

Assessment of Influence of Inquiry-Based Approach on Student's Attitudes towards Biology in Secondary Schools in Kiambu County, Kenya

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Abstract: Research evidence shows that students' interest in a subject, their motivation to study, career choice, participation in extracurricular activities, teaching methods, and teachers' level of experience, are a range of variables that influence students' attitudes and performance. Use of a student-centred approach such as inquiry-based approach (IBA), will influence the development of students' interests and attitudes in the subject, thereby improving their performance. According to research evidence, students' attitudes are related to achievement. It was recommended that teachers should implement effective teaching strategies that influence development of positive attitudes towards Biology. The purpose of this study was to establish the influence of inquiry-based approach on the attitudes of students towards Biology. The target population was 37 public secondary schools, 1,194 Form 3 students and 29 Biology teachers. The study adopted simple random and purposive sampling techniques to select 11 secondary schools, 14 Biology teachers and 344 students. Questionnaires and interview schedule were used for data collection. Data was analysed using descriptive analysis with the help of Statistical Package of Social Sciences (SPSS) version 25. On the basis of the findings, it was found that implementation of IBA influenced the attitudes of Form 3 students. Students collaborated to create their own knowledge and engaged in practical activities. However, it was found that a variety of factors, including the availability of resources such as computers and internet access, are critical to assisting students in understanding challenging topics and conducting research. This will increase their interest to engage into the learning activities. It is recommended that Biology teachers implement more of IBA during teaching, since it motivates students, engages them into thinking and reasoning, and asking questions. Teachers should also engage students into more of group work, since it fosters collaboration among students and allows them to handle and manipulate apparatus during practical.

Keywords: Inquiry-Based Learning, Student's Attitudes, Biology, Secondary Schools.

INTRODUCTION

According to Wamukota and Masibo (2017), there are a range of variables that influence students' performance, some of which are: teachers' effectiveness, students' interest in the subject, motivation to study, teachers' level of experience, their ability level, students' career choice, students' participation in extracurricular activities, and teaching methods (Ogutu, *et al.*, 2014). Use of an effective teaching method will develop students' interests and attitudes thereby, improving their performance. According to Schibeci, (1986), students' attitudes are related to achievement. Owino, *et al.*, (2015), recommended that teachers should implement effective teaching strategies that encourage development of positive attitudes towards Biology. The study concluded by encouraging teachers to use group discussion and practical activities to stimulate learning. The effective integration of IBA influences both the attitudes of students and their performance (Briones, *et al.*, 2021; Chemiat, 2020; Islam & Tasnim, 2021; Olufemioladebinu, *et al.*, 2018). Considering the integration of learner-centred teaching approaches, Wamukota and Masibo, (2017), established that the problem-solving method, process-based approach, and inquiry-based approach are student-centred teaching approaches that can be utilized to involve the

students in the process of learning, resulting in better learning.

Lopez, (2021) established that the adoption of inquiry-based teaching strategy influences students' attitude and improves performance. It was found that if teachers are equipped and educated on how to implement IBA, students will develop confidence to perform well. Annan, *et al.*, (2019) and Wambui (2017), revealed that students' attitudes about their studies, which may be positive or negative, influence how well they perform. Students could choose to focus their studies on a topic they are interested in, especially if they like the teacher who is teaching it. According to the study, students' performance will be poor if they are not prepared to use more of their time to study. The studies revealed that students become motivated and perform well in Biology if they develop positive attitudes. Integrating inquiry-based approach in the classroom will enhance students' performance, develop their interests and attitudes, and stimulate them to learn (Annan, *et al.*, 2019).

Andrini (2016), found that the interest and creativity of science students to learn is influenced by selecting appropriate approaches to learn. IBA was discovered to be one of the better teaching

methods that may be utilized to teach during the learning process. In an inquiry-based teaching class, teachers become facilitators and mediators to facilitate students learning by using their skills to gain knowledge. According to the findings of study, integration of IBA engages the students to actively observe, guess, and infer through group activities and communicate results from the investigation. Suwondo and Wulandari (2013), acknowledged that use of inquiry-based approach increases students' performance and improves their learning preferences particularly, while performing Biology practical activities (Falemu & Akinwumi, 2021). This will lead to acquiring skills and retaining information learned for possible knowledge transfer.

Ogutu, *et al.*, (2014), revealed that students' interests and attitudes towards a subject is very important. Attitudes and interest are factors that encourage students and can enhance better performance. Acquiring interest in Biology develops students' positive attitude. This enables students to put in more time to study. Osborne, *et al.*, (2003), stressed that an effective teaching method stimulates students' interest and engages them with the materials. This makes them develop positive attitude and interest in the lesson with more focus to study, thereby increasing performance. Prokop, *et al.*, (2007), revealed that during practical activities, engaging students with real objects like plants and animals in Biology lessons, motivates and creates interest in students to learn. Moreover, Gimba, *et al.*, (2018), argued that students' attitudes will improve if they spend more time interacting with and practicing Biology materials through activities and engagements.

Tordzro, *et al.*, (2021), acknowledged that the best method for teaching and learning Biology is through hands-on activities that can be completed in the field, laboratory, or in the classroom. The Educational Reform of Ghana (ERG), according to the study, highlighted that Biology instruction should be centred on practical activities since hands-on activities inspire Biology students' interest. It also improves knowledge acquisition and transfer. The study revealed that teachers are facilitators and play major roles in developing students' interest towards Biology to improve their performance. According to Hattie (2003), and Blanchard, *et al.*, (2010), teachers contribute 30% of students' achievement, while teachers' influence, the environment of the school whether conducive or uncomfortable, parental influence on

the student and peers contribute 20% toward the student's performance.

In Nyakach District, Kisumu County, Kenya, Ogutu, *et al.*, (2014), revealed that the levels of students' motivation and attitudes about Biology will affect how well they perform on the KCSE examinations. It was established that since students lack the motivation to study Biology, participate in class discussion, and perform laboratory activities, their performance became poor in Biology KCSE. Owino, *et al.*, (2015), and Muthoni (2012), in Thika West District, found that an individual with a positive attitude will perform better while an unfavourable attitude will lead to dismal performance. Correia and Harrison (2020), reported that teachers are being encouraged to implement inquiry-based approach because it promotes students' investigative skills and understanding conceptual knowledge of Biology. Ogutu, *et al.*, (2014), said, students' consistent dismal performance in Biology KCSE examinations is an indication of poor teaching and learning quality, and if not reversed, will affect the possibility of Kenya's attaining Vision 2030.

According to Isaboke, *et al.*, (2021), the transition from a content-based curriculum to a competency-based curriculum demands a change in the teaching approach. Implementation of inquiry-based approach (IBA) will enable Biology teachers to maintain and extend the spirit of the Competence-Based Curriculum (CBC). It will prepare teachers for primary students who are currently being taught the CBC. Integrating IBA will enhance the goals of the new curriculum (CBC) to be achieved. Mentioning some goals of CBC, M'mboga (2021), revealed that CBC has the ability to promote the acquisition of skills. Sifuna and Obonyo (2019), acknowledged that CBC emphasizes on the improvement of skills and use of information in practical life situation. It aims at developing the skills of students to use appropriate knowledge that will enable them complete a project (Atieno & Kanake, 2021; Amunga, *et al.*, 2020; Ngwacho, 2019).

Integration of Inquiry-Based Approach correlates and fulfils CBC's objectives as it motivates and engages students into extracurricular activities, thereby improving their performance (Waseka & Simatwa, 2016). In Nyeri County, Njoroge, *et al.*, (2014) revealed that integration of inquiry-based approach facilitates students to achieve higher scores in Physics. The study encouraged teachers to apply inquiry-based approach in Kenyan

schools. Ndirangu (2017), discovered that the level of IBA integrated was negatively influenced by head teachers' unfavourable attitudes regarding the use of learner-centred approach and their absence from SMASSE INSET training programmes.

Muriithi (2022), further acknowledged that, educationalists and medics have raised concerns in Kenya that the numbers of students qualifying for diploma in nursing courses have declined due to low performance in Biology KCSE. Student needs to earn a mean grade of C⁺ in Biology to be eligible to pursue a diploma in nursing. The study concluded by encouraging senior secondary school students to develop interest in Biology and apply more efforts to perform better in it, while teachers and parents are to motivate students to be serious about studying Biology. However, Ochungo, *et al.*, (2021), showed that performance in Biology, both at national and county level, is alarming, and draws concerns since students who perform below C⁺ in Biology are not allowed to pursue courses such as medicine, engineering, law and pharmacy in Kenya (Waseka & Simatwa, 2016). Therefore, the implementation of IBA for conceptual understanding of Biology, which will influence students' attitude towards Biology and improve their academic performance, is a concern in Kenya.

REVIEW OF RELATED LITERATURE

Chu, *et al.*, (2017), argued that adoption of inquiry teaching influences the performance, attitudes, reading skills, and presentation skills of students. It enhances the creation of knowledge, engages students into deep thinking and reasoning, and promotes their ability to apply knowledge. Inquiry-based approach involves asking questions, seeking and testing explanations, and producing knowledge by using Science Process Skills (SPS). It facilitates students to gain knowledge and develop extensive understanding of concepts which has the ability to influence students' performance and their attitudes.

An experimental study conducted by Abdi, (2014) in Iran, demonstrated that the adoption of inquiry activities significantly influenced the performance of students. Bezen and Bilgisi (2020), added that inquiry-based teaching positively changed students' attitudes as they develop more interest in the lesson. According to the study, inquiry-based approach enables students to understand the concepts of Biology and develop process skills in science. However, it did not change their attitudes due to the teaching intervention designed and the

short time it was implemented (Şimşek & Kabapinar, 2010).

In Australia, Attard, *et al.*, (2021) demonstrated that, students' continual interactions with their teachers, classmates and active engagement into learning was influenced as IBA was implemented. As the teachers supported the learning process, it significantly influenced students' active engagement in the inquiry-based classroom. Continual interaction among students resulted to independence giving them ownership of their learning. Jensen, *et al.*, (2012), acknowledged that collaborative learning helps to shape individuals' insight as they listen and learn from others which results in the conceptual understanding of the lesson.

In Germany, Schmid and Bogner (2015), revealed that, although teaching through inquiry cannot be fully implemented because of limited time, teachers can implement it by focusing on certain aspects of the lessons as deemed necessary. The integration of inquiry-based teaching influences students' performance and long-term retention. It enables students' ability to recall information and understand principles needed to answer content knowledge questions. According to Saunders-Stewart, *et al.*, (2012), students acquire knowledge and skills when they engage in inquiry-based learning activities. Students become motivated, develop positive attitudes with improved performance, and creative thinking skills (Duran & Dökme, 2016; Madhuri, *et al.*, 2012). Irwanto, *et al.*, (2019) established that teaching through inquiry enables students thinking skills and integrate knowledge to practical life situations thereby, promoting their ability to learn. Gormally, *et al.*, (2009), demonstrated that inquiry-based teaching enhances students' reading proficiency, acquisition of communication, teamwork, thinking critically and problem solving skills, ability to research, and self-confidence in learning. The analysis of the findings established that students interact, engage in the lesson, and collaborate during learning in an inquiry-based class. It is a concern about the activity students in Githunguri sub-County, Kenya, are engaged with in an inquiry classroom and how it influences their attitudes.

In Hong Kong, Chan, *et al.*, (2012), said learning through inquiry facilitates students to work in group to derive collective knowledge, promotes questioning skills and improves performance. Andrini (2016), points out that Students will be able to connect newly taught material with

previously known information, resulting in meaningful learning. To ensure that students understand how to use their skills to acquire knowledge, teachers must be able to support the learning process in an inquiry-based learning classroom. A study conducted by Enebechi, (2021) in Nigeria, indicated that inquiry-based approach promotes students' ability to retain concepts learned in Biology. It also promotes a deeper understanding of contents. The study concluded by encouraging teachers of Biology to integrate inquiry-based teaching in order to develop students' ability to retain information learned.

In Kenya, Mukhwana, (2016) did a study in Wareng sub-County, and found that students' performance progressed positively when inquiry-based approach was implemented (Njoroge, *et al.*, 2014). Kunga, *et al.*, (2022), noted that teaching through an inquiry approach enhances student performance and builds their Science Process Skills (SPS). Mulyeni, *et al.*, (2019), described SPS as the ability to observe, classify, investigate, experiment and infer the findings of an investigation.

OBJECTIVE

The study's objective was to establish the influence of inquiry-based approach on students' attitudes toward Biology in Githunguri sub-County, Kenya.

RESEARCH QUESTION

What is the influence of inquiry-based learning on students' attitudes towards Biology?

THEORETICAL REVIEW

The study was based on two the Experiential Learning Theory (ELT) proposed by Kolb, (1984) and the theory of Constructivism proposed by Bruner, (1961). The experiential learning theory by Kolb is based on four different steps which include concrete experience, reflective observation, abstract conceptualization, and active experimentation. Effective learning occurs when a student has a concrete experience, observes it, and reflects on it. This process results in the production of abstract concepts and generalizations, which are subsequently applied to test hypotheses in new life situations. According to Kolb, learners enter the cycle of learning at any stage but the stages should be followed sequentially. Reflection is the key that would lead to new understanding. The theory indicates that students have different styles of learning which include divergence, assimilation, convergence or accommodation. While the aspect of inquiry-based teaching is recognizable in each

category, the accommodation groups are most comfortable with experiential approaches.

Jerome Bruner's theory of Constructivism emphasizes students as custodians of their learning and captures learning by doing where students focus on problem-based learning. It presents science concepts by relating it to the real world. In teaching, there is always a relationship between facts and concepts for conceptual understanding to solve problems which ensures the transfer of knowledge acquired, enhances understanding of the subject under discussion, and promotes retention. These theories are relevant because, like inquiry-based approach, they engage students to learn, experience the process of learning through hands-on activities, creating their own knowledge and acquiring skills

RESEARCH METHODOLOGY

This research adopted both qualitative and quantitative methods. Shorten and Smith (2017), described mixed research method as a methodology in which qualitative and quantitative data are gathered, analyzed, and evaluated within the same study. The approach was suitable because it may be utilized to better understand the relationships or disparities between qualitative data and quantitative data, allowing participants to speak up and share their experiences throughout the process of the study (Shorten & Smith, 2017). According to Mugenda and Mugenda (2019), mixed research method provides opportunity for the researcher to gain skills in both qualitative and quantitative approaches. It provides explanation on the data derived from quantitative studies that presents the underlying explanation behind the given figures and statistics (Orodho, Nzabalirwa., *et al.*, 2016). Qualitatively, it provides appropriate explanations of research questions to support the results with some numbers. Therefore, it was appropriate to combine the two approaches to get thorough results that are helpful to the research.

RESEARCH VARIABLES

According to Gould (2001), a variable is something that changes or varies. This study's independent variable was the integration of inquiry-based approach. The independent variable (IV) was students' attitudes towards Biology. The IV interacted with the intervening variables to determine whether students have positive or negative attitude toward Biology, which will then influence students' performance. The intervening variables are outlined as students' motivation, teachers' ability and level of training, and

availability of resources. The effective interactions of these intervening variables and the independent variable influenced the dependent variable.

STUDY FINDINGS

Findings from students questionnaires on influence of inquiry based approach on students' attitudes towards Biology

Table 1: Students responses to "I collaborate to create knowledge"

Response	Frequency	% of Frequency
Agree	259	75.3
Not Sure	21	6.1
Disagree	64	18.6
Total	344	100.0

Table 1 shows that 75.3% of the students agree they I collaborate to create knowledge, while 18.6% of the students disagree to the statement. Moreover, 6.1% of the students were not sure.

Table 2: Students responses to "I learn from each other by asking questions during class discussion or *hands-on-activities*"

Response	Frequency	% of Frequency
Agree	218	63.4
Not Sure	45	13.1
Disagree	81	23.5
Total	344	100.0

The data presented in Table 2 shows that 63.4% of students agree that they learn from each other by asking questions during class discussion or hands-on-activities, while 23.5% disagree. Furthermore, 13.1% of the students were not sure.

Table 3: Students responses to "I am motivated to learn"

Response	Frequency	% of Frequency
Agree	319	92.8
Not Sure	11	3.2
Disagree	14	4.0
Total	344	100.0

Table 3 shows that 92.8% agree that they are motivated to learn, while 4.0% of the students disagree to the statement. However, 3.2% of the students were not sure.

Table 4: Students responses to "I ask scientifically oriented questions"

Response	Frequency	% of Frequency
Agree	144	41.9
Not Sure	7	1.9
Disagree	128	37.2
Total	344	100.0

The responses of the students presented in Table 4 show that, 41.9% of the students agree that they ask scientifically oriented questions, while 35.7% disagree to the statement. Also, only 1.9% of the students were not sure of the statement.

Table 5: Students responses to "I am able to handle and manipulate the apparatus during practical"

Response	Frequency	% of Frequency
Agree	143	41.7
Not Sure	7	1.9
Disagree	166	48.3
Total	344	100.0

Table 5 shows that 48.3% of the students disagree that they are able to handle and manipulate the apparatus during practical to do Biology whereas, 41.7% indicated their ability and only 1.9% were undecided to the statement.

Table 6: Students responses to “I am able to plan and design experiments”

Response	Frequency	% of Frequency
Agree	212	61.6
Not Sure	21	6.1
Disagree	201	58.4
Total	344	100.0

Table 6 shows that 61.1% of the students expressed their ability to plan and design experiments, while 58.4% did not agree that Biology is difficult. Only 6.1% were not sure.

Table 7: Students responses to “I am able to collect and record data during lab”

Response	Frequency	% of Frequency
Agree	210	61.1
Not Sure	35	10.2
Disagree	99	28.8
Total	344	100.0

The data presented in Table 7 shows that 61.1% of the students agree that they are able to collect and record data during lab, while 28.8% disagree to the statement. Furthermore, 10.2% of the students were not sure.

Table 8: Students responses to “I enjoy Biology lessons”

Response	Frequency	% of Frequency
Agree	320	92.9
Not Sure	24	7.1
Disagree	0	0.0
Total	344	100.0

The data presented in Table 8 shows that 92.9% of the students enjoy Biology lessons, whereas 7.1% of the students were not sure of enjoying Biology lessons.

Table 9: Students responses to “I compete to answer questions to make my points”

Response	Frequency	% of Frequency
Agree	344	100
Not Sure	0	0.0
Disagree	0	0.0
Total	344	100.0

Data found in Table 9 reveals that 100% of the students agree that they compete to answer questions to make their points in class.

4.1.2 Findings from teachers’ questionnaires on influence of IBA on students’ attitudes towards Biology

Table 10: Teachers responses to “My students collaborate to create knowledge”

Response	Frequency	% of Frequency
Agree	270	78.6
Not Sure	0	0.0
Disagree	74	21.4
Total	344	100.0

Findings in Table 110 shows that 78.6% of the teachers agree that students collaborate to create

knowledge, whereas 21.4% did not agree to the statement.

Table 11: Teachers responses to “My students learn from each other by asking questions during class discussion or hands-on-activities”

Response	Frequency	% of Frequency
Agree	270	78.6
Not Sure	0	0.0
Disagree	74	21.4
Total	344	100.0

In Table 11, 78.6% of the teachers agree that their students learn from each other by asking questions

during class discussion or hands-on-activities, whereas 21.4% did not agree.

Table 12: Teachers' responses to "My students are motivated to learn"

Response	Frequency	% of Frequency
Agree	320	92.9
Not Sure	0	0.0
Disagree	24	7.1
Total	344	100.0

In Table 12, 92.9% of the teachers agree that of their students are motivated to learn, while 7.1% disagree to the statement.

Table 13: Teachers' responses to "My students ask scientifically oriented questions"

Response	Frequency	% of Frequency
Agree	270	78.6
Not Sure	24	7.1
Disagree	50	14.3
Total	344	100.0

In Table 13, 78.6% of the teachers agree that students ask scientifically oriented questions, whereas 14.3% disagree to the statement.

Table 14: Teachers' responses to "My students handle and manipulate the apparatus during practical"

Response	Frequency	% of Frequency
Agree	172	50
Not Sure	98	28.6
Disagree	74	21.4
Total	344	100.0

Data presented in Table 14 shows that 50% of the teachers said, students handle and manipulate the apparatus during practical, whereas 21.4%

disagree to the statement. Further, 28.6% were undecided to the statement.

Table 15: Teachers responses to "Students plan and design experiments"

Response	Frequency	% of Frequency
Agree	163	47.5
Not Sure	0	0.0
Disagree	181	52.5
Total	344	100.0

The report presented in Table 15 shows that 52.5% of the teachers said students did not plan and

design experiments, while 47.5% agree that students plan and design experiments.

Table 16: Teachers responses to "My students collect and record data during lab"

Response	Frequency	% of Frequency
Agree	279	81.1
Not Sure	35	10.2
Disagree	30	8.8
Total	344	100.0

The data presented in Table 16 shows that 81.1% of the teachers agree that students collect and record data during lab, whereas 10.2% were

undecided. Moreover, 8.8% of the teachers disagree to the statement.

Table 17: Teachers responses to "My students enjoy Biology lessons."

Response	Frequency	% of Frequency
Agree	320	92.9
Not Sure	0	0.0
Disagree	24	7.1
Total	344	100.0

Table 17 shows that 92.9% of the teachers agree that students enjoy Biology lessons, while 7.1%

did not agree that their students enjoy Biology lessons.

Table 18: Teachers responses to “My students compete to answer questions to make their points.”

Response	Frequency	% of Frequency
Agree	246	71.4
Not Sure	0	0.0
Disagree	98	28.6
Total	344	100.0

According to the data in Table 18, 71.4% of Biology teachers agree that their students compete to answer questions to make their points, while 28.6% disagree to the statement.

DISCUSSION OF FINDINGS

According to Chu, *et al.*, (2017), implementation of inquiry-based teaching approach influences students' attitudes, reading skills, and presentation skills. It engages students into deep thinking and reasoning, and promotes their ability to apply knowledge. Inquiry-based approach involves asking questions, seeking and testing explanations. It facilitates students to gain knowledge and develop extensive understanding of concepts taught, which has the ability to influence their performance and their attitudes. The finding correlates to this study's responses. According to the finding in Table 1, 75.3% of the students collaborated to create knowledge. This was crossed checked with the teachers Findings in Table 10. It shows that 78.6% of the teachers said students collaborate to create knowledge. Moreover, the data in Table 2 shows that 63.4% of students learn from each other by asking questions during class discussion or hands-on-activities. In Table 11, 78.6% of the teachers also agree that their students learn from each other. Jensen, *et al.*, (2012), stated that collaborative learning helps to shape students' insight as they listen and learn from others which results in the conceptual understanding of the lesson. Table 3 shows that 92.8% agree that students are motivated to learn.

Chu, *et al.*, (2017), said IBA involves asking questions and produces knowledge by using Science Process Skills (SPS). This is true to the finding of this study. The responses of the students presented in Table 4 show that, 41.9% of the students agree that they ask scientifically oriented questions, while 35.7% disagree to the statement. In Table 5, 48.3% of the students disagree that they are able to handle and manipulate the apparatus during Biology practical class whereas, 41.7% indicated their ability. Table 6 shows that 61.1% of the students expressed their ability to plan and design experiments, while 58.4% did not

agree that Biology is difficult. The data presented in Table 7 shows that 61.1% of the students agree that they are able to collect and record data during lab, while 28.8% disagree to the statement. Bezen and Bilgisi (2020), added that inquiry-based teaching positively changed students' attitudes as they develop more interest in the lesson. The data presented in Table 8 shows that 92.9% of the students enjoy Biology lessons. Data found in Table 9 reveals that all of the students agree that they compete to answer questions to make their points in class. According to the data in Table 18, 71.4% of Biology teachers agree that their students compete to answer questions to make their points, while 28.6% disagree to the statement.

CONCLUSION

On the basis of this study, it was concluded that implementation of IBA influenced majority of Form 3 students' attitudes towards Biology in Githunguri sub-County, Kiambu County, Kenya. Implementation of IBA facilitated students to gain knowledge and develop extensive understanding of concepts taught and it influenced their attitudes. Students were motivated to learn.

RECOMMENDATIONS

It is recommended that Biology teachers should use more of IBA during teaching since it motivates students, engages them into thinking and reasoning, asking questions, seeking and testing explanations. Teachers should also engage students into more of group work since it fosters collaboration among students. Teachers should also allow students to handle and manipulate the apparatus during practical.

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