Integration Of the Inquiry Based Learning and Its Influence on Learners' Achievement in Physics in Secondary Schools in Nairobi City County, Kenya.

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Abstract

Teaching methods significantly influence learners' academic achievement and motivation. This study investigated the integration of Inquiry-Based Learning (IBL) in the instruction of Physics and its influence on student achievement. In particular, the research explored the degree to which secondary school Teachers of Physics in Nairobi City County, Kenya, utilized IBL strategies, assess the impact of these strategies on student performance, and identify challenges teachers face in implementing IBL. The research was based on Constructivist Theory and utilized the Descriptive survey design to collect and analyze data. The research targeted a population of 3200 Form Two students taking physics and 75 teachers teaching physics in Nairobi City County Public Secondary Schools. Eleven schools were chosen using stratified random sampling technique. Purposive sampling technique was employed to pick 11 teachers while 326 students in Form two were selected for the study using simple random sampling technique. For data collection, the study used questionnaires, interview, and Lesson Observation Schedule. For pilot study, two schools participated in order to determine the validity and reliability of the research instruments. Data was collected using structured questionnaires administered to both students and teachers. Lessons were attended for Observation and Interview carried out with the teachers of physics. The study employed descriptive and inferential statistics through the use of SPSS to analyze the quantitative data. Findings from the study showed that the teachers of physics do not fully integrate IBL in their teaching of physics. The study also concluded that IBL has positive influences on learner achievement in physics and overall learning outcomes when fully utilized. The study also identified lack of enough resources, lack of enough laboratory apparatus, lack of professional training in IBL, lack of enough time to cover the syllabus as well as large class sizes as the main challenges to implementation of IBL in physics lessons. The study recommends that Continuous Teacher Professional Development training on IBL oriented pedagogy be enhanced, Integration of IBL modules in the training of teachers at the universities and colleges be enacted, allocation of sufficient funds to public secondary schools in order to have adequate teaching and learning resources by the government, alignment of the curriculum with IBL principles through incorporation of IBL activities in learning outcomes and lesson guidelines among others. The findings of the study inform the education stakeholders of the senior school science teachers' preparedness in handling the Competency Based Curriculum starting in grade 10 in the new Competency Based Education system in which IBL is highly recommended as a teaching approach for the science subjects.

Keywords

Integration of Inquiry Based Learning, Influence on Learners' Achievement in Physics,

Secondary Schools, Challenges in Implementation of IBL.

Introduction

Inquiry-Based Learning (IBL) is a learner-centered, open-minded approach that encourages curiosity, questioning, and hands-on investigation. This approach supports discovery, exploration, and problem-solving, which enhances learner participation, particularly in science practical where investigative skills are key. The IBL helps the learners develop the confidence and skills to explore and answer questions independently. The core of IBL is to develop learners' manipulative and process skills through research activities, which culminate in group or individual presentations of findings.

Background to the study

According to the Partnership for 21st Century Skills (2011), the core competencies needed for success in today's world include creativity, critical thinking, collaboration, and communication, known as the '4 Cs' are vital for preparing learners for evolving global environments. Integrating these skills into curricula and pedagogy increases learners' comprehension of academic content

(Donovan, Green, & Mason, 2014). Heuristic teaching methods, including IBL, have been encouraged to promote the acquisition of these competencies. Among these, inquiry-based constructivist approaches have emerged as powerful models for knowledge acquisition and have shown better outcomes than traditional expository methods worldwide.

In the United States, there's been a strong push to make science education more engaging and meaningful through IBL by fostering major national reforms, such as Project 2061and the National Science Education Standards. The reforms emphasize the importance of students actively exploring scientific ideas rather than just memorizing facts. In Australia, studies reveal that teachers use varied strategies to foster engaging classroom cultures conducive to IBL (Peters, Cornu, & Collins, 2003). In South Africa, Venter (2001) advocates for constructivist approaches in teacher training to better prepare educators for implementing such methods. Around the world, science educators are being encouraged to embrace teaching methods that are not only effective but also relevant to the fast-paced changes in science and technology.

In Kenya, Physics enrollment and performance at the form four final exams, have been low according to the Kenya National Examinations Council [KNEC] report of 2022. Several factors have contributed to the persistent challenges in Physics education, including low student motivation, ineffective teaching strategies, limited teacher content mastery, minimal use of scientific language, the perception of Physics as a difficult subject, lack of adequate instructional materials, and weak supervision (Etkina, 2005; Kiboss, 2002; Ndirangu, 2000; Oyoo, 2009; SMASSE, 1998;). In response, the Strengthening of Mathematics and Sciences in Secondary Education (SMASSE) project introduced nationwide In-Service Education and Training (INSET), promoting learner-centered strategies such as Activity, Student, Experiment, and Improvisation (ASEI) and the Plan-Do-See-Improve (PDSI) approach (SMASSE, 1998). Despite these interventions, the performance of students in Physics has remained consistently low, as seen in the Kenya Certificate of Secondary Education (KCSE) results from 2016 to 2022

Table 1 KCSE Enrollment and Physics Performance (2016–2022)

Year	Total KCSE Candidates	Physics Candidates	% of Total	Average Score (%)	Standard Deviation
2016	574,125	149,790	26.09	39.76	21.20
2017	611,952	160,182	26.18	35.05	19.80

2018	660,204	172,676	26.15	34.27	17.66
2019	679,222	184,559	27.17	32.59	16.98
2020	752,602	217,126	28.85	35.52	17.56
2021	826,807	253,963	30.72	29.70	16.50
2022	881,416	276,296	31.35	33.06	19.35

Note: Data from Kenya National Examinations Council (KNEC, 2022).

Research has consistently demonstrated that learner-centered, constructivist teaching approaches can substantially improve students' engagement and educational outcomes. For example, Mwanda et al. (2017) study showed that students who were taught Biology using constructivist strategies performed better academically. Likewise, Njoroge et al. (2014) revealed that using IBL in Physics classrooms led to improved achievement and greater motivation among secondary school students in Nyeri County, Kenya. These findings motivated further investigation into the integration of IBL in Physics education in Nairobi City County, to evaluate its impact on learner achievement and find out the challenges that affect its implementation.

Statement of the Problem

Despite its importance in national development and in Science, Technology, Engineering, and Mathematics (STEM) fields, Physics has continued to record low performance and enrollment at the final examination level in Kenya. According to KCSE data, the average national Physics scores have remained below 40%, with enrollment levels falling below 32% as of the 2022 examination (Kenya National Examinations Council [KNEC], 2022). This trend is concerning, as high school Physics forms the foundational knowledge for physics-related courses in tertiary education, which are essential to the fulfilment of Kenya's development goals.

Several studies and education reports attribute the low achievement and enrollment in Physics to ineffective, teacher-centered instructional approaches that fail to engage learners or cultivate essential scientific skills.

Physics, by its nature, requires learner-centered strategies that promote inquiry, creativity, and critical thinking which are competencies at the heart of the Competency-Based Education (CBE). In IBL, particularly the use of the 5E instructional model (Engage, Explore, Explain, Elaborate, and Evaluate), has been shown to foster motivation, conceptual understanding, and student engagement. However, utilization of the IBL in the Physics classrooms in secondary schools in Nairobi City County had not been established through studies and hence the basis for this study. This study, therefore is explored the extent of IBL utilization and its effect in Physics instruction in Nairobi City County public secondary schools. The study investigated the extent to which IBL is being implemented in the physics lessons, the impacts that come with it and the challenges the teachers face when IBL is being implemented. This study was to inform the stakeholders of the gaps that need to be addressed as the country shifts from the performance-based KCSE curriculum to the Competency Based Education (CBE) in senior school where physics is a core subject in the STEM pathway.

Purpose of the Study

This study aimed to explore how Inquiry-Based Learning (IBL) is being applied in the teaching of Physics in secondary schools across Nairobi City County, Kenya. It sought to understand the extent to which teachers are using IBL in their lessons and how this approach influences students' learning and overall performance.

Objectives of the Study

The study was conducted based on the following objectives:

i. To find out the extent to which teachers are utilizing Inquiry-Based Learning (IBL) as a teaching approach in Physics classes in secondary schools across Nairobi City County, Kenya.

ii. To evaluate how the use of Inquiry-Based Learning (IBL) influences students' performance and overall learning outcomes in Physics in secondary schools within Nairobi City County, Kenya.

iii. To identify the challenges teachers and students face when implementing Inquiry-Based Learning (IBL) as a teaching approach in secondary schools across Nairobi City County, Kenya.

Significance of the Study

The outcomes of this study will be valuable to a broad range of stakeholders in the education sector. For Physics teachers, it will provide insights into the utilization of the Inquiry-Based Learning (IBL) in the classroom practices. For teacher educators and trainers, the study offers evidence-based information that can guide the planning and professional development of future teachers. Curriculum developers may also benefit by gaining a clearer understanding of how IBL approaches align with effective instruction of Physics, especially in relation to secondary education. Additionally, educational researchers interested in innovative pedagogies will find the study useful in advancing further inquiry into constructivist approaches. Ultimately, this research aims to improve the IBL approach in the physics classrooms. Specifically, the study will provide insights into how IBL influences student performance in Physics, thereby helping teachers identify and address existing instructional gaps.

For the Ministry of Education (MoE), the study has offered evidence-based recommendations for enhancing Physics instruction. With the emphasis on the use of IBL in the teaching of the Integrated Science at the Junior Secondary School level and Senior School in the new curriculum, the research will also inform the preparedness of senior secondary school teachers in implementing the Competency-Based Education (CBE).

Furthermore, the results will assist curriculum developers in designing effective frameworks for Physics instruction that foster improved student motivation and good learning outcomes in the subject.

Theoretical Framework

Constructivist Theory provided the conceptual framework for this study, supporting the idea that learning is a process of building understanding through experience. It was advanced by John Dewey (1933) and Jean Piaget (1972). According to this theory, learning is not simply about absorbing information; rather, it is an interactive learning process where learners acquire knowledge by connecting it to what they already know. Rooted in the Constructivist framework, this research views learning as an active, experiential process through which students build their own understanding in hands-on, reflective, and meaningful learning experiences. In this view, learners do not only receive information but actively make sense of new ideas through exploration, questioning, and collaboration. Instead of simply receiving information passively, learners interpret and make meaning from new experiences based on what they already know (Oliver, 2000).

According to Phillips (1995), learners come to new learning situations with prior knowledge, which shapes how they construct new or modified understanding. Key concepts within this theory include assimilation, where new information fits into existing knowledge, and accommodation, where the learner adjusts their mental frameworks to incorporate new ideas.

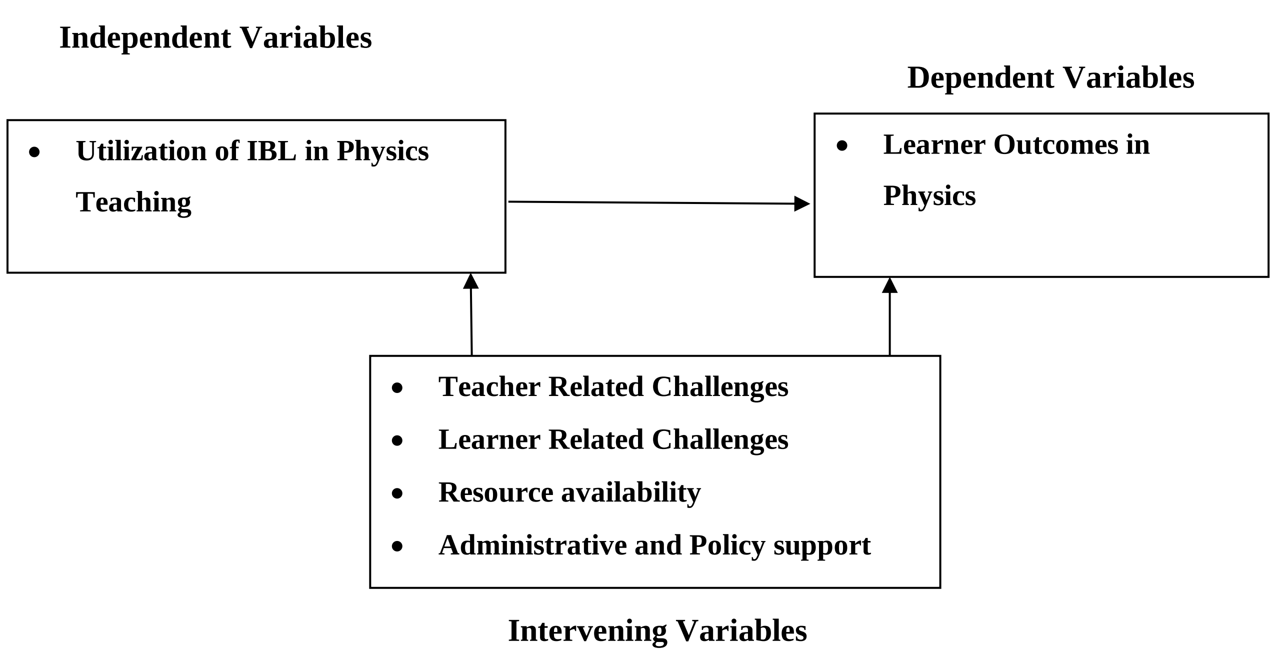
Constructivist approaches are especially well-suited for developing higher cognitive abilities like critical analysis and effective problem-solving (Tam, 2000). This theory thus provides a strong foundation for understanding how IBL can be utilized in the learning of Physics.

Conceptual Framework

This study is grounded in the belief that Inquiry-Based Learning (IBL) significantly influences students' performance in Physics. At the center of this framework is the belief that when teachers actively use IBL in their teaching, it can significantly boost students' understanding and performance in Physics.

The framework also recognizes the importance of certain supportive conditions that can influence how well IBL works. These include teacher training and professional development, access to teaching and learning resources, and strong administrative or policy support. These elements serve as moderating variables and as such have the potential to either reinforce or undermine the link between IBL implementation and students' academic performance.

Figure 1 Conceptual framework



Review of Related Literature

Extent of Inquiry-Based Learning Utilization in Teaching Physics

Teachers are key to the successful implementation of IBL. As facilitators, they guide lesson objectives, steer student discussions, and support exploration phases in the learning process (Byrne, Rietdijk, & Cheek, 2016). IBL encourages collaboration and communication, with learners working in small groups to explore questions and present findings, often with minimal direct instruction (MacDonald, 2016).

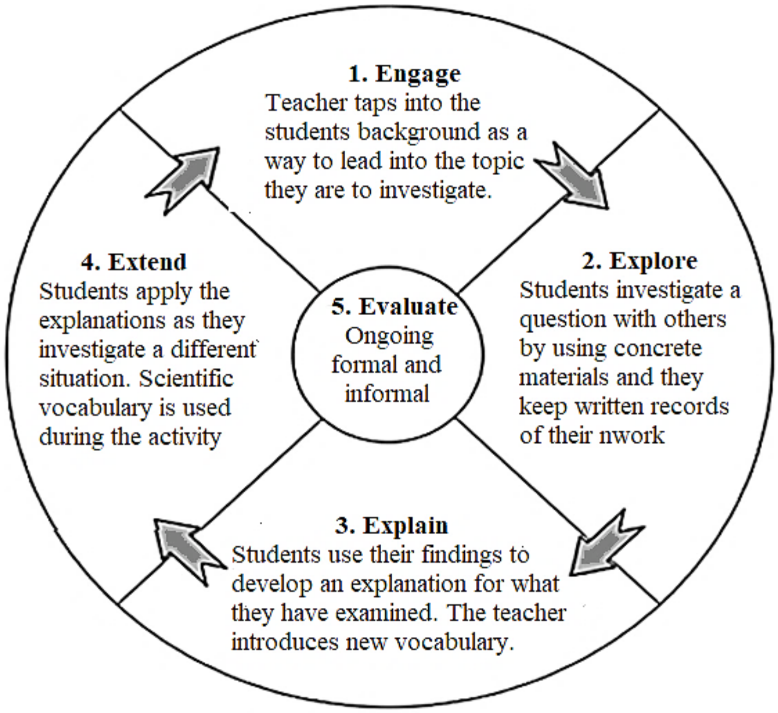
Globally, education systems are increasingly emphasizing the use of the skills that are considered to be of the 21st-century. They include the “4Cs” that are the collaboration, communication, creativity and the critical thinking (Partnership for 21st Century Skills, 2011). These skills are essential in preparing students for dynamic professional environments and are best fostered through learner-centered approaches like IBL (Donovan, Green, & Mason, 2014).

Heuristic instructional models, particularly constructivist approaches like IBL, have been shown to enhance learners’ mastery of these essential 21st-century skills. IBL is grounded in experiential learning and places great emphasis on the inquiry process, where students acquire knowledge by engaging in thoughtful questioning and hands-on exploration (Abd-El-Khalick, Lederman, & Schwartz, 2015; MacDonald, 2016). Teachers and students take on active roles that differ markedly from traditional teacher-centered classrooms (Chichekian & Shore, 2016).

Exline (2004) defines inquiry as a process of seeking truth or knowledge through questioning. The National Research Council (1996) extends this definition to include the diverse methods scientists use to study natural phenomena and develop evidence-based explanations. IBL, therefore, mirrors scientific practice and equips students with relevant investigative skills (Zheng & Geelan, 2013).

The Engagement, Exploration, Explanation, Elaboration, and the Evaluation phases which make the 5Es instructional approach, is widely recognized for facilitating inquiry in science classrooms (Bybee & Landes, 1990; Duran & Duran, 2004). This model guides students through a progressive learning cycle that helps build and extend understanding (Bybee et al., 2006; Routledge et al., 2012).

Figure 2 The Instructional Model of the 5Es



Source: Routledge/Taylor & Francis 2012

Influence of Inquiry-Based Learning on Learner Performance in Physics

Research on the effectiveness of Inquiry-Based Learning (IBL) in enhancing learning outcomes and fostering deeper understanding in science education has been done before. In Kenya, Changeiywo, Ndirangu, Njoroge, (2014) found that students exposed to IBL performed better in Physics in form two. Similarly, Ojo and Sola (2007) observed increased learner motivation and interest when IBL was applied, which improved achievement.

Motivation is a key driver of academic success, as it influences how much effort students are willing to invest in their learning and how they persist through challenges. Harold, Kushman, and Sieber (2000) noted that increased learner motivation leads to better academic outcomes. In China, educational reforms have promoted learner-centered approaches, including inquiry and discovery-based learning, as a means to foster independence and scientific process skills (Geelan & Zheng, 2013).

IBL enables learners to develop and refine their inquiry abilities by engaging in open-ended investigations, managing research activities, analyzing results, and communicating findings. These skills are integral to meaningful learning in Physics and contribute to deeper conceptual understanding (Edelson, Gordin, & Pea, 1999).

Moreover, IBL stimulates intellectual curiosity by problematizing existing knowledge, prompting learners to seek answers actively (Hiebert et al., 1996; Berlyne, 1966). It encourages learners to put their knowledge into practice in novel contexts, promoting the discovery of new insights and the reinforcement of prior learning.

Challenges in Integrating Inquiry-Based Learning in Physics Education

Despite its advantages, IBL is not without challenges. Teachers often struggle to articulate the educational purposes of practical activities. In the UK, studies by Donnelly (1995) and Wellington (1998) showed that many teachers were unclear about the rationale behind hands-on learning. Similarly, Gott and Duggan (1995) found that teachers were "confused as to the role and purpose" of investigations within the science curriculum.

Learners also face difficulties with inquiry activities, particularly in areas such as planning investigations, collecting data, interpreting results, and effectively communicating their findings These challenges are due to inadequate prior knowledge and being unmotivated (Edelson, Gordin, & Pea, 1999).

Soloway et al. (1994) identified three basic barriers to learner-focused instruction, including motivation, cognitive load, and the accessibility of tools for diverse learners. These concerns are particularly relevant in under-resourced educational environments, where disparities in learning readiness and access to instructional materials may hinder IBL implementation.

Institutional and systemic factors also pose obstacles. Gholam (2019) found that student teachers viewed school structures and rigid curricula as major barriers to using IBL effectively. While IBL promotes deep and transferable learning, fosters engagement, and supports differentiation, its integration remains limited by educational systems that favor conventional pedagogies.

Methodology

Research Design

To effectively examine the research objectives, a descriptive survey design was employed. Komar (2005) outlined the definition of a research design as a structured strategic plan formulated to guide the investigation and provide research questions with suitable answers. Similarly, Kothari and

Garg (2014) describe it as a comprehensive format that outlines the procedures for the collection of data, measurement, and analysis. According to Denzin and Lincoln (1994), it is a comprehensive strategy containing many assumptions to detailed methods of collecting data and analyzing it. The design allowed the researcher to obtain information from the selected sample to describe the current practices regarding IBL in Physics education and hence suitable for this research. To ensure a proper understanding of the research investigation, the study utilized both qualitative and quantitative data collection methods. They included questionnaires for broader data collection, interviews for in-depth insights, and observation schedules to capture real-time classroom practices.

Target Population and Sample Size

The population of interest comprised secondary school students and their Physics teachers in Nairobi City County. As described by Fisher (2016), an aggregate of individuals or units possessing certain characteristics relevant to the study gives the target population. With approximately 107 public secondary schools offering the KCSE curriculum in the county, the study was conducted in 11 public secondary schools, from each category; two national, three extra-county, three county and three sub-county schools. A total of 337 participants who comprised 326 students and 11 teachers of physics participated in the study. Specifically, the study targeted Form two students taking Physics and their respective teachers. Table 3.1 gives a summary of the targeted schools by category and gender.

Table 3.1: Target Population

School Category	No. of Schools	Boys	Girls	Mixed
National Schools	2	1	1	0
Extra-County Schools	3	1	2	0
County Schools	3	2	1	0
Sub-County Schools	3	1	1	1
Total	**11**	**5**	**5**	**1**

Table 3.2: Target population by Gender

School Category	No. of Boys	%	No. of Girls	%
National Schools	48	14.7	44	13.5
Extra-County Schools	52	16.0	43	13.2
County Schools	45	13.8	30	9.2
Sub-County Schools	39	12.0	25	7.7
Total	**184**	**56.4**	**142**	**43.6**

Sampling Techniques and Sample Size

To achieve a balanced and meaningful sample, the study applied purposive sampling for targeted selection, alongside stratified random sampling to ensure representation across subgroups. Purposive sampling was particularly suitable since the researcher possessed prior knowledge of the population and hence focused on specific characteristics that were relevant to the study's objectives (Fraenkel & Wallen, 2009). To ensure a representative sample, stratified random sampling was then used to draw participants from different subgroups within the population. According to Mugenda and Mugenda (2003), a selection of 10% to 30% of the population is considered sufficient for descriptive research, making this approach both methodologically sound and practical for the study's context. The selected 11 schools represent 10.3% of the 107 public secondary schools in the county, which is sufficient. The Public Secondary Schools served as the sampling units. Stratified random sampling was used within the selected schools to ensure representativeness across school categories. Purposive sampling was used to identify the students taking Physics and their Physics teachers.

Research Instruments

The research used three instruments: questionnaires for both teachers and students, interview guides for Physics teachers, and observation schedules that were used to assess classroom practices. These instruments helped gather data in alignment with the study's objectives.

Questionnaire for Teachers

The questionnaire for the teachers consisted of four (4) sections: Section A had six (6) items that contained the background information. Section B had eight (8) items investigating the extent to which IBL is utilized by the teachers, while section C had eleven (11) items measuring the influence of IBL in students' performance and overall learning outcomes in Physics and section D which had six (6) items measuring the challenges faced by the teachers while implementing the IBL.

Questionnaires for Students

The questionnaire for the students consisted of four (4) sections: A, B, C and D. Section A had four (4) items that contained the background information. Section B had ten (10) items investigating the extent to which IBL is utilized in class, while section C had eleven (9) items measuring the influence of IBL in students' performance and overall learning outcomes in Physics and section D which had four (4) items measuring the challenges faced by the students while IBL is being implemented.

Interview Guide for Teachers of Physics

The interview guide was used to collect first-hand information on IBL from the teachers using eight (8) questions. The semi-structured interview questions were as follows; question 1- 4 was used to obtain information on the extent to which the physics teachers integrate IBL in their lessons, question 5 and 6 was used to establish the influences of IBL on the learner and also the teacher and questions 7 and 8 were used to find out the challenges that the teachers encounter as they teach physics with IBL integration. Eleven teachers, one from each school were interviewed within the period of data collection which was roughly two weeks. The researcher took down the points as the interviewees answered the questions and also recorded the voices for further consideration if what was written was not clear. The information obtained through the interviews was decoded and interpreted.

Lesson Observation Schedule

The Lesson Observation Schedule was used to observe and record the activities in a physics class. The schedule was divided into three areas of observations based on the objectives of the research. The whole Observation Schedule was based on a 3-point Likert Scale of Low, one (1) point, Mid, two (2) points and High, three (3) points. In section A, the observations for the extent to which IBL was utilized was recorded. In this section, the researcher observed the application of the 5Es model approach of Engagement, Exploration, Explanation, Elaboration and Evaluation phases. Section B observed the influences on the learners that came with IBL integration in the lesson. The observation was based on: self-efficacy and curiosity, creativity and critical thinking, the understanding of concepts, confidence, collaboration and communication skills of the leaners. Section C of the schedule was used to observe the real life challenges the learners go through in a physics lesson class. The observation items were; concept grasping difficulty, the resources availability, teamwork and collaboration of learners during the lesson and overall class management.

Data Analysis

The research tools included questionnaires, interviews and the class observation schedules.

A mixed-methods approach was employed, incorporating both quantitative and qualitative data collection techniques. The questionnaires produced quantitative data while the interview guide and the observation schedule produced the qualitative data. The quantitative data underwent sorting, editing, and coding in preparation for statistical analysis. Qualitative data was analyzed thematically by analyzing the content, with findings being grouped by research objectives and presented narratively. Patterns and linkages were identified meaningful conclusions drawn. The quantitative data was analysed using descriptive statistics along with measures of central tendency. The qualitative data was coded and analysed. Analysis was done using SPSS version 25 and Microsoft excel. The findings were presented using frequency tables, charts and narratives which utilized descriptive statistics which consisted frequency and percentages.

Logistical and Ethical Considerations

Pre-research tasks were conducted before the actual research was conducted. These activities included the writing of the proposal to meet the required standards, obtaining a research approval and an introductory letter to National Commission for Science, Technology and Innovation (NACOSTI) for research approval from the graduate school of Kenyatta University, obtaining the research permit from NACOSTI and getting the research approval from the Nairobi County Regional Commissioner and the Ministry of Education.

Ethical considerations include informed consent, confidentiality, and voluntary participation (Orodho, 2009). The ethical considerations involved voluntary participation and total anonymity of respondents. The purpose of the study was made clear to all participants before collection of data and all data collected was treated with utmost confidentiality. No names or identifiable information was recorded. Schools, students, and teachers were coded to preserve anonymity. Data was stored securely in soft copy format and was only accessible by the researcher and authorized university supervisors.

Study Findings

Teacher Gender

The research showed there are more male teachers teaching physics than the female counterparts. This clearly indicates that the teaching of physics is a male dominated field and few women are in the physics education careers. This gender disparity indicates that few female learners opt to take physics in their O levels compared to the male students.

Teacher Qualifications

This shows that all the physics teachers that participated in the study were qualified to teach physics. It also shows that some level of advancement is notable with at least one teacher having had a master's degree. This is an indication of lack of motivation or lack of opportunities that may influence the teacher to pursue higher education.

Teacher Experience

There were no teachers who had less than two years of experience. 18% of the teachers had between 2-5 years of experience, 46% of them had between 5-10 years of experience and 36% had over 10 years of teaching experience. The mean teaching experience is 8.6 years which implies that the teaching force is moderately to highly experienced. The results also show a gap in teacher recruitment to have newly experienced teachers in the workforce.

Schools' Mean Performance in Physics

None of the schools that the researcher investigated had a mean above 9.5 points and none had below 3.5 points. 18% of the schools had between 7.5 and 9.4 points and 82% of the schools had between 3.5 and 7.4 points. The results shows that majority of the schools perform below average and a small portion having relatively higher scores. Excellent performance in physics which is a score of above 9.5 is rare. This is an indication that there are challenges that needs to be addressed for better performance in physics in secondary schools.

Category of Schools

The category of schools that were visited for research are 2 national schools, 3 Extra-County Schools, 3 County Schools and 3 Sub-County schools. This represents 18% of the National Schools

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category and 27% of each of the other categories

Teacher Training in IBL

45% of the teachers had received training in IBL approaches and 55% of them did not have training in IBL. The findings indicate that less than half of the teachers that the researcher investigated are adequately equipped with IBL pedagogical skills and a greater percentage did not have the training needed to implement IBL in a physics class. This shows a significant professional development gap in physics education which may hinder proper integration of IBL in class.

Findings on how widely teachers of physics use IBL

The results indicate that teachers of Physics do not often use IBL as a teaching approach. On the application of the 5Es model during the lesson, the Engagement phase and Exploration phase were not well executed in many classes. The most used phases were the explanation, majorly from the teacher, elaboration and evaluation where learners were given questions to answer. During the Engagement phase, the introduction of the topic based on the previous topic was employed by many teachers; however, there were not lots of activities to capture the learners' attention and to make the learner engaged. In the Exploration phase, many classes did not have enough resources nor a variation of resources for the learner to research on. Few learners had only one text book on their desk and others just had note books. Rather, the learners just answered questions posed by the teacher by simple application of the knowledge gained. The Explanation phase was majorly from the teachers. Learners only explained facts from the knowledge they had previously gained and not on researched new knowledge on their own. Elaboration from the teacher was quite involving because learners did not have prior research on the concepts being taught. All the teachers observed used well the Evaluation phase, giving the learners further work in class to do and present and as assignment to be submitted later. The teachers also acknowledged during the interview that the heuristic teaching method which is learner centred is not always the best approach. They cited time constraints and syllabus coverage as factors that make the teacher use the expository approaches which are teacher centred. Also, some topics required the teacher centred approach due to their nature. While Physics teachers in Nairobi City County appear to integrate certain aspects of the Inquiry-Based Learning model, particularly during the engagement and elaboration stages, its full adoption across all phases is not yet consistent. The findings highlight a tendency for teachers to maintain control of the learning process, especially during exploration and explanation stages, where learners should ideally take a more active role. This pattern suggests the need for targeted professional development to strengthen teachers' capacity and confidence in facilitating learner-centered, inquiry-based instruction.

Influences of IBL on students' performance and overall learning outcomes

Table 4.21 Teachers' Responses on Influences of IBL on students' performance and overall learning outcomes in Physics

Impact of using IBL	SA (%)	A (%)	N (%)	D (%)	SD (%)
IBL enhances students' understanding of Physics concepts	54.5	45.5	0.0	0.0	0.0
Students are more engaged when I use IBL approaches	72.7	27.3	0.0	0.0	0.0
I feel confident implementing IBL in my Physics classroom	36.4	63.6	0.0	0.0	0.0
IBL enhances students' understanding of Physics concepts	45.5	54.5	0.0	0.0	0.0
Students become more actively engaged when I use IBL strategies	63.6	36.4	0.0	0.0	0.0
IBL improves students' ability to apply knowledge to new situations	36.4	63.6	0.0	0.0	0.0
Learners show greater motivation to learn when engaged in inquiry	63.6	27.3	9.1	0.0	0.0
IBL develops learners' critical thinking and problem-solving skills	54.5	45.5	0.0	0.0	0.0
Students work better in groups during IBL activities	45.5	36.4	18.1	0.0	0.0
IBL positively influences learners' performance in Physics assessments	63.6	36.4	0.0	0.0	0.0
IBL helps students become more independent learners	54.5	27.3	18.2	0.0	0.0

The data reveal a strongly positive perception among Physics teachers regarding the influence of Inquiry-Based Learning (IBL) on both teaching and learning outcomes. A striking trend in the results is the uniform agreement, whether strong or moderate, across nearly all items, signaling a shared recognition of IBL as an effective and transformative teaching approach.

Every teacher surveyed either *agreed* or *strongly agreed* that IBL enhances students' understanding of Physics concepts. This unanimous view highlights a collective belief that inquiry-oriented lessons help students make sense of abstract scientific ideas through exploration and experimentation, rather than through rote memorization. The finding points to a noticeable transition from traditional content delivery toward deeper, more conceptual learning is an essential hallmark of the inquiry-based model. The results also demonstrate that IBL is not only well-received but also produces clear pedagogical benefits. Teachers recognize it as a practical and effective approach that fosters curiosity, enhances problem-solving abilities, and improves both academic performance and learner independence. The evidence strongly suggests that strengthening and sustaining IBL practices could greatly enhance the quality, engagement, and relevance of Physics education in Nairobi City County.

Challenges teachers face when implementing Inquiry-Based Learning (IBL) as a teaching approach

The findings on the challenges teachers of physics when implementing IBL face were categorized into three responses in a Likert scale. These were Not a Challenge, Minor Challenge and Major Challenge. Table 4.30 shows 6 statements on the challenges.

Table 4.32 Challenges teachers face when implementing Inquiry-Based Learning (IBL) as a teaching approach in Physics

Challenge	Not a Challenge	%	Minor Challenge	%	Major Challenge	%
Lack of laboratory equipment	5	45.5	4	36.4	2	18.2
Large class sizes	2	18.2	4	36.4	5	45.5
Limited time to cover the syllabus	3	27.3	2	18.2	6	54.5
Lack of professional training in IBL	3	27.3	5	45.5	3	27.3
Inadequate support from school leadership	6	54.5	4	36.4	1	9.1
Lack of enough Teaching Resources	2	18.2	4	36.4	5	45.5

The data from the findings highlight several key challenges that hinder the effective implementation of IBL in Physics classrooms across Nairobi City County. Overall, the findings show that both structural and instructional barriers limit teachers' and learners' ability to fully engage in inquiry-oriented teaching and learning. In summary, the researcher's classroom observations revealed that the main challenges in implementing Inquiry-Based Learning in Physics lessons include inadequate instructional resources, weak learner collaboration, limited instructional time, and difficulties in conceptual understanding. These constraints suggest that while teachers are making efforts to apply inquiry-oriented methods, practical and structural limitations often hinder full implementation. Students' findings indicate that while students value the interactive and exploratory nature of IBL, they face significant obstacles that limit its effectiveness. The main challenges include inadequate learning resources, insufficient lesson time, and dependence on the teacher for conceptual understanding. Although teamwork is improving, inconsistencies remain in how students collaborate during inquiry tasks. Addressing these issues through improved resource provision, extended instructional time, and structured scaffolding could enhance the effectiveness of IBL in Physics classrooms.

The research findings are in agreement with Crawford (2017) and Roslan et al. (2023), who found that even when teachers value and support inquiry-based teaching, they often fall back on traditional methods that feel safer, quicker, and more predictable, especially when under pressure to cover the syllabus and prepare students for exams.

Conclusions

The research concluded that most teachers do not utilize widely the IBL approach in the teaching of physics. It also found out that the Engagement and Exploration Phases which form the basis for IBL were poorly integrated in the teaching of physics mainly due to lack of resources and teachers not being creative enough. The research also concluded that IBL has lots of positive effects on the learner achievement and performance in physics. The research also established that the main challenges in implementation of IBL is lack of enough teaching resources, lack of enough time to cover large syllabus content, lack of proper training and large class sizes especially where all learners in a class take physics or where its elective, one large class is established.

Recommendations

In order to strengthen the teaching of physics in secondary schools, it's important that IBL is supported through policies. The following recommendations aim at guiding the policy makers for the benefit of teachers and learners in physics and science education in general.

i. Continuous Teacher Professional Development training on IBL oriented pedagogy
ii. Integration of IBL modules in the training of teachers at the universities and colleges.
iii. The government and other education stakeholders should allocate sufficient funds to public secondary schools in order to have adequate teaching and learning resources. Digital learning resources should also be provided.

iv. The curriculum should be aligned with IBL principles through incorporation of IBL activities in learning outcomes and lesson guidelines.

v. Assessment practices should be reformed to capture IBL skills rather than rote learning examinations.

vi. The government and other stakeholders should have regular monitoring and evaluation by education officers to check on IBL implementation in science classes in schools.

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