descriptions of the following: Strand; Sub-Strand; Specific Learning Outcomes; Suggested Learning Experiences; Key Inquiry Question(s); Core competences to be developed and how the experiences help in the development of each competency; Pertinent and Contemporary Issues (PCIs); Values; Links to other subjects; Assessment Rubrics and the specific Indicators that determine what should be judged as Exceeds expectation, Meets expectation, Approaches expectation or Below expectation. All these should be reflected in the lesson plan.

3.5. Appropriate Interaction, Strategies and Approaches of Teaching Science in CBL

Competence based learning is a child-centred approach which according to UNESCO International Bureau of Education (1995-2022) places the child at the notional centre of the learning process in which they are active participants. Involves giving children choices of learning activities, with the teacher acting as facilitator of learning. Whatever approach the teacher may choose for CBL, it ought to demonstrate various aspects (Moon, 2014; Mkonongwa, 2018; Bates, 2019; Sudderth, 2022) which include;

i. Authentic and meaningful contexts- learners should be allowed to learn in a natural way in order to experience the relevance and the meaning of the competences to be acquired. Use of locally available materials, improvisation, re-designing as well as developing authentic contexts should be a key focus of the CBC teacher

ii. Use of Discovery learning- learning should not involve the teacher providing information but learns seeking, reflecting, analyzing and discovering for themselves. The teacher facilitates the process by making content and resources available and accessible. Learning is done through inductive approaches that allow learners to carry out a series of activities, make observations, develop patterns, use the patterns to develop generalization and thus discover theories, rules, principles and laws.

iii. Collaborative, cooperative and interactive learning. Learners construct knowledge through interaction with peers, teachers and knowledgeable persons. The opportunities should consider the diversity of learner needs and thus expose them to activities within their interests. The use of projects and community based learning provides learners with opportunities to cooperate and collaborate.

iv. Constructivism- competency-based teaching and learning is based on social constructivism. Learners must therefore, actively interact with their environment in order to construct their own knowledge. Learning of science should therefore focus on development of practical activities, the construction of projects, models, products, guidelines, reports, or other tangible outputs.

v. Personalised learning- In the competence based learning, the learner constructs his/her own personal knowledge and competences. Though social and cooperative learning is necessary, information, knowledge, strategies, only become meaningful for a person if they become an integral part of their own personal body of knowledge and competences. In education this implies that students need to be able to identify with the contexts, the persons, the situations and interests that are included in the learning domains involved.

vi. Reflective learning- Competency-based learning requires learner to keep reflecting on their learning. The learner reflects on their own interests, needs, motivation, learning process, progress in learning and approaches used. Self-assessments are used to help learners establish their own process and progress in learning. Learning to learn is a competency that can only be achieved through focused reflective practice.

vii. Multidisciplinary approach -Competences are holistic and as a consequence the educative approach needs to be integrative and holistic. Subject content should be liked in order to develop wholesome understanding of phenomena. KICD curriculum designs provides links with other subject for every strand and sub-strand.

3.6. Learning Assessment in CBL

Competence based learning goes hand in hand with assessment. According to CBC basic curriculum framework, the teacher requires to carry out constant formative assessment as well as summative assessment. The assessment is based on the principles of being current (frequent), valid, reliable, flexible, fair and safe. The assessment should be formative (to monitor learning and provide feedback), criterion-based (on clearly-communicated competencies and standards) and collaborative (conducted in partnership with the learners). Assessment should be used as a tool that leads learners to develop autonomous learning and improve learner achievements.

The teachers should use a variety of assessment tools for integrated science such as; performance based assessment (direct observation of the learner as he/she carries out an activity), observations (captured through observation schedules, checklists and ratings scales) written papers, portfolios, projects, observed student performance, portfolios, profiling, journaling and projects. Peer and self-evaluation should be encouraged (BECF, 2019). Practical oriented learning involves learners demonstrating practical skills and tangible outcomes to determine competence. Practical skills will have indicators such as accuracy, using appropriate methods, quality product, speed and efficiency, and coherence (BECF, 2019; Mkonongwa, 2019). The CBC curriculum design for integrated science in Kenya provides the rubrics that explicitly assess student progress on competencies to guide the teacher in assessing learning.

4. METHODS OF TEACHING USED IN CBL

There are many methods that can be used to teach science at secondary school level. They vary in type from Transmission type (transfer of knowledge), Apprenticeship (modelling ways of being-learning by doing under supervision), Developmental (cultivating ways of thinking), Nurturing (facilitating self-efficacy) and Social Reform type (seeking a better society) (Bates, 2019). Some forms of teaching fit better with the development of the skills and competences needed in CBL. Teachers should therefore use methods that focus on conceptual development, such as dialogue and inquiry, collaboration, and knowledge management, rather than information transmission. Experiential learning in real-world contexts, is more likely to develop the high level skills required in the 21st Century. The focus of this paper is on methods that can be employed in school-based teaching rather than those based on digital and online technologies. Though no single teaching method is likely to meet all the requirements of CBL a combination of methods and techniques can be employed.

4.1. Interactive Lectures, Seminars and Tutorials

Interactive lectures are in-class discussions that involve analytical or critical thinking or problem-solving. Learners carry out analysis, synthesis, comparisons and evaluation. A seminar involves group meeting where a number of students actively participate through brainstorming, buzz groups, discussions and case analysis. The teacher facilitates learning through designing of the group experience, such as choosing topics and assigning tasks to individual learners. A tutorial is either a one-on-one session between a teacher and a learner, or a very small group of learners (three or four), where the learners are at least as active in discussion and presentation of ideas as the teacher (Bates, 2019)..

To facilitate learning through interactive lectures, seminars and tutorials, the teacher can ask all the students in a group to do some specified observation of a phenomena, advanced reading or study. During the class, the teacher introduces questions for general discussion within the seminar that requires students to draw on their earlier work. The teacher can also set advance work for the learners, and then have them present their work to the class for discussion, criticism and suggestions for improvement. To promote cooperative learning, the teacher can include; brainstorming with peers, paired activity where learners can interview each other and become aware of each other's interest, listen and recall (they listen to each other), paired questioning, think-pair-share and group discussions.

4.2. Experiential Learning: Learning by Doing

Experiential learning involves active engagement of learners in opportunities to learn through doing, and reflection on those activities, which empowers them to apply their theoretical knowledge to practical situations in a multitude of settings inside and outside of the classroom. It is composed of an external or internal event or action, the associated sensation and perception and the resulting interpretation. An event is experienced in terms of existing mental constructs in the light of previous events. Action and interpretation are linked. A reflection on the action and experience enhances understanding. Experiential learning model proposed by Kolb (1984) suggest four cyclical stages which are Active Experimentation; Concrete Experience; Reflective Observation and Abstract Conceptualization. In experiential learning, learners actively perform a task, and reflect on their experience on performance, so as to gain conceptual insight as well as practical expertise. There is a wide range of design models that aim to embed learning within real world contexts, including: Students' laboratory practical work, workshop or studio work; apprenticeship; problem- based learning; case-based learning; project-based learning; inquiry-based learning; cooperative (work- or community-based) learning (Bates, 2019). A brief

discussion on the application of the methods that most commonly used in integrated science is made in the following sections.

4.3. Student Laboratory Practical Work

Laboratory practical wok is accepted as part of science teaching. Teaching science through student laboratory practical work involves learners carrying out motor activities thus developing practical abilities and skills. It also improves understanding of concepts and develop creative thinking and problem solving skills. Learners are involved in choosing and using common scientific, engineering or trades equipment appropriately. The engagement of learners in practical work gives the learner the feel of being a scientist and scientific feel, and enables the learner use scientific methods of research through designing and/or conducting experiments. They enable students learn how to test hypotheses or to see how well concepts, theories, procedures actually work when tested under laboratory conditions. This keeps the learners interested in learning and fully engaged and actively participating.

The use of practical work requires adequate preparation of the teacher. This involves checking for availability and conditions of resources available for the identified learner activities, developing a working guide, preview of experiment to ensure the experiment is working, eliminates sources of error and improves confidence. The teacher then sets out the required apparatus. During the performing the experiment, the teacher should introduce the lesson objectives, organize learners in groups, share materials with the learners and engage the learners in activities. The engagement of the learners in practical work must involve investigative practical activity. According to (Ituma, 2015) this would involve:

- A discussion of the aims of the experimental work.
- Have a discussion of the background of the experimental work including the focus questions, competencies to be developed, values and pertinent and contemporary issues.
- Organize learners in groups as appropriate. Small groups of 2-5 students are more useful than large groups.
- Share the resources and describe the use of any new apparatus and resources.
- Involve the learners in brainstorming on the possible use of available resources to achieve the objective or solve a problem.
- Learners collaborate in the development of experimental plans that could lead to the expected outcomes.
- The teacher moves around groups supporting their thought processes and stimulating their thinking through questions towards the experimental plans. Allow the learners to develop predictions and hypothesis. Clarify points in instruction, maintain discipline and emphasize on safety measures.
- Let the learners carry out the plans that they have designed. The teacher supports and guides learners through the implementation of their plans.
- Discussion and presentation of their findings in a plenary session. Receive responses from learners of ideas and findings including any incidental learning.
- Guide the learners in the use of the results to discuss the underlying concepts, make conclusions/generalisations and thus develop an understanding of concepts, theories, laws and principles.
- Evaluate the lesson.

The teacher should prepare for practical experiences that allow the learners to increase confidence as well as competence in the skills required. Learners should be provided with opportunities for repeated practice of the skills learnt using relevant materials available, until mastery of the skill is demonstrated (O'sullivan & Burce, 2014).

4.4. Problem-Based Learning (PBL)

Problem-based learning follows a strongly systematic approach to solving real life issues. The role of the teacher is critical in facilitating and guiding the learning process. The PBL makes use of realistic scenarios to engage and interact with students by building on their prior knowledge, enhancing comprehension of basic concepts, and moulding knowledge gained in specific activities to establish a complex yet elaborate and well-integrated knowledge structure. This integrates and concretizes theoretical knowledge with its relevance in the world. Working in groups, students identify what they already know, what they need to know, and how and where to access new information that may lead to resolution of a problem. Student practical work can be carried out through PBL. The learning allows learners to select their materials from a wide variety of items, and requires them to construct and design their own investigative procedure. Although the detailed steps and sequence tend to vary to some extent, depending on the subject domain. Bates (2019) provides that the model consists of seven-step cyclical PBL learning process:

1) Present the problem statement; clarify the concepts- the teacher can choose the problem and/guide the learners through choosing the problems appropriate for the curriculum content.

2) Analyse the problem statement; define and discuss the problem- this can be achieved through interactive lectures, brainstorming and seminars in collaborative groups.
3) Identify possible explanation/solution-prediction-use learner discussions focused towards possible explanation or solution.
4) Formulate the investigation plan; Set the tasks, present the investigation plan: tasks objectives-plan with consideration of available resources, the environment, the nature of the problem and the ability of the learner. Steps to follow in solving the problem should be clearly outlined. The teacher checks to ensure the plans are workable.
5) Carry out the investigation plan as outlined.
6) Present results, conclusions and recommendations; class presentation help improve conceptualization and communication.
7) Evaluate and propose new inquiry-synthesize/ reflect on the practice

Considering that the learners in junior secondary have not acquired sufficient foundational knowledge base to solve some of the problems, the teacher must choose the problems carefully. The problems should be chosen so as to cover all the required components of the curriculum and should also increase in difficulty and complexity as the learner progresses in attaining the competences. PBL helps foster active and deep learning (as students interact with learning materials and relate concepts to everyday activities), construct broad and flexible knowledge base improve understanding, increase knowledge retention, develop effective problem solving skills, become motivated to learn, develop self-directed and develop lifelong learning skills. PBL can take the form of student practical work, case based learning or project work.

4.5. Case-Based Learning

In case-based learning, learners are provided with knowledge that can assist in analysing the case. Students in case-based learning develop skills in analytical thinking and reflective judgment by reading and discussing complex, real-life scenarios. It is sometimes considered a variation of PBL. Case-based learning may start with telling a short story or describing a phenomenon with a focus on an interest-arousing issue that is relevant to the learner. It may include direct quotations from the characters and be conflict provoking, decision forcing and able to create empathy with the central characters. The case should have generality. Learners get actively involved in discussing, analysing and making recommendations regarding the case. The teacher should provide direction and feedback to learners in their discussions. When discussing the case with learners the teacher should avoid bias and model professional thinking and action. Group discussions and collaborative learning environment should be utilized. Case-based learning can be particularly valuable for dealing with complex, interdisciplinary topics or issues which have no obvious 'right or wrong' solutions, or where learners need to evaluate and decide on competing, alternative explanations (Bates, 2019).

4.6. Project-Based Learning

Project-based learning involves learner autonomy and responsibility in choosing the topics based around real world problems, developing the methods and conducting the project. This gives learners a sense of responsibility and ownership in their learning activities and have an expanded view of subject matter. Project-based learning enhances constructive and context-based approach to learning that enhances subject links and connect learning to the real world. Project based learning has a lot of potential to enhance 21st century skills in the learner.

Haatainen & Aksela (2021) carried out a study on active teachers' project based learning practices and their perceptions of the advantages and challenges of implementing project-based learning in integrated science education. The study found that the teachers exploited project based practices that were theme- and inquiry-based, collaborative and engaging to students. Though the teachers experienced various challenges, they reported that project based learning is a useful strategy whose implementation needed support. Some of the challenges included: teachers' resistance to student-centred learning; confusing inquiry-based instruction with hands-on activities; inability to motivate students to work in collaborative teams; scaffolding instruction, and the development of authentic assessment. Project work must be carefully guided and facilitated. Bates (2019) argues that the project can take on a life of its own which may cause a loss focus on the key, essential learning objectives and important content areas may not be adequately covered. Thus project-based learning needs careful design and monitoring by the teacher. Though there may be difficulties in outlining a specific design for project work, there are several best practices or guidelines for successful project work (Bates, 2019; Haatainen & Aksela, 2021; Kokotsaki et al. 2016). It is basically necessary that the project if directed to fulfil an educational purpose and yet be meaningful and within the interest of the learner. Some these practices include:

i. The content of project based learning should ensure the achievement of the learning goals of CBC integrated science curriculum including understanding of concepts, acquisition of skills and attainment of competencies.
ii. The project should be a process through which learning takes place and not just a culmination of

learning. Project based learning is a process of constructing knowledge which can be achieved through critical thinking, in-depth inquiry, reflection and the use of problem-solving.

iii. A project should be meaningful, authentic, related to a real-world context or an important issue, and be connected to learners concerns and interests. Projects require a well-designed and open-ended driving question or a problem, at the appropriate level of challenge for students, that serves to organize all the project activities.
iv. Teachers should foster student engagement from the beginning of the project to the end. Though the project work involves learner autonomy and responsibility, the teacher should ensure active participation of all learners. A teacher can use some form of checklist to determine the progress of work.
v. The teacher should make use of instructional scaffolding. This is a process through which a teacher systematically builds (adds supports) on learners' knowledge and experiences in order to enhance learning and aid in the mastery of tasks. This helps the learners to accomplish more difficult tasks than they otherwise are capable of completing on their own.
vi. The activities of the project should involve the creation of a final tangible product that addresses the problem/driving question and offers adequate representation of students learning. Teachers should therefore encourage learners to carry out the project work themselves rather than have other persons work for them.
vii. Collaboration should be utilized throughout all stages of project work. Project based learning requires social negotiation of knowledge and working collaboratively in groups, to develop possible solutions.
viii. Formative assessment that aims at supporting students learning should be used. This may include reflection, self and peer evaluation, and feedback from the teacher throughout the project process. The end product of the project should also be assessed. This includes assessment of the project outcome as well as reflection on what the learner has learnt through the process.
ix. Presentation of the project to the public supports the development of communication skills, motivates and provides an opportunity for feedback.

The success of implementation of project based learning in integrated science is dependent on ability of the teacher to effectively guide and motivate learning. Haatainen & Aksela (2021) suggests that the pedagogical competence of science teachers could be promoted through collaborative learning in which students, teachers and other participants are learning from each other.

4.7. Inquiry-Based Learning

Inquiry in science requires developing an explanation of the natural world by use of evidence, logic and imagination. Inquiry-based learning adopts an investigative approach to teaching and learning that allows the learner to explore a theme and choose a topic for research, develop a plan of research, question and test out ideas, make observations, search for possible solutions, think creatively and come up with conclusions. The involvement of the teacher in selecting the question of study and in guiding the learners through the process is less than in the project-based learning. In inquiry learners are involved in doing science where they have opportunities to explore possible solutions, develop explanations for the phenomena under investigation, elaborate on concepts and processes, and evaluate or assess their understandings in the light of available evidence (Gillies, 2020).

There are four levels of inquiry that can be used in teaching integrated science. These are:

1. Confirmation Inquiry also referred to as limited inquiry where learners reinforce prior knowledge by confirming a concept/ principle through an activity when the results are known in advance.
2. Structured Inquiry where learners investigate a teacher-presented question through a prescribed procedure.
3. Guided Inquiry in which learners investigate a teacher-presented research question but design and select their own procedures.
4. Open Inquiry where learners investigate, formulate their own questions and design/select their own procedure which they implement.

learners need to begin at the first level and work through the other levels to open inquiry. As the learner progresses through the levels, there is more involvement in the process. The learning of practical science in the 8-4-4 system in Kenya has mainly relied on level (1) and (2). Competence based learning requires more use of level (3) and (4). In inquiry based learning, teachers should focus on arousing learner's interest and curiosity, providing for them to work cooperatively and encourage them to ask questions in order to clarify ideas, test ideas, reflect on proposed solutions and verify hypothesis. The teacher should provide prompt feedback towards progress in learning.

Teachers intending to use inquiry based learning can consider applying the 5E Instructional Model by Bybee (2014) which has proven to be useful in teaching science through inquiry. The 5E Instructional Model brings coherence to different teaching strategies, provides connections among educational activities, and helps

science teachers make decisions about interactions with students. The 5E learning cycle leads learners through five phases: Engage, Explore, Explain, Elaborate, and Evaluate (Duran and Duran, 2004).

i. Engagement – this is the phase where learners create a desire to learn more about the content. The teacher should not lecture or provide explanations mentally engage learners with a question or an activity. This is the main use of focus question in the CBC integrated science design. The phase allows one to determine the learners' prior knowledge and/or identify possible misconceptions. The teacher can use various activities such as video clips, games, discussions, demonstrations, picture observations, physical activities and write-ups.

ii. Exploration- learners engage in the investigative process including the hands-on activities. Experiential learning is applied. This phase incorporates the main inquiry-based experience, which nurtures learners' understanding and generate new ideas. This involves formulating the question of research, forming hypothesis, experimentation, gathering data, analyzing, interpreting data, drawing conclusions and communicating the findings.

iii. Explanation-The teacher makes sense of the concepts and skills learnt during exploration. This should involve interactive lectures and tutorials, presentations, discussions and use of other technological tools. The learners may explain their understanding of concepts and the teacher may provide formal definitions, notes, applications and labels as well as corrects learners' misconceptions.

iv. Elaboration-learners conduct additional activities to apply the understanding of concepts and skills in new situations. This helps reinforce the new skills and thus improve development of competency. The learner can develop new products, apply their knowledge and skills in project work and integrate science with other content areas. The teacher can utilize guidelines provided in the CBC designs on Key Pertinent Issues and Community Based Learning (BECF, 2019)

v. Evaluation- involves the use of formative and summative assessment to determine learner progress toward achieving the educational objectives. In CBL these include acquisition of knowledge, skills and attitudes that constitute the required competences. Performance based assessments, self- evaluations, claim-evidence-reasoning, portfolios and presentations can be used.

Inquiry-based learning does not only support classroom learning objectives but also build learners' soft skills that are applicable to all areas of their lives. It encourages curiosity, provides learner autonomy and a feeling of fulfilment. It also develops creativity, improves problem-solving skills, provides for learner differences and demonstrates interconnectedness of learning thus reducing knowledge fragmentation.

4.8. The Nurturing and Social Reform Models-Learning By Feeling

Nurturing and social reform perspectives on teaching are important in that they reflect many of the assumptions or beliefs around connectivism. A nurturing approach on teaching requires that the teacher adopt a highly dedicated and unselfish approach, putting the demands and needs of the learner first. Most times, teachers who are experts in their subject hold back the transmission and sharing of their knowledge until the learner is 'ready'. To a large extent, many subject experts may feel as if they have been denied their own needs and identity. The teacher should focus on the interests of the learner, be able to empathize, be a good listener, support the learners and demonstrate care and love. The teacher should create supportive environments or contexts for the learner that encourages rather than inhibits their natural tendency to learn, through open inquiry. A deep understanding of learner's needs, interests, aspirations and their readiness to learn helps the teacher decide on how to direct the learner into appropriate learning tasks.

A social reform perspective in CBL is that the society needs change, and the teacher as a social reformer knows how to bring about this change. The teachers' actions are therefore based upon an explicitly stated ideal or set of principles linked to a vision of a better social order (Bates, 2019). One of the key pillars of CBC in Kenya is values. In order to achieve the envisioned ethical citizen, learning should involve acquisition of values of love, responsibility, respect, unity, peace, patriotism, social justice and integrity (BECF, 2019). These values need to be promoted during the learning of science. Value based education can be realized by holistic approach to learner development, appropriate learning environment, learning for enrichment & improvement and relevance to local and global contexts. Values like responsibility can be promoted as learners take up and perform their different roles during a learning activity, Unity is promoted as the learners work together during a discussion or practical activity, respect is developed as they learn accept and appreciate each other's opinion during a discussion. The science teacher ought to demonstrate and encourage these values through focusing on the interests of the learner, listening carefully to what the learner is saying and thinking when learning, empathizing with how the learner approaches learning, and providing appropriate, supportive responses in the form of 'consensual validation of experience' (Bates, 2019).

The teaching of integrated science should be situated in the prevailing social-cultural experiences and conditions. The teacher plays a central role in nurturing learning through mentorship and role modelling these values during science teaching. Development of values is within the affective domain of science learning which according (O'sullivan & Burce, 2014), can be developed by the teacher by creating exercises for values,

clarification for personal values through discussion on different values and beliefs. This requires recognition of differing values and beliefs, with time for discussion of how these differences may affect one's ability to perform the competency.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The implementation of CBC at secondary level in various developing countries has faced many challenges. A number of these challenges are associated with teachers' lack of knowledge and skills in competence-based teaching and lack of flexibility among teachers to adopt the new paradigms. The ability of the teachers in guiding CBL as opposed to the conventional outcome oriented classroom is a key factor to improved implementation of the curriculum. CBL should be systematically organized and implemented through use of heuristic methods. This paper provides the teachers with a simple understanding of CBL, designing the learning environment and implementation of CBL. The characteristics that define the methods and approaches of teaching science in CBL are discussed. How each method could be used in CBL of integrated science is provided. Teachers using this guide should therefore have increased confident in implementing CBL. Technology should be applied throughout the teaching of integrated science within different methodologies.

5.2. Recommendations

It is important that the teachers become conversant with CBC and the appropriate methods applied in CBL. Teachers need to make deliberate effort to learn more concerning the application of various methods from subject experts as well as from online and internet sources. There is need of the government of Kenya, through KICD to intensify teacher training for CBC implementation. Teacher training should focus on specific teaching methods with specific examples for their application. Experts in pedagogy in science should be involved in the training of Junior secondary integrated science teachers. The contents of this paper can also be used by persons providing training to the teachers. The government needs to provide adequate facilities and equipment to support experiential learning of integrated science.

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