

BARRIERS TO THE EFFECTIVE DELIVERY OF INTEGRATED SCIENCE IN JUNIOR SECONDARY SCHOOLS IN KIRINYAGA COUNTY, KENYA

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ABSTRACT

The aim of this research was to determine barriers to effective delivery of integrated science within the competency-Based curriculum (CBC) in Junior Secondary schools in Kirinyaga County in Kenya. A survey questionnaire consisting of open and closed-ended items was used to data from 212 teachers who teach integrated science in Junior Secondary schools. Data from closed-ended items of the survey questionnaire was analysed using SPSS (Statistical Package for Social Sciences), while the one from open-ended items was analysed thematically. Results show that barriers to effective delivery of integrated science include the following: lack of laboratory apparatus and equipment, inappropriate number of qualified teachers, inadequate and inappropriate instructional materials, inappropriate teaching methods employed teachers in the teaching of integrated science, limited possibilities to students on having hands-on experience on integrated science activities and opportunities, and insufficient teaching and learning materials, among others. Also challenges associated with pedagogical were noted as barriers to effective teaching of integrated science in junior secondary schools. This further suggests that within the CBC delivery, learners lack opportunities for hands on experience. Although some schools have acquired apparatus/equipment, they are still limited for meaningful learning in sciences; In terms of biology, materials/specimens are not available for some experiments. Learners in urban centres cannot obtain specimen and teachers are unable to travel to rural areas to collect them. Also a majority of the schools lack permanently prepared slides for various experiments or practical sessions; although schools have acquired some equipment/apparatus, they only permit limited demonstration due to risks involved, due to lack of laboratories. A majority of the demonstrations take place in classroom which are not suitable for high quality practical sessions. Most practical require well equipped laboratory. Partnership with senior secondary schools in a majority of the cases is not possible due to distance and logistical issues; in chemistry, for instance practical involving commercial acids was not possible due to the risks involved and limited resources/materials and space for practical. In conclusion, teaching and learning of integrated sciences in junior secondary schools in Kirinyaga County faces serious barriers.

Keywords: Junior secondary school, integrated science, competency-based education, lesson delivery, Kirinyaga County, barriers

INTRODUCTION

The aim of teaching integrated science is to provide a student-centered learning environment that meets the needs of individual students through the adoption of differentiated instructional strategies and to deliver an outcome-based curriculum with high pedagogical standards (Parker, Osei-Himah, Asare and Ackah, 2018). This is unlike the teacher-centered approach (parker, et al., 2018). According to Winarno, Rusdiana, Riandi, Susilowati, Mego and Afifah, (2020) integrated science learning at the basic and secondary levels can equip pupils with a

solid foundation for learning additional integrated science or specialist subjects. However, that aim is hampered by the following barriers or obstacles: teachers' incompetence (Dorsah, Awini, Okyer, Alhassan, Shahedu, Kaningen and Kpemuonye, 2024): teachers' insufficient knowledge and pedagogical skills, inadequate and inappropriate mechanisms of instruction, a lack of effective supervision and monitoring at school and a lack of motivation for teachers, an insufficient number of qualified teachers and poor attitudes the teaching of science. Teaching and learning resources can be described as the tools used to convey and transmit the specified educational materials such as: images, maps, pictures, sketches, schematics, films and written information such newspaper clippings or articles from scientific and technical literature (Dorsah, et al., 2024).

This study set out to investigate barriers to the teaching and learning of integrated science in Kirinyaga Country as there are limited studies in this subject within the region.

LITERATURE REVIEW

Review of literature in various contexts reveal various barriers facing the teaching and learning in secondary schools. For instance, teaching integrated science is teacher-centered, thereby limiting student participation, also teachers continue to emphasize one subject over others (Dorsah, et al., 2024). Quality teaching and learning of integrated sciences is required for citizens to understand fundamental scientific concepts and processes (Quansah, Sakyi-Hagan, and Essiam, 2011). Besides, Quansah, et al. (2011) and Anamiah-Mensah, Ananga, Wesbrook and Kankam , 2017) have also identified a number of barriers to the teaching and learning of integrated sciences in schools and include: teachers' insufficient content knowledge and pedagogical skills, inadequate and inappropriate materials, inappropriate mechanism of instruction, a lack of effective supervision and monitoring at schools, a lack of motivation among teachers, an insufficient number of qualified teachers and poor attitudes affecting the teaching of integrated science. Further Kaptan and Timurlenk (2012) observe that issues facing scientific education include inadequate teachers' salaries and professional development, recruitment of low-quality science teachers and a lack of in-service training. Also there are issues of teachers' incompetence, reflected by the way in which they teach science (Parker, Osei-Himah, Asare and Ackah, 2018). They further observe that the quality of the educational experience offered by the instructor is the most important element that influences learners' attitude towards school science (Parker, et al., 2018). One explanation for positive student attitudes towards classroom science is a dearth of skilled science teachers (Dorsah, et al., 2024).

In some schools many science teachers are compelled to teach subjects outside their area of expertise which undermine their confidence (Kaptan and Timurlenk, 2012). Parker, et al., (2018) observe that teachers lack of confidence when teaching topics outside their area of expertise which has been demonstrated when preparing lesson plans, choosing or devising activities and analogies to aid student learning, answering students questions, linking and applying various concepts and principles to everyday life situations generating students' interests and passion for integrated science. In this regard, Kaptan and Timurlenk (2012) observe that teachers must recognise what the learners bring to their studies as well as how various teaching approaches engage with their learning. Appropriate teaching approaches should be employed to accommodate the diversity of students' learning styles.

According to Parker, et al. (2018), the purpose of teaching integrated science is to provide student-centered learning environment that meets the needs of individual students through adopting differentiated instructional strategies and to deliver an outcome-based curriculum with high pedagogical standards. This is unlike the traditional teacher-centered teaching

approach which was adopted in schools, child-centered approach is necessary to deliver a curriculum that is focused on developing critical thinking rather than rote learning (Davidson, 2010). This calls for the teachers' knowledge base which strongly influence all aspects of teaching and learning such as preparation, planning and decision-making regarding the choice of content (De Jong, Veal and Van Driel, 2002). Therefore, it can be argued that the most important characteristics of being a good teacher include having good basis of subjects matter and good pedagogical content knowledge which enable science teachers to blend "content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented and adapted to diverse interests and abilities of learners and presented for instruction" (Parker, et al., 2018, p.66). Magnusson, et al., 1999) as cited in Parker, et al., 2018), describes pedagogical content knowledge for science teaching as the transformation of several types of knowledge not only subject matter knowledge. Pedagogical content knowledge areas consists of five components which include: orientation towards science teaching, knowledge and beliefs about the science curriculum and assessment in science, knowledge about student understanding of specific science topics and knowledge about instructional strategies for teaching science or topic specific pedagogy (Parker, et al., 2018). The teachers' pedagogical content knowledge develops with his or her experience (Abell, 2008; Davis, et al., 2007). It is a cyclical process whereby teachers transform, reflect and evaluate their practices and continue to learn as they develop their practices (Parker, et al., 2018). Pedagogical content knowledge is also content-specific or subject specific knowledge that entails generated strategies applicable to teach science (Magnusson, et al., 1999). Further, content –specific strategies such as illustrations, models, analogies, experiences and activities are required when teaching particular topics within science field (Parker, et al., 2018). Also when teachers have in-depth knowledge of subject matter it helps them to provide alternative explanations or use different approaches to help students understand complex scientific concepts (Parker, et al., 2018). The teachers' confidence in specific area of content is closely related to knowledge of that content (Harlen and Holy-royd, 1997: 103). Confidence is also influenced by other factors such as school personal experiences, then nature of initial and in-service experience, pressure of curriculum overload, support from colleagues and materials resources and the teachers' own view of professional capability (Parker, et al., 2018). These factors contribute to the teachers' perceived self-efficacy (Parker et al., 2018; Bandura, 1997). According Bandura (1997), perceived self-efficacy is the beliefs in one's capabilities to organise and execute the course of action required to produce given attainment."(P. 3). According to Gess-Newsome (1999), teachers perceived to be quality have content knowledge, attitude, and good pedagogical skills, information about student's learning behaviours and sound acquaintance with curriculum issues.

Studies conducted in Kuwait, reveals a number of challenges facing science teachers and include: the difficulty of the content, heavy workload, lack of teaching tools, inadequate professional development and lack of enough time allocated to teach science and class management issues due to large class sizes (Al Shammers, 2013). Another study conducted in Turkey to investigate the challenges facing primary science teachers identify challenges such as lack of pedagogical knowledge, lack of physical resources and time constraint (Sengul, Cetin and Gur, 2008). Also a study conducted at Al Dammam in the Kingdom of Saudia Arabia involving science teachers reveal a number of barriers that hinder effective implementation of the reformed science curricula and include: insufficient instructional time, limited physical space scarcity of resources and professional development (Parker, et al., 2018).

There are also issues associated with context, for instance, lack of infrastructure, spacious classrooms, science laboratories, science equipment and apparatus (Humphrey-Darkeh, Owusu-Sekyere and Mensah, 2022). These factors limit effective teaching and learning of integrated science in schools.

Further, Kebbie (2019), identifies the following factors that undermine the teaching and learning of integrated science and make students perform poorly in science subjects: poor teaching methods, poorly equipped science laboratories, over dependence on print materials, lack of laboratory, lack of qualified science teachers and institutional objectives in science teachers. Others include, problem of adequacy of textbooks, lack of learner's interest, unqualified science teachers and psychological fears of science subjects by pupils (Kebbie, 2019). Also most laboratories are not well equipped and science subjects' classes are large and teachers are not motivated through incentives (Kebbie, 2019). All these constitute barriers to effective teaching of integrated sciences in secondary schools in the world.

THEORETICAL FRAMEWORK

Three theories underpinned or guided this study. They include the following: Behaviourism theory Cognitivism Learning theory and Constructivism Theory.

- i) Behaviourism Theory: The theory focuses on overt behaviours that can be observed and measured (Nglandu, Hambulo, Haambokama and Milingo, 2013; Good and Brophy, 1990). Behaviourists do not pay attention to what is happening in the learner. They argue that what is happening inside the learner is not available to be observed directly (Watson, 1913). One of the contribution of behaviourism to education is the use of lesson objectives in that they set standards on how the learners are expected to behave at the end of the learning experience (Saethler, 1990:288; Eggen and Kauchak, 2001). Further, a behavioural objective states learning in "specified quantifiable terminal behaviours" (Saethler, 1990: 288). Behaviourist define learning as a relatively enduring change in observable behaviour that occurs as a result of experience (Eggen and Kauchak, 2001: 214). For effective learning to occur the teacher has to control the learning environment in an effort to ensure that it is conducive or favourable for learning (Skinner, 1968:64). Teachers can achieve favourable environment learning by reinforcing appropriate behaviour and extinguishing inappropriate ones (Skinner, 1968).
- ii) Cognitivism Learning Theory: According to Piaget, learners actively construct knowledge through stages (Sensorimotor; Preoperational; Concrete operational and formal operation (Rahim and Rashid, 2025). Each stage involves profound changes in how learners understand the world ranging from sensory experiences and object manipulation to logical and abstract thinking (Rahim and Rashid, 2025). Further, humans adapt to their physical and social environment in which they live through two basic processes, namely accommodation and assimilation (Pakpahan and Savagih, 2022). Accommodation refers to the process through which the existing schemas or structures are modified to meet the resistance to straightforward grasping of assimilation of new objects or events (Pakpahan and Saragih, 2022). While assimilation refers to the process by which new objects or events are grasped or incorporated within the scope of existing schema or structures (Pakpahan and Saragih, 2022).
- iii) Constructivism Theory: According to constructivism theory humans construct meaning from current knowledge structures (Lamanauskas, 2010). Further, learning of science involves being initiated into a culture of science

(Lamanauskas, 2010). Also learners need to be given access to the knowledge systems of science that allows them to go beyond personal empirical enquiry to concepts and models of conventional science (Drivers et al., 194 as cited in Lamanauskas, 2010). The constructivist theory of teaching must be based upon the constructivist theory of learning (Selley, 1999). It brings out the importance learner’s prior knowledge in learning science (Lamanauskas, 2010). Further, learning involves the formation of a connection between stimulus and response (Ng’andu, Hambulo, Haambokoma and Tomaida, 2013).

RESEARCH METHOD

The study was conducted to increase understanding or awareness of the barriers undermining the teaching and learning of the integrated science in junior secondary schools in Kenya. The study adopted a descriptive research design and employed survey questionnaires to collect data. The questionnaire format consisted of closed, open-ended and rating scale items, in order to increase diversity as well as reducing question fatigue (Watson and Coombes) as cited in Onderi and Makori (2013).

The open-ended sections of the questionnaire, allowed respondents to expand or clarify some of their closed-ended responses. And in that way, offered some insights to researchers and readers regarding their perspectives in terms of factors that undermine the teaching of integrated science in the country.

The study respondents consisted of 212 teachers who teach integrated science in junior secondary schools in Kirinyaga County in Kenya. Both the county and participants were purposively selected for the study. Respondents were made aware of the purpose of the study and the implications of their involvement. They consented to be involved in the study and completed a consent form. They were assured of confidentiality and anonymity.

Quantitative data obtained through closed-ended items was analysed using SPSS resulting in descriptive data. The open-ended information or data resulted in qualitative data which was analysed thematically, and used to clarify or expand on their responses in quantitative data.

RESULTS

Challenges affecting the teaching and learning of integrated science in junior secondary schools in Kirinyaga County, Kenya are indicated in Table 1 below:

Table 1. Challenges (barriers) affecting Integrated Science

Item	SD		D		N		A		SA	
	F	%	F	%	F	%	F	%	F	%
Students lack preparedness in the teaching and learning of integrated science	0	0.0	3	5.4	8	14.3	18	32.1	27	48.2
Lack laboratories or science kits	1	1.8	4	7.1	9	16.1	21	37.5	21	37.5
Lack of laboratory apparatus and equipment	0	0.0	2	3.6	4	7.1	19	33.9	31	55.4
Lack of updated textbooks and equipment	2	3.6	1	1.8	3	5.4	21	37.5	29	51.8

Inadequate and inappropriate instructional materials	1	1.8	3	5.4	7	12.5	23	41.1	22	39.3
Inappropriate number of qualified teachers	2	3.6	0	0.0	3	5.4	17	30.4	34	60.7
Lack of effective supervision and monitoring at school	1	1.8	1	1.8	5	8.9	23	41.1	26	46.4
Inappropriate methods teachers use in teaching integrated science	0	0.0	2	3.6	13	23.2	16	28.6	24	44.6
Physical structures available	0	0.0	1	1.8	9	16.1	13	25.0	32	57.1
Interpersonal relationship between teachers and students	1	1.8	3	5.4	12	3.6	22	39.3	28	50.0
Lack of integrated science resource materials	2	3.6	0	0.0	3	5.4	17	30.4	34	60.7
Supervisory role the heads of schools embrace during integrated science lessons	0	0.0	0	0.0	3	5.4	12	23.2	40	71.4
Lack of motivation for integrated science teachers	2	3.6	1	1.8	2	8.9	15	33.9	29	51.8
Poor interest of pupils in integrated science	1	1.8	0	0.0	0	0.0	19	33.9	36	64.3
Due to limited time and teacher need to cover topics in the integrated science teaching syllabus they use lecture methods	0	0.0	1	1.8	1	1.8	12	21.4	42	75.0
Limited possibility of pupils having hands-on integrated science activities opportunities	0	0.0	0	0.0	1	1.8	9	16.1	46	82.1
Lack of chemicals for simple experiments	0	0.0	0	0.0	2	3.6	4	7.1	50	89.3
Insufficient teaching and learning materials	0	0.0	0	0.0	2	3.6	4	7.1	50	89.3
Insufficient curriculum materials	0	0.0	0	0.0	2	3.6	4	7.1	50	89.3
Teaching integrated science is teacher-centered, limiting student participation	1	1.8	13	23.2	12	21.4	17	28.6	14	25.0
Lack of adequate parental support	1	1.8	2	3.6	4	7.1	18	32.1	31	55.4
The current integrated science curriculum does not adequately prepare learners as future scientists	1	1.8	1	1.8	2	3.6	16	28.6	36	64.3
In the currently changing world integrated science may not be the best approach in teaching science	0	0.0	4	7.1	18	32.1	14	25.0	20	35.7

Limited exposure of learners to practical activities undermines their growth and creativity required in science teaching and learning	0	0.0	1	1.8	3	5.4	20	35.7	33	57.1
In some integrated science lessons practical is not possible due to lack of materials or specimen	0	0.0	0	0.0	2	3.6	4	7.1	50	89.3
Some experiments in chemistry within integrated science cannot be carried out in the classroom environment due to risks involved	0	0.0	0	0.0	2	3.6	4	7.1	50	89.3
In chemistry, experiments involving commercial acids cannot be done in the classroom environment	0	0.0	0	0.0	1	1.8	6	10.7	49	87.5
Successful teaching and learning of integrated science in Junior secondary schools is undermined by lack or limited resources and materials	0	0.0	0	0.0	2	3.6	11	19.6	43	76.8
Partnership with other secondary schools with well-equipped laboratory is undermined by distance and other logistical restriction	1	1.8	2	3.6	6	10.7	19	33.9	28	50.0
Many schools lack essential laboratory equipment, chemicals and apparatus needed for practical integrated science lessons	0	0.0	1	1.8	4	7.1	22	39.3	29	51.8
Lack of essential resources and materials hinders students' ability to engage in hands-on activities and grasp scientific concepts effectively.	1	1.8	0	0.0	2	3.6	33	58.9	20	35.7
A majority of learners in the integrated science lessons lack practical experience	1	1.8	2	3.6	7	12.5	19	33.9	27	48.2
Limited availability of relevant and adequate textbooks, workbooks, and other teaching aids.	0	0.0	0	0.0	3	5.4	21	37.5	32	57.1
The school lacks functional digital resources and access to reliable internet	0	0.0	0	0.0	6	10.7	21	37.5	29	51.8

Some teachers may lack sufficient training in integrated science pedagogy and therefore not adequately prepared to teach the subject effectively	0	0.0	4	7.1	11	1.8	17	30.4	34	60.7
Heavy workload and limited professional development	0	0.0	2	3.6	7	12.5	21	37.5	26	46.4
The school faces a serious shortage of qualified teachers in integrated science leading to larger class sizes and increased pressure on existing teachers	0	0.0	2	3.6	0	0.0	26	46.4	28	50.0
A number of teachers may have insufficient background knowledge in integrated science which can impact their confidence and ability to teach the subject effectively	1	1.8	7	12.5	9	16.1	21	37.5	18	32.1
Overcrowded classroom can make it difficult for teachers to provide individualized attention and create an effective learning environment.	0	0.0	0	0.0	0	0.0	17	30.4	39	69.6
Lack of parental support and engagement may also affect student's attitudes and performance in integrated science	1	1.8	2	3.6	9	16.1	23	23.2	31	55.4
Lack of chemicals for performing basic experiments or demonstrations	0	0.0	2	3.6	4	7.1	17	30.4	33	58.9
Lack of chemicals for doing food tests	0	0.0	0	0.0	2	3.6	14	25.0	40	71.4
Lack of litmus papers for testing acids and bases	0	0.0	1	1.8	6	10.7	19	33.9	30	53.6
Lack of enough magnets to teach magnetism	0	0.0	2	3.6	5	8.9	11	19.6	38	67.9
Lack of models for teaching human skeleton	0	0.0	1	1.8	7	12.5	22	39.3	26	46.4
Lack of charts and posters for teaching integrated science processes such as digestion and respiration	1	1.8	0	0.0	2	3.6	4	7.1	49	87.5
Lack of other indicators e.g. Methyl orange for testing acids and bases	0	0.0	0	0.0	0	0.0	6	10.7	50	89.3

Result from Table 1 has been used to create themes or categories presented in tables 2- 8 below, for better understanding.

Table 2. Barriers related to inadequate teaching and learning resources/materials

S/NO	Lack of adequate teaching and learning resources/materials	Percentages (n=212)
i)	Lack of laboratories or science kits	(75%)
ii)	Lack of laboratory apparatus and equipment	(90%)
III)	Lack of updated textbooks and equipment	(89%)
iv)	Lack of integrated science resources	(91%)
v)	Lack of chemicals for simple experiments	(96%)
vi)	Insufficient teaching and learning materials	(96%)
vii)	Insufficient curriculum materials	(96%)
vii)	Lack of adequate parental support	(87%)
viii)	Lack of chemicals for performing basic experiments	(89%)
ix)	Lack of chemicals for carrying out food tests	(96%)
x)	Lack of litmus paper for testing acids and bases	(87%)
xi)	Lack magnets for teaching magnetism	(79%)
xii)	Lack of models for teaching human skeleton	(86%)
xiii)	Lack of charts and posters for teaching integrated science concepts and processes such as digestion and respiration	(94%)
xiv)	Lack of indicators e.g. Methyl Orange for testing acids and bases	(100%)

Based on Table 2 above, it is evident that more than three-quarters of teachers who participated in this study reported serious lack of resources in relation to the teaching and learning of integrated sciences is in junior secondary schools which undermined or constrained the effectiveness of integrated science lesson delivery.

Table 3. Barriers related to workload issues/challenges

S/NO	Workload issues/barriers	Percentages (n=212)
i)	Due to limited time and teacher need to cover topics in the integrated science teaching syllabus they use lecture methods	(98%)
ii)	Heavy workload and limited professional development	(84%)
iii)	Overcrowded classroom can make it difficult for teachers to provide individualized attention so as to create an effective learning environment for specific learners	(100%)
iv)	Inappropriate number of qualified teachers	(91%)

Issues emerging issues associated with workload based on Table 3 include:

- i. Limited time and wide syllabus coverage;
- ii. Heavy workload and limited professional development of teachers teaching integrated science;
- iii. Overcrowded classrooms which limit opportunities for individualized attention;
- iv. Inappropriate number of qualified teachers.

Table 4. Barriers related to limited hands-on experience opportunities to learners

S/NO	Limited hands-on experience factors	Percentage (n=212)
i)	Lack of essential resources and materials hinders students' ability to engage in hands-on activities and grasp scientific concepts effectively.	(95%)
ii)	A majority of learners in the integrated science lessons lack practical experience	(82%)
iii)	Many schools lack essential laboratory equipment, chemicals and apparatus needed for practical integrated science lessons.	(91%)
iv)	Lack of chemicals for performing basic experiments or demonstrations	(89%)
v)	Lack of chemicals for doing specific tests e.g. food tests	
vi)	Lack of litmus papers for testing acids and bases	(96%)
vii)	Lack of enough magnets to teach magnetism	(90%)
viii)	Lack laboratories or science kits	(88%)
ix)	Lack of laboratory apparatus and equipment	(80%)
x)	Lack of chemicals for simple experiments	(89%)
xi)	Limited exposure of learners to practical activities undermines their growth and creativity required in science teaching and learning	(96%) (93%)
xii)	Limited possibility of pupils having hands-on integrated science activities opportunities	(98%)
xiii)	In some integrated science lessons practical is not possible due to lack of materials or specimen	(96%)
xiv)	In chemistry experiments involving commercial acids cannot be done in the classroom environment due to the risk involved	(98%)
xv)	Partnership with other secondary schools with well-equipped laboratory is undermined by distance and other logistical restriction	(84%)

On the basis of Table 4 above, the following issues related to limited students opportunities to engage in hands-on activities:

- i. Lack of essential resources and materials leading to limited opportunities for learners to engage on hands-on activities;
- ii. Learners lack practical experiences;
- iii. Lack of essential laboratory equipment, chemicals and apparatus needed for practical; science lessons

Table 5. Barriers related to training and pedagogical issues among teachers

S/No	Training and pedagogical issues/challenges among teaching staff	Percentages (n=212)
i)	A number of teachers may have insufficient background knowledge in integrated science which can impact their confidence and ability to teach the subject effectively	(70%)
ii)	The school faces a serious shortage of qualified teachers in integrated science leading to larger class sizes and increased pressure on existing teachers	(96%)
iii)	Some teachers may lack sufficient training in integrated science pedagogy and therefore not adequately prepared to teach the subject effectively	(91%)
iv)	Inappropriate methods teachers use in teaching integrated science	(73%)

On the basis of Table 5 above, the following barriers emerge:

- i. A significant number of teachers handling integrated science lack sufficient background knowledge which further undermine their confidence and ability to teach the subject effectively;
- ii. Shortage of qualified teachers to teach integrated science leading to large class sizes and pressure on existing qualified teachers;
- iii. Some teachers lack sufficient training in integrated science pedagogy, further suggesting lack of adequate preparedness to handle integrated science subjects effectively;
- iv. Use of inappropriate methods by teachers teaching integrated science

Table 6. Barriers related to parental support and engagement

S/No	Lack of parental support and engagement	Percentages (n=212)
i)	Lack of adequate parental support	(87%)
ii)	Lack of parental support and engagement may also affect student’s attitudes and performance in integrated science	(76%)
iii)	Poor interest of pupils in integrated science	(100%)
iv)	Students lack preparedness in the teaching and learning of integrated science	(80%)

Table 6 above, reveal the following issues:

- i. Lack of parental engagement and support which further affects the attitudes and performance of students in integrated science subjects;
- ii. Learners lack preparedness in teaching and learning of integrated science

Table 7. Barriers related to other factors that undermine the teaching and learning of integrated science

S/NO	Other factors that undermines the teaching and learning of integrated science	Percentages (n=212)
i)	Lack of charts and posters for teaching integrated science processes such as digestion and respiration	(95%)
ii)	Lack of motivation for integrated science teachers	(86%)
iii)	Supervisory role the heads of schools embrace during integrated science lesson	(95%)
iv)	Inadequate and inappropriate instructional materials	(88%)
v)	Lack of effective supervision and monitoring at school	(88%)
vi)	Limited availability of relevant and adequate textbooks, workbooks, and other teaching aids.	(91%)

On the basis of Table 7 above the following issues emerge:

- i. Lack of motivation for integrated science teachers;
- ii. Inadequate and inappropriate instructional materials;
- iii. Lack of effective supervision and monitoring of teaching and learning at the school;
- iv. Limited availability of relevant and adequate textbooks, workbooks and other teaching aids

Table 8. Relevance and future role of integrated science

S/NO	Relevance and future role of integrated science	Percentages (n=212)
i)	The current integrated science within CBC curriculum does not adequately prepare learners as future scientists	(93%)
ii)	In the currently changing world integrated science may not be the best approach in teaching science	(61%)

On the basis of Table 8 the teaching and learning of integrated science does not adequately prepare learners for a rapidly changing and innovative scientific world.

DISCUSSION AND INTERPRETATION

The study findings are presented and discussed in the following categories or themes:

a) Barriers related to inadequate teaching and learning resources/ materials.

The study identified the following inadequacies in relation to teaching and learning resources or materials. They include, lack of laboratories or science kits, lack of updated textbooks and equipment, lack of chemicals for simple experiments, Lack of chemicals for performing basic experiments, Lack of chemicals for carrying out food tests, lack magnetism, lack litmus paper for testing acids and bases, lack of charts and posters for teaching integrated science concepts and processes such as digestion, and respiration; lack of indicators, e.g. methyl orange for testing acids and bases, insufficient teaching and learning materials. Lack of indicators e.g. methyl orange was reported by 100% (n=212) of the teachers who took part in the study. This is in line with a study conducted in Al Dammam in the Kingdom of Saudi Arabia reveal scarcity of resources and professional

development (Parker, al., 2018). Also a study conducted in Turkey (Sengul, Cetin and Gur, 2008) identified problems such as lack of physical resources and time constraints. These problems undermine the effective teaching and learning of integrated science in various schools. Teaching and learning resources described as tools are used to convey and transmit the specified education materials. Such materials include images, maps, pictures, sketches, schematics, films and written information such as newspaper clippings or articles from scientific and technical literature (Dorsah, et al., 2024). Adequate and appropriate use of instructional materials ensure effective teaching and learning of science. Further, adequate instructional materials and strategies give students the chance to use their senses of hearing, smelling, tasting, seeing and feeling (Opara and Etukudo, 2014). Also teaching and learning resources have benefits such as increasing students motivation to learn, developing creativity, evoking prior knowledge, encourage understanding, decoding, organizing, synthesizing educational content, local thinking, communication to the development of different skills and the acquisition of values (Bušljeta, 2013). Also teaching and learning resources enhances learners' hands-on activities and thus improving their experience and confidence in science subjects.

b) Barriers related to workload issues

In relations to workload, the study identified a number of barriers including: Heavy workload and limited professional development; limited time for the amount of work to be covered in the integrated science, forcing teachers to use lecture methods; inappropriate number of qualified teachers and overcrowded classroom makes it difficult to provide individualized attention and create an effective learning environment. All these factors contribute to poor performance in examinations. This in line with the study conducted in Kuwait, they report that heavy workload and lack of teaching tools as serious barriers to effective teaching and learning of integrated science (Al Shammer, 2013). Also it is in line with issues of insufficient instructional time and limited physical space that were identified in a study conducted at Al Dammam in the Kingdom of Saudi Arabia (Parker, et al., 2018).

c) Barriers related to hands-on experience opportunities for the learner.

Science subjects demands that students are exposed to activities that improve their hands-on experiences. Limited hands-on experience among integrated science students is associated with absence of practical materials and specimen. According to the current study, lack of essential resources and materials limit students' ability to engage on practical or hands-on activities. Hands' on activities enable learners to grasp scientific concepts effectively. It is also reported that a majority of the learners in the integrated science lessons lack practical experience. Also a majority of the schools involved in the study lack essential laboratory equipment, chemical and apparatus needed for practical integrated science lessons. Further, in some integrated science lessons practical is not possible due to lack of materials or specimens. In chemistry, experiments involving commercial acids cannot be done in the classroom environment due to the risk associated with them. They need to be carried out in laboratories. However, most junior schools in Kenya lack laboratories and therefore limits learners' opportunity to engage in science subjects.

d) Barriers related to training and pedagogical issues, among teachers;

The study findings reveal that teachers teaching integrated science use inappropriate methods. This suggests that they may not be well trained to teach integrated science and also raises serious pedagogical content knowledge and skills concerns. It is also reported

in the current study that some teachers may lack sufficient training in integrated science pedagogy and therefore not adequately prepared to teach the subject effectively. Further, it was reported that schools face a serious shortage of qualified teachers in integrated science leading to larger class sizes and increased pressure on existing teachers. Appropriate training contributes to ones' subject matter knowledge and pedagogical content knowledge. It is being argued that the most important character of being a good science teacher is having good basis of subject knowledge and development of pedagogical content knowledge (Parker, et al., 2018), which enable science teachers to blend content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented and adapted to diverse interests and abilities of learners and presented for instruction (Parker, et al., 2018). Also the teacher's knowledge base strongly influence all aspects of teaching like preparation, planning and decision-making regarding the choice of content to learners (De jong, Veal and Van Driel, 2002). Further, if teachers acquire the professional competence and attitudes that enable them to effectively perform their multiple tasks in the classroom in the school and community they will become the single most important contributing factor in ensuring quality educational provision (Humphrey-Darkeh, Owusu-Sekjere and Mensah, 2022).

e) Barriers related to other factors that undermine the teaching and learning of integrated science

Other challenges include: limited availability of relevant and adequate textbooks, workbooks and other teaching aids; lack of supervision and monitoring of schools; inadequate and inappropriate instructional materials; Lack of charts and posters for teaching integrated science processes such as digestion and respiration; lack of motivation of integrated science teachers; the current integrated science curriculum does not adequately prepare learners as future scientists; in the currently changing world integrated science may not be the best approach in teaching science and lack of parental support and engagement may also affect students' attitudes, motivation and performance in integrated science.

CONCLUSION AND RECOMMENDATION

This study has established that the teaching and learning of integrated science in Kirinyaga County, in Kenya, is faces serious myriad barriers that undermine their effectiveness in delivering quality education. The study has identified serious inadequacies in terms of teaching and learning resources and materials as well as methods of teaching integrated science subjects. Also there were issues related to training and pedagogy, which compel teachers to use inappropriate methods in teaching.

Some recommendations including, first and foremost, more studies to be conducted at various counties to determine the extent and implications of the current situation linked to the teaching and learning of integrated science. Secondly, the government of Kenya to reconsider moving junior secondary students from primary schools which starved with resources secondary schools. There no justification for the current system of junior and senior secondary schools structures in Kenya. Primary schools do not have laboratories and other important resources and materials to handle integrated science subjects. This may further suggest that the current junior secondary schools do not prepare learners for senior secondary schools science education.

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