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# Analysis of the Ability Levels of Biology Teachers to Implement Inquiry-Based Approach in Secondary Schools in Kiambu County, Kenya

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## Abstract

The ability levels of teachers to implement an Inquiry-Based Approach (IBA) during teaching corresponds to the ability of teachers to prepare and present inquiry activities, possess pedagogical content knowledge, engage students in critical thinking and questioning skills, understand teaching inquiry using the levels of inquiry effectively, and providing guidance for students during inquiry. Inquiry-based classroom requires building a scientific environment similar to that of scientists which requires asking questions, observing, experimenting, and communicating results. This study investigated the ability levels of Biology Teachers to implement an Inquiry-Based Approach. The study adopted the descriptive survey design which involved qualitative and quantitative data with a target population of 1,194 students from Form 3, 29 Biology teachers, and 37 secondary schools. Data was collected using Biology teachers' questionnaires, Form 3 students' questionnaires, and classroom observation schedules. Data was analyzed using descriptive and thematic analysis. The findings show that majority of the teachers understand IBA and can implement IBA during teaching. However, Biology teachers pointed out that, students' preparedness, inadequate teachers' training in IBA, limited time, and students' weak entry behavior in Biology posed challenges to their ability to implement IBA. The study recommends training programs should be organized for Biology teachers to enable them to implement IBA. The study also recommends that the Biology curriculum should have an extended time to enable Biology teachers to implement IBA frequently.

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

## 1.0 Introduction

The ability levels of teachers to implement an Inquiry-Based Approach (IBA) during teaching refers to the ability to prepare and teach inquiry activities. It also refers to ability of teachers to possess pedagogical content knowledge, the ability to engage students in critical thinking and questioning skills, understanding the teaching of IBA using the levels of inquiry effectively and guiding students during the inquiry. IBA is a pedagogical approach that invites students to explore academic content by posing, investigating, and answering questions. It develops students' interest in the subject and improves academic performance. According to DiBiase and Mcdonald (2015), the inability of teachers to implement IBA is rooted in their feeling of being unprepared as they lack the basic understanding necessary to implement inquiry. The

capability of teachers to integrate IBA will ensure that students will understand the concepts of science better.

Inquiry-based classroom requires building a scientific environment similar to that of scientists which requires asking questions, observing, experimenting, and communicating results. Guidance should be provided for students in the process of learning (Gathage et al., 2021). This will enable students to follow the steps of scientists to experience the process of developing knowledge and defending it. According to the study, to grow a technological country, this approach to teaching is preferable.

Correia and Harrison (2020), reported that teachers are being encouraged to implement an inquiry-based approach because it promotes students' investigative skills and understanding of conceptual knowledge of Biology. Annan et al. (2019) and Gathage et al. (2021), acknowledged the recommendation made for teachers to integrate IBA. However, teachers found it challenging to integrate IBA due to inadequate, quiet, and supportive environment, and inadequate laboratory. Ogutu et al. (2014), in Nyakach District, Kisumu County, revealed that the consistently dismal performance of students 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. Muriithi (2022), further acknowledged that educationalists and medics have raised concerns in Kenya that the number of students qualifying for diploma in nursing courses have declined due to low performance in Biology KCSE. However, the ability levels of Biology teachers to implement IBA in Githunguri sub-County, Kiambu County, Kenya is not known. Therefore, the researcher, after considering this, chose to analyze the ability levels of Biology teachers to implement IBA in Secondary Schools in Kiambu County, Kenya to recommend suggestions to education stakeholders about providing training to enable Biology teachers to implement IBA regularly to develop interest and improve performance among students.

### *1.1 Objective of the study*

The objective of the study was to determine the ability levels of Biology teachers to implement an inquiry-based approach to teaching Biology.

## 2.0 Literature Review

The ability levels of teachers to integrate IBA during teaching refers to their ability to prepare and present inquiry activities, possess pedagogical content knowledge, engage students in critical thinking and questioning skills, understand teaching inquiry using the levels of inquiry effectively, and provide guidance for students during inquiry activities (Ceran & Ates, 2020; Eltanahy & Forawi, 2019). According to DiBiase and Mcdonald (2015), the inability of teachers to implement an inquiry-based approach is rooted in their feeling of being unprepared. Teachers claimed that they lack basic understanding necessary to integrate inquiry.

The capability of teachers to integrate an Inquiry-Based Approach (IBA) will ensure that students will understand the concepts of science better. A study that involved 275 science teachers on their attitudes, beliefs, and values toward scientific inquiry in America, revealed that despite realizing the value of scientific inquiry, the inability of teachers to apply it in the classroom is a concern (DiBiase & Mcdonald, 2015). According to the study, 65% of the teachers expressed concern about their ability to implement inquiry-based teaching, and 63% argued that IBA required sufficient basic understanding to be implemented fully. In addition, 76% of the teachers claimed that it was challenging to implement an inquiry-based approach due to the difficulties it presents in attaining instructional objectives. The ability levels of teachers to plan inquiry-based lessons and activities is key to implementing the approach.

However, the ability levels of teachers to plan inquiry lessons in Githunguri sub-county was the purpose of this study.

The study revealed that teachers need background knowledge which include; content knowledge, pedagogical knowledge, and experience to facilitate their ability to implement inquiry-based approach. Research evidence showed that though the United States reform documents recognized the importance of IBA as the centre of teaching strategy, only a few highly motivated teachers implement it (Capps & Crawford, 2013; Hord, 2018). The analysis of the study shows that the ability levels of teachers and their understanding of the inquiry-based approach will influence the implementation of IBA. This study therefore sought to determine the ability levels, content knowledge, and understanding teachers have about IBA in Githunguri sub-County, Kenya.

In USA, Kaya et al. (2021), found that explanatory teaching of science was more frequently used by teachers than the learner-centered approach. It was revealed that belief in the ability to implement IBA correlates to possessing strong content knowledge, pedagogical knowledge, and experiences. These skills facilitate teachers' ability to create relevant questions for investigation and provide guidance for students during inquiry activities. However, mandatory tests and students' readiness to learn through inquiry-based teaching activities affected teachers' ability to implement inquiry. Thus, this study aimed to determine the ability levels of teachers to present Biology content in the class during teaching. The study's finding was supported by Dibiase and Mcdonald (2015). It revealed that 78% of teachers were concerned that students find it difficult to create knowledge from lessons taught using an inquiry-based approach. The study established that, with constant training to improve the knowledge and ability of teachers to implement inquiry teaching, students will gradually develop the skills required for inquiry activities (Correia & Harrison, 2020; Silm et al., 2017; Velthuis et al., 2014). According to Wee et al. (2007), there is evidence to suggest that professional development programs will provide experiences that will help teachers develop their overall knowledge and ability about inquiry. This will enable them to develop a more acute vision of inquiry-based implementations in the classroom.

According to Eltanahy and Forawi (2019), teachers in Dubai have a good understanding of using teaching strategies to teach science subjects through an inquiry-based approach. Despite these abilities, teachers have misconceptions about inquiry-based approaches and are unable to differentiate between the various types of inquiry which include; confirmatory, structured, guided, and open inquiry. Although it was recommended that teachers integrate structured and guided inquiry in their science lessons, challenges like time limitation, lack of teaching materials, and students, limited background knowledge, reduced their ability levels to frequently implement the inquiry-based approach. The analysis of these challenges outlined were a priority area for this study in Githunguri sub-County, Kenya.

In Nigeria, Gimba et al. (2018), pointed out that teachers' inability to effectively teach science and technology resulted in students developing a poor foundation in the subject. This led to the unwillingness of students to learn. This finding was acknowledged by Hackman et al. (2021) in Liberia, revealing that many Liberian teachers have insufficient understanding and ability to teach science and technology resulting in students with low interest to pursue science courses in the country. This study sought to determine the ability levels of teachers to teach using IBA in Githunguri sub-County, Kenya.

In Ghana, Annan et al. (2019) recommended that teaching should be done through the implementation of inquiry since it improves students' performance. According to Annan et al.

(2019), an inquiry-based classroom requires building a scientific environment similar to that of scientists which requires asking questions, observing, experimenting, and communicating results. Guidance should be provided for students in the process of learning (Gathage et al., 2021). This will enable them to follow the steps of scientists to experience the process of developing knowledge and defending it. According to the study, to grow a technological country, this approach to teaching is preferable. Annan et al. (2019) and Gathage et al. (2021), revealed that recommendation was made for teachers to integrate IBA. However, teachers found it challenging to integrate IBA due to inadequate, quiet, and supportive environment, inadequate laboratory, and teachers' negative attitudes. Instead, teachers rely on the conventional lecture teaching method which they found easy to implement. As a result, Inquiry-Based Approach is not often implemented as expected by curriculum developers **(**Ertikanto et al., 2017; Silm et al., 2017). It was also found that continual feedback which has a significant impact on students' performance was limited in the classrooms. Students' evaluation which can be summative or formative, is one method of receiving feedback. The most popular type of assessment in Biology classes is summative (Gathage et al., 2021; Omokaadejo, 2012; Sandoval & Reiser, 2004; Sakariyau et al., 2016).

In South Africa, Ramnarain and Hlatswayo (2018), found that teachers claimed that they have inadequate knowledge to teach science by implementing an inquiry-based approach. Crawford (2000), acknowledged that elementary teachers have insufficient understanding and inadequate knowledge to teach using inquiry. The study revealed that teachers claimed that integrating the Inquiry-Based Approach is difficult to manage and they do not understand it. Ramnarain (2016), found that, due to insufficient science content knowledge, and pedagogical content knowledge (PCK), teachers who taught science subjects disregarded the process of teaching through the use of inquiry approach. According to the findings of the study, students were not engaged in question-driven discussions that demanded them to think critically to solve the problems due to the use of traditional teaching methods which was the cause of poor performance.

In Kenya, science teaching has been recommended to focus on hands-on methods, but the process of implementing the hands-on activities has been slow (Atieno, 2013). A study conducted in Migori County, Kenya, by Khavugwi and Amolloh (2017), established that teachers who are trained in inquiry teaching effectively implemented an inquiry-based approach. According to the study, teachers need to be trained so that they can introduce students to science concepts and methods to facilitate them to develop abilities in solving problems. Isaboke et al. (2021) concluded that there is a relationship between teachers' extent of training and their ability to implement the curriculum. Kiige and Atina (2016) argued that SMASSE, which is one of the teachers' training programs in Kenya influences teachers' ability to teach despite the prevailing challenges of using the IBA. It was revealed that the knowledge teachers acquire in the subject matter, the teaching approach, and the belief about inquiry, determine their ability for inquiry implementation. It is established that the training teachers received enabled them to effectively teach the curriculum using IBA. However, it is unknown as to what training teachers have received in Githunguri sub-county to enable the integration of the IBA. Thus, the purpose of this research study.

## 3.0 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), the mixed research method provides an opportunity for the researcher to gain skills in both qualitative and quantitative approaches. It explains the data derived from quantitative studies that present 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.

## 4.0 Results and Discussion

### *4.1 Findings from Students' Questionnaires on students' attitudes towards Biology*

#### 4.1.1 Ability levels of teachers to implement inquiry-based approach in teaching Biology

This objective was to determine ability levels of teachers to implement an inquiry-based approach in teaching Biology.

**Table 1: Biology teachers' response to "I understand how to use inquiry-based approach"**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 5 | 35.7 |
| Agree | 4 | 28.6 |
| Not Sure | 1 | 7.1 |
| Disagree | 2 | 14.3 |
| Strongly Disagree | 2 | 14.3 |
| **Total** | **14** | **100.0** |

The data presented in Table 1 shows that 64.3% of the teachers agree that they understand how to use an inquiry-based approach whereas, 28.6% of the Biology teachers disagree that they understand how to use an inquiry-based approach. Furthermore, the findings reveal that 7.1% of the teachers were not sure.

**Table 2: Biology teachers' response to "I can implement IBA through teaching."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 9 | 64.3 |
| Agree | 2 | 14.3 |
| Not Sure | 0 | 0.0 |
| Disagree | 0 | 0.0 |
| Strongly Disagree | 3 | 21.4 |
| **Total** | **14** | **100.0** |

The data presented in Table 2 shows that 78.6% of the teachers agree that they can implement IBA through teaching, while 21.4% of the teachers disagree with the statement that they can implement IBA through teaching.

**Table 3 Biology teachers' response to "It is difficult to teach Biology through an inquiry-based approach."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 8 | 57.1 |
| Agree | 3 | 21.4 |
| Not Sure | 1 | 7.1 |
| Disagree | 2 | 14.4 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **14** | **100.0** |

According to the data in Table 3, 78.5% of the Biology teachers agree that it is difficult to teach Biology through an inquiry-based approach. The data further show that 14.4% of the teachers disagreed with the statement while 7.1% of the teachers were not sure.

**Table 4 Biology teachers' response to "I enjoy teaching using IBA."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 5 | 35.7 |
| Agree | 1 | 7.1 |
| Not Sure | 0 | 0.0 |
| Disagree | 2 | 14.3 |
| Strongly Disagree | 6 | 42.9 |
| **Total** | **14** | **100.0** |

According to the data found in Table 4, 42.8% of Biology teachers agree that they enjoy teaching using IBA, while 57.2% of the teachers disagree with the statement.

**Table 5: Biology teachers' response to "Students work together in a class project and present their findings in class."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 2 | 14.3 |
| Agree | 9 | 64.3 |
| Not Sure | 0 | 0.0 |
| Disagree | 2 | 14.3 |
| Strongly Disagree | 1 | 17.1 |
| **Total** | **14** | **100.0** |

Biology teachers' responses presented in Table 5 show that 78.6% of the teachers agree that students work together on a class project and present their findings, whereas 31.4% disagree.

**Table 6: Biology teachers' response to "Students learn better when they are guided to come up with their questions for investigation."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 4 | 28.6 |
| Agree | 6 | 42.9 |
| Not Sure | 0 | 0.0 |
| Disagree | 3 | 21.4 |
| Strongly Disagree | 1 | 7.1 |
| Total | 14 | 100.0 |

The data presented in Table 6 shows that 71.5% of the teachers agree that students learn better when they are guided to come up with their questions, while 28.1% disagree with the statement.

**Table 7: Biology teachers' response to "I encourage students to work together in a class project and present their findings in class."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 6 | 42.9 |
| Agree | 5 | 35.7 |
| Not Sure | 3 | 21.4 |
| Disagree | 0 | 0.0 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **14** | **100.0** |

According to the data presented in Table 7, 78.6% of the teachers encourage students to work together on a class project and present their findings in class, whereas 21.4% were not sure of the statement.

**Table 8: Biology teachers' response to "I encourage students to think and ask questions."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 8 | 57.1 |
| Agree | 6 | 42.9 |
| Not Sure | 0 | 0.0 |
| Disagree | 0 | 0.0 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **14** | **100.0** |

The data in Table 8 shows that 100% of the teachers agree to encourage students to think and ask questions.

**Table 9: Biology teachers' response to "I allow students to think and ask questions."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 6 | 42.9 |
| Agree | 5 | 35.7 |
| Not Sure | 0 | 0.0 |
| Disagree | 3 | 21.4 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **14** | **100.0** |

According to the data presented in Table 9, 78.6% of the biology teachers agree that they allow students to think and ask questions students draw. On the other hand, 21.4% strongly disagree with the statement.

**Table 10: Biology teachers' response to "I provide step-by-step procedures when carrying out investigations."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 6 | 42.9 |
| Agree | 8 | 57.1 |
| Not Sure | 0 | 0.0 |
| Disagree | 0 | 0.0 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **14** | **100.0** |

The data presented in Table 10 shows that 100% of the Biology teachers agree that they provide step-by-step procedures when carrying out investigations.

**Table 11: Biology teachers' responses to "It is easier to use inquiry-based approach lessons when the teacher gives students questions and procedures to follow during investigation."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 6 | 42.9 |
| Agree | 3 | 21.4 |
| Not Sure | 5 | 35.7 |
| Disagree | 0 | 0.0 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **14** | **100.0** |

Table 11 shows that 64.3% of the Biology teachers agree that it is easier to use inquiry-based approach lessons when the teacher gives students questions and procedures to follow during investigation. However, 35.7% of the teachers were not sure of the statement.

***4.2 Findings from Students' Questionnaires on Ability levels of teachers to implement inquiry-based approach in teaching Biology***

**Table 12: Students' response to "The Biology teacher distributes questions fairly among all students."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 148 | 42.9 |
| Agree | 123 | 35.7 |
| Not Sure | 0 | 0.0 |
| Disagree | 73 | 21.4 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **344** | **100.0** |

In Table 12, it shows that 78.6% of the students agree that the Biology teacher distributes questions fairly among all students. However, 21.4% of the students disagree with the statement.

**Table 13: Students' response to "The Biology teacher allows me to share my ideas with other students."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 123 | 35.7 |
| Agree | 98 | 28.6 |
| Not Sure | 49 | 14.3 |
| Disagree | 74 | 21.4 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **344** | **100.0** |

Data presented in Table 13 indicates that 64.3% of the students agree that the Biology teachers allow them to share their ideas with other students, while 14.3% were not sure. However, 21.4% of the students disagree with the statement.

**Table 14: Students' response to "My Biology teacher allows me to ask questions in class."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 202 | 58.6 |
| Agree | 49 | 14.3 |
| Not Sure | 0 | 0.0 |
| Disagree | 93 | 27.1 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **344** | **100.0** |

Data presented in Table 14 shows that 72.9% of the students agree that their Biology teachers allow them to ask questions in class, whereas 27.1% of them disagree.

**Table 15: Students' response to "My Biology teacher allows us to design investigations."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 73 | 21.4 |
| Agree | 49 | 14.3 |
| Not Sure | 0 | 0.0 |
| Disagree | 74 | 21.4 |
| Strongly Disagree | 148 | 42.9 |
| **Total** | **344** | **100.0** |

The findings presented in Table 15 indicate that 35.7% of the students agree that the Biology teachers allow them to design investigations, whereas 64.3% disagree with the statement.

**Table 16: Students' response to "We develop our procedures for conducting investigations in Biology."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 73 | 21.4 |
| Agree | 49 | 14.3 |
| Not Sure | 0 | 0.0 |
| Disagree | 73 | 21.4 |
| Strongly Disagree | 148 | 42.9 |
| **Total** | **344** | **100.0** |

The data presented in Table 16 shows that 35.7% of the students agree that they develop their procedures for conducting investigations in Biology. However, 64.3% disagree with the statement.

**Table 17: Students' response to "The Biology teacher gives us questions to investigate in Biology."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 221 | 64.3 |
| Agree | 0 | 0.0 |
| Not Sure | 0 | 0.0 |
| Disagree | 74 | 21.4 |
| Strongly Disagree | 49 | 14.3 |
| **Total** | **344** | **100.0** |

The findings presented in Table 17 reveal that 64.3% of the students agree that their Biology teachers give them questions to investigate in Biology. Further, 35.7% disagree with the statement.

**Table 18: Students' response to "The Biology teacher guides us in working on investigations in Biology."**

| Response | Frequency | % of Frequency |
|---|---|---|
| Strongly Agree | 202 | 58.6 |
| Agree | 49 | 14.3 |
| Not Sure | 0 | 0.0 |
| Disagree | 93 | 27.1 |
| Strongly Disagree | 0 | 0.0 |
| **Total** | **344** | **100.0** |

According to the data in Table 18, it shows that 72.9% of the students agree that Biology teachers guide them in working on investigations in Biology, while 27.1% of the students disagree with the statement.

### *4.3 Findings from Classroom Observation Guide on Ability levels of teachers to implement inquiry-based approach in teaching Biology*

The researcher observed ability levels of teachers to implement an inquiry-based approach in teaching Biology and the findings are summarized in Table 19.

**Table 19: Teachers' Ability Levels to Implement IBA**

| | No | | Yes | |
|---|---|---|---|---|
| **Teachers' Ability Levels to Implement IBA** | **Count** | **%** | **Count** | **%** |
| Teacher asks students to make their prior ideas explicit before presenting new concepts | 7 | 36.4% | 4 | 63.6% |
| Teachers connect new knowledge and understanding to real-life context | 4 | 36.4% | 7 | 63.6% |
| Teachers can explain to students Biology concepts in simple terms | 1 | 0.0% | 10 | 100.0% |
| Teachers evaluate concepts learned by students through questioning | 0 | 60% | 11 | 40.0% |
| The teacher-guided students to think of questions | 5 | 63.6% | 6 | 36.4% |
| Teachers challenge students to think of questions | 10 | 90.9% | 1 | 9.1% |
| Students came up with questions on their own | 9 | 81.8% | 2 | 18.2% |

**N=11**

Data found in Table 19 shows that 63.6% of Biology teachers ask students to make their prior ideas explicit before presenting new concepts and connecting new knowledge and understanding to real-life contexts. The researcher further observed that 100% of the teachers can explain to students Biology concepts in simple terms, 40% of them evaluated concepts learned by students through questioning, whereas 54.5% of the teachers guided students to think of questions. Furthermore, the researcher observed that 90.9% of the teachers did not challenge students to think of questions while 81.8% of the teachers did not allow students to come up with questions on their own.

### *4.4 Findings from Teachers' Interview Schedule on ability levels of teachers to implement inquiry-based approach in teaching Biology*

Teachers were asked to state their subject specialization and the result is presented in Figure 1.

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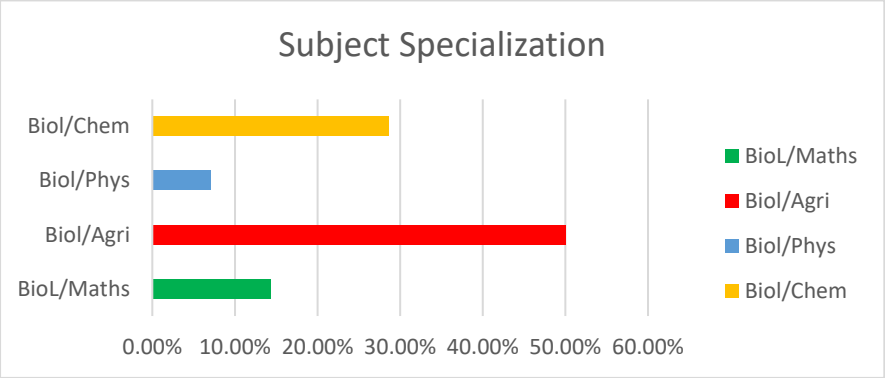


**Figure 1: Subject Specialization**

Teachers were asked to explain their understanding of Inquiry-Based Approach in teaching and the findings in presented in Figure 1.

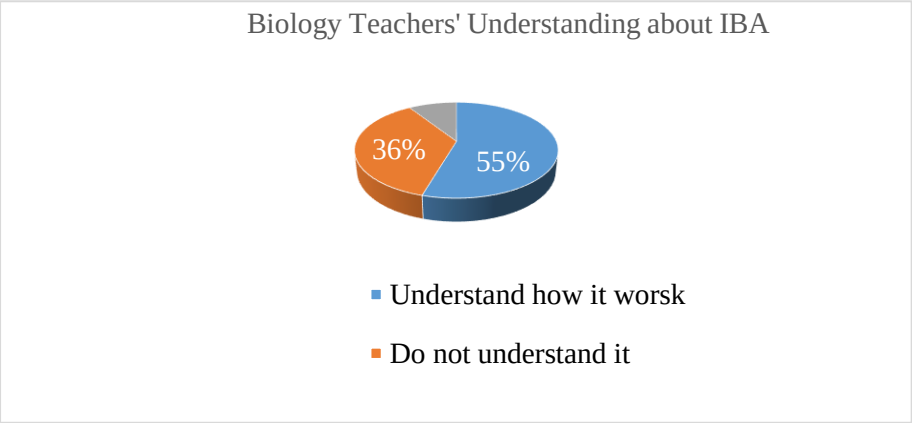


**Figure 2: Biology Teachers' Understanding about IBA, N=14**

Data in Figure 2 reveals that 55% of the teachers said that they understand about IBA and how it works. Further, 36% of them do not understand IBA while 9% heard about IBA but do need more understanding.

Biology teachers were asked in an interview about their ability to implement IBA and the findings are recorded in Figure 3.

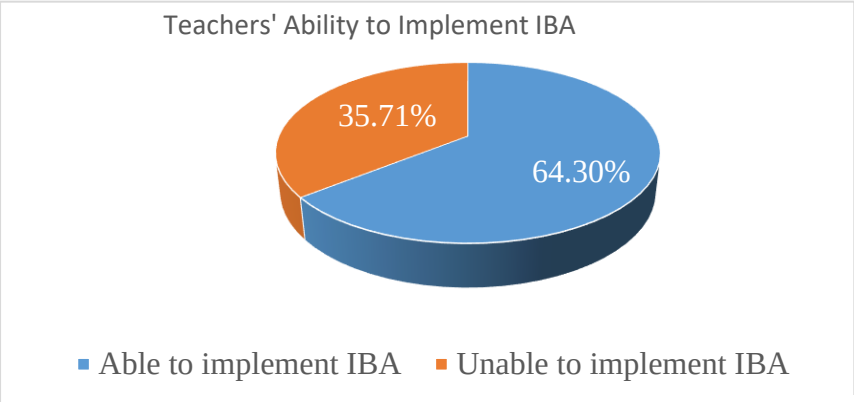


**Figure 3: Teacher' Ability to Implement IBA**

**N=11**

Figure 3 shows that 64.30% of the teachers expressed their ability to implement IBA, while 35.71% said they are unable.

The teachers were further asked to explain about challenges encountered in implementing IBA and the results are found in Figure 4.

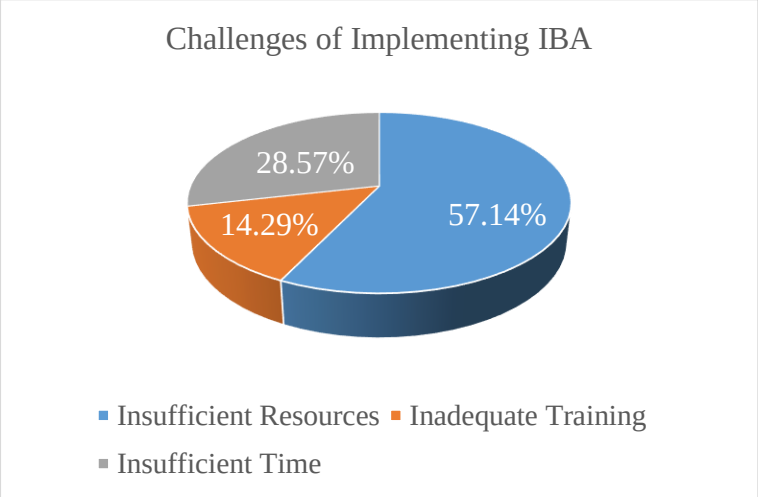


**Figure 4: Challenges of Implementing IBA**

**N=11**

As recorded in Figure 4 on the challenge encountered while implementing IBA, 57.14% of the teachers recorded insufficient resources, 28.57% noted inadequate training, and 14.29% said insufficient time posed challenges to implementing an inquiry-based approach in their lesson.

### *4.4 Discussion*

According to Eltanahy and Forawi (2019), Ceran and Ates (2020), the ability of teachers to implement IBA includes preparing and presenting inquiry activities which corresponds to the findings presented in Table 1. Moreover, Dudu and Vhurumuku (2012), said simply asking teachers to engage students in certain investigative activities does not necessarily guarantee that they will participate in high levels of inquiry. Teacher education programs are expected to provide them with the required knowledge and skills needed to engage students in real inquiry activities. The findings in Table 1, reveal that 64.3% of the teachers agree that they understand how to implement IBA. In Table 2, 78.6% of the teachers can implement IBA through teaching. According to DiBiase and McDonald (2015), the ability levels of teachers to plan inquiry-based lessons and activities is key to implementing the approach.

According to the findings presented in Table 10, all of the teachers provided step-by-step procedures for their students when carrying out investigations. This was crosschecked by students' responses recorded in Table 18, where 72.9% of the students said their teachers guided them in working on investigations in Biology. On the other hand, Table 7 shows that 78.6% of the teachers encouraged students to work together on a class project and present their findings. According to the results found in Table 8, all teachers encouraged students to think and ask questions. This finding is a reflection of Eltanahy and Forawi (2019) findings which show that teachers' ability to implement IBA is found in guiding students during inquiry activities.

In Table 19, the researcher observed that 90.9% of the teachers have the ability to explain to students Biology concepts in simple terms, and the a majority of them evaluated concepts

learned by students through questioning. However, the researcher observed that 63.6% of the teachers did not challenge students to think of questions. Additionally, the findings presented in Table 15, reveal that 64.3% of the students disagree that Biology teachers allow them to design investigations, while results in Table 16 indicate that 64.3% of the students did not develop their procedures for conducting investigations in Biology which indicates limited adoption of IBA. The findings support Mohammed et al. (2020)'s findings, that there is a limited adoption of the Inquiry-Based Approach. Although this current study focused on in-service teachers, it mirrors that of Sizer et al. (2021) findings that, although pre-service teachers understand how Science subjects should be taught using Inquiry-Based Approach, they did not adopt it because of insufficient knowledge.

Fitzgerald et al. (2019), noted that the promotion of inquiry-based learning in science classes is greatly facilitated by teacher professional development. According to Kiige and Atina (2016), the knowledge teachers acquire in the subject matter, the teaching approach, and the belief about inquiry, determine their ability to implement inquiry and the training teachers receive facilitates them to effectively teach the curriculum. Data in Figure 1 shows that 50% of the Teachers specialized in Biology and Agriculture. However, teachers did not guide their students to learn on a higher level of inquiry such as guided inquiry and open inquiry, instead, they provided all that the students wanted. This is supported by the findings in Table 11. It shows that 64.3% of Biology teachers agree that it is easier to use IBA lessons when teachers give students questions and procedures to follow during investigation.

In an interview, Biology teachers were asked to describe the activities students involved in an inquiry-based class. Most of the teachers said that students engage in asking and answering questions, they become the teacher of the class, and doing practical work as well as experiments in the laboratory. Additionally, most teachers noted that implementation of IBA makes teaching easier because teachers share tasks with students as they teach themselves and help their colleagues. Teachers also remarked that students become excited when they engage in practical activities. This facilitated a better understanding of the concept taught. However, teachers also noted that they experienced noise, disrespect from students, difficulties in controlling students, and slow learners. According to Kaya et al. (2021), beliefs in the ability levels of teachers to implement IBA correlate to possessing strong content knowledge, pedagogical knowledge, and experiences, which facilitate teachers' ability to create relevant questions for investigation and provide guidance for students during inquiry activities. Also, students' readiness to learn through inquiry-based teaching activities affected teachers' ability to implement inquiry.

According to Correia and Harrison (2020), the education level of teachers has a significant impact on the frequency or extent of adopting IBA in the classroom. Fitzgerald et al. (2019), acknowledged that the promotion of IBA in science classes is greatly facilitated by Teacher Professional Development (TPD). In an interview with teachers on their knowledge about IBA, as presented in Figure 2, 55% of the teachers said they understand IBA, while 36% of the teachers do not understand IBA. Furthermore, only 9% heard about IBA and request for training in order to understand it better for adoption. This may be the reasons emphasized in Figure 2, where 14% of the teachers said IBA should not be adopted. This finding was emphasized in an interview with Biology teachers where some of them said *"We do not use IBA, and since we are just from Covid-19, it is a bit challenging to allow students to do their study because we want to cover lost time."* This is true with the findings of Otara et al. (2019), that teachers will show a negative attitude toward a learner-centered approach if they are

inadequately trained. Kang and Keinonen (2016) also said teachers with low confidence levels in teaching science will also adopt IBA to a low level.

DiBiase and McDonald (2015), revealed that 76% of teachers said implementation of inquiry-based approach was challenging due to the challenges it presents, while other teachers expressed concerns about their ability. In an interview, Biology teachers were asked to explain the challenges encountered in implementing IBA, and the results are found in Figure 4. Teachers outlined the insufficiency of resources, inadequate training in IBA, and limited time to implement IBA. Khavugwi and Amolloh (2017), established that teachers who are trained in inquiry teaching effectively implement an inquiry-based approach. Isaboke et al. (2021) found that there is a relationship between teachers' extent of training and their ability to implement the curriculum.

## 5.0 Conclusion

According to the findings, 64.3% of the teachers understand how to implement IBA, while 78.6% can implement IBA through teaching. The findings presented in Table 10 show that all of the teachers provided step-by-step procedures for their students when carrying out investigations. This was supported by statements from the students. Majority of the students representing 72.9% said their teachers guided them in working on investigations in Biology. Eltanahy and Forawi (2019) said that teachers' ability to implement IBA is found in guiding students during inquiry activities.

In Table 19, the researcher observed that majority of the teachers have the ability to explain to students Biology concepts in simple terms, and all of the teachers evaluate concepts learned by students through questioning. However, it was observed that 63.6% of the teachers did not challenge students to think of questions. Fitzgerald et al. (2019), noted that the promotion of inquiry-based learning in science classes is greatly facilitated by teacher professional development. DiBiase and McDonald (2015), revealed that 76% of teachers said implementation of inquiry-based approach was challenging due to the difficulties it presents, while other teachers expressed concerns about their ability. Findings in Figure 4 show that the insufficiency of resources, inadequate teachers' training in IBA, limited time, students' weak entry behavior in Biology, and students' behaviors posed challenges to teachers' ability to frequently implement IBA.

## 6.0 Recommendations

The study recommends that teachers a training programme in IBA should be organized for Biology teachers to enable them to adopt IBA in public secondary schools. The biology curriculum should have an extended time to enable Biology teachers to implement IBA frequently since it influences students' attitudes toward the subject.

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