

**LEARNING GAIN AND INQUIRY BASED APPROACH TO TEACHING IN  
SECONDARY SCHOOLS IN KENYA**

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## DECLARATION

This research project is my original work and it has not been submitted to any other College or University

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This research project has been submitted for examination with my approval as University Supervisor

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## **DEDICATION**

Thanks and praise goes to Allah for having seen me this far. Special thanks to my family particularly my husband and children for their support and encouragement during the period of my study.

## **AKNOWLEDGEMENT**

I wish to sincerely thank Dr. Karen Odhiambo for guidance patience and most important her understanding during my studies. Her mentorship was important in providing holistic development that is vital for my future career aspiration. I would also like to acknowledge Nairobi Muslim Academy for awarding me a scholarship making my studies possible.

## ABSTRACT

The purpose of this study was to investigate the impact of inquiry based teaching on learning gain in biology in Kenyan secondary school. The objectives of the study were: (a) to determine if IBT approach results in improved scores specifically in Biology, (b) to determine if there is evident difference in academic achievement regarding regular and IBT approach to teaching (c) to determine if there is a difference in academic achievement depending on the gender of the teacher,(d) to determine teacher's perception regarding IBT approach (e) to make recommendations to policy regarding IBT as a approach in ensuring learning gain. Data relating to learners achievement was gathered using Biology Achievement Tests (BAT). BAT 1 was used for pre-test while BAT II was for the post test. Data relating to teachers outlook on the inquiry based teaching was collected using teachers' questionnaire identified as Appendix III. The questionnaire was made up of two parts. Part one was designed to correct demographic data of age, gender, qualifications, nature of school and teaching experience. Part two of the questionnaire gathered data on factors affecting the usage of inquiry based teaching in the study of biology. SPSS was used to analyze the data. t test were used to test the level of significance. The conclusion of these findings is that IBT approach compared to regular teaching instructions modes led to improved performance. The study also found that the gender of the teacher does not necessarily influence learning gain. The study also found out that teachers were aware of IBT approach and its significance in enabling learning gains, however they acknowledge that there is need for more time which neither the curriculum as designed nor the

timetable caters for. The researcher is also aware that training is required for better application of IBT in classroom learning. The conclusion is with caution as there is need for further exploration with different groups of learners and a larger sample of teachers. This study recommended the following:(a) shift from regular to IBT instruction mode of instructions the MOE should consider a policy on IBT and facilitate its application in the classroom by having a more flexible learning schedule, (b) there is need to carry out further research with larger group and bigger sample of teachers in order to establish if there is a gender implication (c) teachers need to be trained in IBT in teacher training institutions so that they adopt IBT approach to teaching.

## ACRONYMS

ANOVA:	Analysis of Variance
GOK :	Government of Kenya
KCSE:	Kenya Certificate of Education
KICD:	Kenya Institute of Curriculum Development
KNEC:	Kenya National Examinations Council
QUASO:	Quality Assurance Standards officer
BAT:	Biology Achievement Test
SPSS:	Statistical Packages for Social Sciences
IBT:	Inquiry Based Teaching



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## CHAPTER ONE

### INTRODUCTION

#### **1.1 Background of the Study**

The primary purpose of teaching at any level of education is to bring a fundamental change in the learner (Tebabal&Kahssay, 2011). To facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives and level exit outcomes. In the traditional epoch, many teaching practitioners widely applied teacher-centered methods to impart knowledge to learners comparative to student-centered methods. Until today, questions about the effectiveness of teaching methods on student learning have consistently raised considerable interest in the thematic field of educational research (Hightower, 2011). Moreover, research on teaching and learning constantly endeavor to examine the extent to which different teaching methods enhance growth in student learning. Quite remarkably, regular poor academic performance by the majority students is fundamentally linked to application of ineffective teaching methods by teachers to impart knowledge to learners (Adunola, 2011). Substantial research on the effectiveness of teaching methods indicates that the quality of teaching is often reflected by the achievements of learners.

In order for the method used for teaching to be effective, Adunola (2011) maintains that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered .As an educator, the researcher has always been fascinated by the relationship between teaching methods and students' academic performance; especially when it comes to applications in the context of 21st century education.

Every student learns and responds to information uniquely (Chang, 2010). Teaching and learning styles improve student's achievement (Stitt-Gohdes, 2001; Henson, 2004 & Hou, 2007). Zeeb's (2004) study indicated that aligning learning styles of students with teaching styles of instructors could lead to an improvement in academic achievement. The effect of teaching methods on students' learning should be the interest of every teacher and student. In the field of education, there have been various studies done in an attempt to measure teaching methods. Gray (2004) conducted a case study on several teaching methods in schools to explore the reasons for their use, and perceptions of effectiveness. The result of their study suggested that various methods do influence teaching effectiveness.

According to Keene (2007), each student learns best using strategies and objectives that reflect his experiences, abilities, aptitudes and interest. Similarly, there is no standard teaching method. The various teaching methods overlap in definition and application; none being mutually exclusive although researchers often delineate several teaching strategies.

The rapid changes and increased complexity of today's world present new challenges and put new demands on our education system. There has been generally a growing awareness of the necessity to change and improve the preparation of students for productive functioning in the continually changing and highly demanding environment. These changes including technological advancement, scientific innovation, increased globalization, shifting workforce demands, and pressures of economic competitiveness are redefining the broad skill sets that students require. In confronting this challenge it is necessary to consider the complexity of the education system and the multitude of

problems that must be addressed. Secondary school education is a critical level in any educational system.

The structure and content of the secondary school curriculum of a nation is constantly revised with the aim of making it relevant and sensitive to the country's educational goals and aspirations. In Kenya, numerous curriculum reforms aimed at making education responsive to the national development goals have been made. Thus Science educators and in particular biology teachers in secondary schools need to change their teaching approaches to make them more effective and relevant to a much larger proportion of the student population than in the past (International Bureau of Education, 2000; Wieman and Perkins, 2005).

The 8-4-4 education system introduced in 1985 aimed at introducing vocational and technical education so as to meet the demands of the economy, fostering national development, providing a relevant curriculum for the Kenyan youth, addressing the economic and regional disparities and providing a practical oriented curriculum (MOHEST, 2004). Thus, the system introduced a broad based curriculum at every level. Science subjects were initially classified into chemistry, biology, biology, biological sciences and physical sciences. However, the science curriculum has undergone several structural and fundamental changes and currently pure sciences are offered in all secondary schools in Kenya (Kenya Institute of Curriculum Development [KICD], 2002).

The Programme for International Student Assessment (PISA) has noted that the performance of a country's students in science subjects have implications for the part which that country will play in tomorrow's advanced technology sector, and for its

general international competitiveness (PISA, 2003). This report has further emphasized on the critical role of science subjects in the socio-economic development of a country.

Biology is one of the science subjects that are offered at the secondary school education cycle in Kenya (KICD, 2002). The knowledge of biology contributes to scientific literacy so that people can understand the world around them and enable them to make informed choices about their health care, their environment and the society in which they live (Karen, 2008).

According to the KICD (2002), the study of biology aims at equipping the learner with knowledge, skills and attitudes that are necessary for controlling and preserving the environment; enables the learner to appreciate humans as part of the broader community of living organisms; is a foundation for careers in health, agriculture, environment and education; and is the precursor of biotechnology which is a tool for industrial and technological development. KICD which is the national curriculum development and research centre in Kenya has identified objectives that a learner should acquire after going through the four year Biology course at the secondary school education cycle (KICD, 2002)

These objectives include the ability to communicate biological information in a precise, clear and logical manner; apply the knowledge gained to improve and maintain the health of the individual, family and the community; develop positive attitudes and interest towards Biology and the relevant practical skills; create awareness of the value of cooperation in solving problems; and acquire a firm foundation of relevant knowledge, skills and attitudes for further education and training in related scientific fields. These



objectives are a further recognition of the critical role that the knowledge of Biology contributes towards the socio-economic development of a country.

Through the knowledge of Biology, researchers have been able to develop high yielding, disease resistant and fast maturing food crops and animals to meet the food requirements of an ever increasing world population. Biology is a prerequisite subject for admission into courses in the health profession such as Human and Veterinary Medicine, Pharmacy and Dentistry among others.

Successful learning depends on various factors that are not all teacher-related, but the methods that a teacher uses continue to play an important role in student learning and in their academic achievement. The challenges that educators face in the 21st century are so diverse that using better teaching methods is more crucial now than ever before. Various recent studies attempting to address the issues that affect teaching methods and student learning today include educational technology integration (Abbitt, 2011), teachers' roles (Webb, 2009), the class environment (Doll et al., 2010), as well as the increased interdependence of society today (Schul, 2011).

According to the Kenya National Examinations Council (KNEC), Biology is clustered with chemistry and Biology. However, students must select and pursue at least two science subjects at Form Three and Four (KNEC, 2005). Majority of the students opt for a combination of chemistry and biology however the state of performance has been appalling. Performance in Biology at KCSE which is offered by KNEC has been poor over the years (MOE, 2005). The worrying implication is that majority of candidates fail to meet the expected mastery of the subject matter which locks them out of careers where

Biology is a prerequisite subject. The national mean of the subject has been below average over the past ten years.

### **1.2 Statement of the Problem**

Teaching-learning process is considered appropriate only if it addresses all the objectives of science education which are spread over knowledge domain, affective domain and psychomotor domain. Biology is a natural science which provides many opportunities and activities for the students. Students getting involved in these activities can develop different scientific skills. The teaching of biology, like other science subjects, should focus on the development of scientific concepts, attitudes and skills. However, prevailing practices and instruction in Kenya are not likely to fulfill such goals in that the emphasis is on the transmission of information from the teacher (and textbook) to the mind of the learner and its subsequent reproduction on an examination paper

The GoK is committed to improve the quality of education and in particular the quality of science education for socio-economic development and technological advancement of the country (GoK, 2007, 2005). However achievement in Biology at the secondary school level nationally has been below average over the last 7 years. In response to the low students' achievement the government of Kenya through Ministry of Education Science and Technology (MoEST) and the government of Japan through Japan International Cooperation Agency (JICA, 2007) launched the Strengthening of Mathematics and Science (SMASSE) in July 1998 as a joint venture. The overall goal of the SMASSE project was to upgrade the capabilities of young Kenyans in mathematics and science education. The baseline study carried out in 1998 in nine pilot districts by SMASSE, Kimani (2010)

notes that teaching methodology was identified as the major factor among other factors. The project identified Activity Student Experiment and Improvisation (ASEI) and Plan Do See Improve (PDSI) strategies for enhancement of classroom practices for quality teaching and learning of biology. Which is a proponent of inquiry based learning.

Inquiry-based teaching is a learner centered teaching approach that combines the curiosity of students and the scientific method to enhance the development of critical thinking skills while learning science. As learners encounter problems they do not understand, they formulate questions, explore problems, observe, and apply new information in seeking a better understanding of the world. The natural process the learners follow when seeking answers and deeper understanding closely follows the generally accepted scientific method. The question is can an inquiry-based learning approach help in any way? The Programme for International Students Assessment (PISA) results of 2003 show that there is a close correlation between the teaching techniques and the performance of learners (OECD, 2004)

Review of literature has not revealed any studies on the effectiveness of inquiry based approach in the teaching and learning of biology in Kenya. This study seeks to fill the gap in the body of knowledge on the effectiveness of inquiry based teaching approach. Therefore, this study aims at finding out the effect of IBT approach on mean achievement scores in biology of students at Nairobi Muslim Academy.

### **1.3 Purpose of the Study**

The purpose of this study was to determine the effect of Inquiry-Based Teaching among secondary school students' looking at their academic achievement.

### **1.4 Objectives of the Study**

- a) To determine if Inquiry Based Teaching (IBT) approach results leads to improved scores specifically in Biology.
- b) To determine if there is a difference in academic achievement regarding regular and IBT approach to teaching
- c) To determine if there is a difference in academic achievement depending on the gender of the teacher
- d) To determine teacher's perception regarding IBT approach
- e) To make recommendations as to policy regarding teaching methods and academic performance

### **1.5 Limitations of the Study**

The study is a case study of Nairobi Muslim Academy which is a girl's only school. For a more conclusive result, all the Districts in Kenya as well as boys schools would have been studied this was however not possible due to time constraints as well as nationwide teachers strike at the time the researcher was set to collect data. The fine-tuning of the study was also affected by time as the researcher had other responsibilities at work place.

## **1.6 Definitions of Operational Terms**

**Achievement:** refers to a measure of performance as measured by the scores of the learners on undertaking the Student Achievement Test (SAT)

**Impact:** cognitive changes as a result of learning experience

**Learners:** refer to the Form Two learners who participated in the study

**Learners' Characteristics:** This refers to the age, gender and attitude of learners to both the inquiry based teaching method and biology

**Biology:** A branch of science that deals with the study of matter, energy, motion and the relationship between these variables. It is one of the science subjects taught in Kenya secondary schools

**Projects:** these are the devices constructed by the students in application to the scientific knowledge acquired during the study of biology. In this study, the projects made were the electromagnet and the electric bell.

**Inquiry based teaching method:** refers to the instructional method used by teachers to instruct students to construct a scientific device in application of Biology knowledge

**Teachers' Characteristics:** This refers to the age, gender, and academic qualifications of biology teachers who participated in the study

**Traditional Methods (TM)**-refers to methods of instruction characterized by lectures and class discussion. This method is teacher-centered

**8-4-4 System:** A system of education that involves eight years of schooling in primary, four years in secondary and four years in college or university

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This section explores the literature related to the study. The purpose of this section is to establish the foundation for the study and identify a framework with which the data collected is contextualized and understood. Better still, by exploring what others have done in the related field of study; the literature review is used to strengthen the findings of the study.

#### **2.2 Trends in the Teaching of Biology**

Biology is one of the branches of science (Wambugu and Changeiywo, 2007). According to National Academy of Sciences (2009), science has been defined as a particular way of understanding the physical universe. This implies that in science, explanations about nature are limited to those based on observation and empirical evidence (Chiapetta&Koballa, 2006).

Biology is the study of nature and it involves understanding the processes of acquiring and developing scientific knowledge; referred to as the process skills and the accumulation of knowledge, referred to as the product science (Trowbridge, Bybee&Sund, 1981). According to Embeywa, (2005), science is either taught using the traditional method or the inquiry method. Traditional method involves teachers passing scientific information to the learners. This method is teacher-centered with little involvement of learners while the inquiry method is learner-centered where the learners are in charge of the learning process and the teacher facilitates, manages and

coordinates the activities undertaken by the learners. Mulei (1985) noted that the method used by the teacher has a bearing on learners' achievement in the subject.

### **2.2.1 Teaching as it relates to high academic performance**

Research on teaching and learning constantly endeavor to examine the extent to which different teaching methods enhance growth in student learning. Quite remarkably, regular poor academic performance by the majority students is fundamentally linked to application of ineffective teaching methods by teachers to impart knowledge to learners (Adunola, 2011). Substantial research on the effectiveness of teaching methods indicates that the quality of teaching is often reflected. Teaching is a set of events, outside the learners which are designed to support internal process of learning. Teaching (Instruction) is outside the learner. Learning is internal to learners. Learning is both a motive and behavior but only behavior is seen, learning is internal, performance is external.

Brown et al. (1982) defines teaching and learning as an attempt to help someone acquire or change some knowledge, skill or attitude. Ayot et al. (1992) further define teaching and learning as a process where one person, the teacher intentionally passes information to another person, the learner. Therefore the goal of teaching is to bring about desirable learning in students. In this process, the learner is expected to receive information, understand it and use it later when the need arises. For effective teaching and learning to occur, the teacher must use an effective approach of conveying the information to the learner (Brown et al., 1982). He further notes that the way a teacher teaches is important in that with the right methods and techniques, students can grasp concepts and ideas while poor methods and techniques frustrate students and minimize their chances of



success. It emerges from the fore-going discussion that for effective teaching and learning the approach adopted by a teacher is paramount and teachers should therefore have a choice of effective teaching and learning approaches for effective learning to occur. According to Ayeni (2011), teaching is a continuous process that involves bringing about desirable changes in learners through use of appropriate methods.

Adunola (2011) indicated that in order to bring desirable changes in students, teaching methods used by educators should be best for the subject matter. Furthermore, Bharadwaj & Pal (2011) sustained that teaching methods work effectively mainly if they suit learners' needs since every learner interprets and responds to questions in a unique way (Chang, 2010). As such, alignment of teaching methods with students' needs and preferred learning influence students' academic attainments (Zeeb, 2004).

Arends (1997) notes that many teaching and learning approaches have been created and studied by educational researchers, classroom teachers, psychologists, industrial trainers and philosophers. He further notes that a teaching and learning approach has four defining attributes: a coherent theoretical rationale made explicit by its creators or developers; a point of view about what and how students learn; specific teaching behaviours that make the approach to work; and, required classroom structures for bringing about intended outcomes.

### **2.3 The Traditional Methods used in teaching Biology**

The traditional methods emphasize the product content of the sciences. The process of acquiring scientific knowledge involves problem identification, collection and analysis of data, making conclusions and generalizations. According to Jevon (1969),

the traditional method involves excessive belief in objectivity and universality of science and in the accumulation of the scientific knowledge. Trowbridge, Bybee and Sund (1991) suggested that the role of the teacher in the traditional method is to transmit the scientific knowledge as efficiently as possible. Learner involvement in this case is minimal. In her comparison between the traditional and the inquiry method of teaching biology, Mulei (1985), noted that the traditional method led to rote learning which led to low level learning. This was also noted by Amadalo, (2006) when he noted that the teaching of biology in Kenya was basically through didactic method which leads to rote learning. When this traditional method is used, then little emphasis is given to the process of acquisition of the scientific knowledge.

According to Aikenhead (1998) the traditional method was criticized as it led to rote learning where learners were not able to apply the scientific knowledge gained in daily life. The works of Piaget (1959), Brunner (1962), and Gagne (1974) in the development of cognitive science spearheaded the attack on rote learning which dominated the traditional science. They called for active participation of the learner in the process of the acquisition of scientific knowledge. Wellington (1989) called for the introduction of process-based learning where learners were actively involved in the learning process. Supporting this change of teaching approach, Graham (1979) noted: “The traditional approach in science should be replaced by the modern methods which treat science not only as accumulation of facts but an experience on investigation and discovery and aim to stimulate an enquiring and analytical mind’

Iraki (1994) noted that most biology students in Kenya lacked skills that are relevant for use in their daily life even after taking the subject up to form four Level. This observation supports the argument of Lewis (1976) who had noted that showing the students the contemporary application of biology such as in technology is necessary. One way of making the learners active in the learning process is by use of the inquiry based teaching (Kibett and Kathuri, 2005). In this method, the learners apply the knowledge gained to come up with a scientific device like an electric bell which has an immediate application to their environment. Also known as teacher-Centered Methods traditional teaching does not apply activity based learning to encourage students to learn real life problems based on applied knowledge. Since the teacher controls the transmission and sharing of knowledge, the lecturer may attempt to maximize the delivery of information while minimizing time and effort. As a result, both interest and understanding of students may get lost.

Ahmad and Aziz (2009) observe that teacher-centered teaching is the traditional teaching method where teachers are at the centre of the class activities: teach, talk and explain all the way. They noted that in traditional classrooms, students have a definite and fixed perception and idea of their own roles and those of their teachers. Their experiences show that teachers behave in certain ways and have particular roles in the process.

The view seems to regard teachers as “custodians of knowledge.” In their study on students’ perceptions on the teachers teaching of literature, Ahmad and Aziz (2009) noted that in teacher-centered classrooms, participation was at a minimum and was allowed

only when teachers recognized it as appropriate. Participation was totally teacher controlled. To address such shortfalls, Zakaria, Chin & Daud (2010) specified that teaching should not merely focus on dispensing rules, definitions and procedures for students to memorize, but should also actively engage students as primary participants.

### **2.3.1 Student-Centered Method**

Student-centered teaching methods shift the focus of activity from the teacher to the learners. These methods include active learning, in which students solve problems, answer questions, formulate questions of their own, discuss, explain, debate, or brainstorm during class; cooperative learning, in which students work in teams on problems and projects under conditions that assure both positive interdependence and individual accountability; and inductive teaching and learning, in which students are first presented with challenges (questions or problems) and learn the course material in the context of addressing the challenges. Inductive methods include inquiry-based learning, case-based instruction, problem-based learning, project-based learning, discovery learning, and just-in-time teaching.

Student-centered methods have repeatedly been shown to be superior to the traditional teacher-centered approach to instruction, a conclusion that applies whether the assessed outcome is short-term mastery, long-term retention, or depth of understanding of course material, acquisition of critical thinking or creative problem-solving skills, formation of positive attitudes toward the subject being taught, or level of confidence in knowledge or skills

A teaching method is regarded more effective if it does not centralize the flow of knowledge from the lecturer to the student (Lindquist, 1995). With the advent of the concept of discovery learning, many scholars today widely adopt more student-centered methods to enhance active learning (Greitzer, 2002). Most teachers today apply the student-centered approach to promote interest, analytical research, critical thinking and enjoyment among students (Hesson & Shad, 2007). The positive impact of such methods have also been documented by Chika (2012), who indicate that interactive methods are more powerful in enhancing learning achievement than teacher-centered pedagogy. Kumar (2006) also indicates that interactive methods have higher impact in overall learning achievement than didactic classrooms. Learner-centered pedagogy contains features that support needs, interest, experience, and ability. Small group instructions supervised by experienced teachers support student-focus goals (Prince & Felder, 2006).

Teachers promote learner-centered pedagogy by encouraging students to manipulate visuals, share observations, and form opinions (Mawhinney & Sagan, 2007). The senses support the cognitive roles, and lead students to discover knowledge through tactile investigations. Prince and Fedler (2006) declared that students find meaning in touching and expressing the discovery of their physical world. Concrete materials stimulate the student senses, promote connected learning, and increase the recall of ideas (Snow, 2005). Object manipulation increases the visual opinions of students. Teaching and learning approaches that are student-centered promote more learning in that learning is more likely to be effective where a student plays a proactive role in the learning process (PISA, 2000)

### **2.3.2 Inquiry-based Teaching**

This is a teaching method that combines the curiosity of students and the scientific method to enhance the development of critical thinking skills while learning science. As learners encounter problems they do not understand, they formulate questions, explore problems, observe, and apply new information in seeking a better understanding of the world. The natural process the learners follow when seeking answers and deeper understanding closely follows the generally accepted scientific method. Often, the answers proposed by learners lead to even more questions much like the outcomes of research.

There are different forms of inquiry learning (Bulbul,2010).In structured inquiry the teacher provides the input for the student with a problem to investigate along with the procedures and materials. This type of inquiry learning is used to teach a specific concept, fact or skill and leads the way to open inquiry where the student formulates his own problem to investigate. An example of a structured inquiry learning approach is the Learning Inquiry Cycle Model, based on Piagets theory of cognitive learning (Bevevino, Dengel, & Adams, 1999). The learning cycle model is a teaching procedure consistent with the inquiry nature of science and with the way children naturally learn (Cavallo&Laubach, 2001). In this study, 5E learning cycle instruction model by Bybee et al. (2006) was used.

The guided inquiry focuses on the structure of laboratory experiments as a lesson within themselves. Each lab is a chance for the student to learn concepts but also for the instructor to implement various teaching strategies. The lab is designed so that the student does much of the work while the teacher guides the students. Guidance occurs in the form

of questioning strategies. The goal is for the students to use their observations and prior knowledge to build to the conclusion that the teacher wants the student to understand. However, the role of the teacher is instrumental in that they ask questions which allow students to make the desired connections. These questions typically fall in the format of “Why did this happen?” or “What do you think this means?”

The power of an inquiry-based approach to teaching and learning is its potential to increase intellectual engagement and foster deep understanding through the development of a hands-on, minds-on and ‘research-based disposition’ towards teaching and learning. Inquiry honours the complex, interconnected nature of knowledge construction, striving to provide opportunities for Inquiry learning has a variety of benefits for students and teachers. With inquiry learning, students engage in learning by drawing upon their prior knowledge and experiences. It uses the student’s prior knowledge as a building block to integrate new understandings with prior learning (Lemlech, 1998). Learning has more meaning for students as it becomes a more relevant part of their lives and they begin to better understand the world around them. Ward (2001) praises inquiry learning when he stated that by building on previously constructed knowledge; students can better grasp the concepts and can move from simply knowing the material to understanding it .There is a general consensus in the literature regarding the positive impact of constructivist approaches on student dispositions (Burriss & Garton, 2007).

Herman & Knobloch (2004) found that the constructivist approach generated increases in affective and cognitive outcomes. They reported that students preferred the constructivist approach because they had been actively responsible for their own educational process. The teacher-researcher reflected that it was exciting to see students building connections,

sharing their own experiences with others in the classroom, and working together as a single unit. Consequently, students are motivated by inquiry learning. Not only because students are actively involved in the process but because the expectation of finding the answer motivates the search for it.

Constructivism is designed to make the student the center of the learning and the teacher serves as the guide on the side instead of the sage on the stage, which is usually the case with teacher-centered, direct instruction classrooms (White-Clark, DiCarlo, & Gilchrist, 2008). This type of constructivist environment promotes students curiosity and motivates them to investigate their interests associated with the material, which promotes independent learning. Inquiry-based learning develops independent problem-solving and critical-thinking skills in students, which is a benefit for both students and teachers. Lemlech (1998) stated that the goal of inquiry learning should be to challenge the student to engage in activity that requires higher level thinking and reflective processes. In addition, this type of learning engages students at their own ability level. Due to the individualistic nature of inquiry learning, all students may not gain the same knowledge, but instead, students are able to discover the knowledge that they need and build upon it.

As stated by Baker et al. (2008), In our view, encouraging students 'problem solving and creative thinking is far better than testing their ability to memorize. The goal of inquiry learning is to help students develop skills that enable them to construct vital concepts and challenge their ingrained misconceptions as teachers; we should desire to move our students beyond regurgitation of facts to becoming life-long learners who can think independently. One way to do this is through inquiry learning.



Inquiry-based learning also emphasizes students 'understanding concepts rather than acquiring skills. It encourages teachers to move away from the tradition in which knowledge is viewed as discrete, hierarchical, sequential, and fixed towards an environment in which knowledge is viewed as an individual construction created by the learner (Draper, 2002). Where both teachers and students collaboratively build, test and reflect on the learning process.

#### **2.4 Demerits of Inquiry-Based Teaching**

Although there are many benefits to inquiry-based learning, as mentioned above, there are also a few drawbacks to this approach. When teachers are introduced to this method of teaching, many teachers are concerned with the amount of time it takes in preparation and implementation. Baker et al. (2008) discussed that the teachers that they interviewed saw scheduling and time constraints associated with inquiry learning was a serious to moderate problem. Herman & Knobloch (2004) found there was a larger workload in developing the constructivist units but recommended that teachers need to consider the payback of their additional time investment when developing and using constructivist units of study.

Another concern of teachers associated with time is that in many cases, such as initially learning how to add and subtract, direct instruction can get the job done much more quickly (Santrock, 2001) Other material may also be seen as more quickly taught through direct instruction, but teachers must also consider students' comprehension and understanding of the material. Direct instruction may quickly allow the students to regurgitate a procedure, but not understand the how or why of the procedure that they

have imitated, which would decrease the students' ability to retain and reuse the procedure.

The study by Baker et al. (2008) also found teacher and student attitudes were a moderate to slight problem. Teachers must believe in and actively use a method of teaching before students will buy in to it. Baker et al. (2008) found that teachers must feel comfortable with instructional methods and accept them before they will use them consistently. The teacher's attitude directly affects students' attitudes, as does students' interests and feelings of connectedness and relevance of the material. Herman and Knobloch (2004) reported that teachers should anticipate mixed attitudes from students who have not experienced constructivist activities in previous learning experiences.

Constructivist activities can confuse students and teachers due to the dramatic change in roles and students' perceptions of how instructional methods impact their learning. Herman and Knobloch recommended gradually modifying units of study, incorporating pieces of constructivist methods over time, so to create a less drastic change for students. They also found that students who were not accustomed to constructivist instruction did not know how to handle a new freedom in the classroom which led to classroom management issues. However, students quickly adapted by the second week to the new situation and became actively engaged. Although there is agreement on the contribution of constructivist approaches to factors such as knowledge retention, student satisfaction, motivation, and critical thinking, there is much less agreement on its role in knowledge acquisition (Burriss & Garton, 2007).

Burris and Garton found that students who were taught with the more traditional approach tended to score higher on content knowledge assessments than students taught with constructivist approaches. While students taught with constructivist instruction may have a deeper understanding of the material, that understanding is not represented at the content knowledge level (Burris &Garton, 2007, p.113). Conversely, Herman and Knobloch (2004) reported that students comprehended more through the constructivist approach as compared to the traditionalist approach.

## **2.5 Teachers' Characteristics and Usage of IBT on Achievement in Biology**

According to Ndegwa (2005), teachers' attitude is concerned with the way they value, appreciate, and act in science situations which involve establishment of instructional methods and techniques of science teaching. The instructional methods used by the science teachers are affected by their attitudes (Witt, 2002). When teachers have positive attitude towards the subject, they perform better and this is reflected in learners' performance. Teacher's attitude highly contributes to learning. Bandura (1982), Bruner, (1966), Zanna and Rampel (1988) asserted that attitude judges ones capability to accomplish a certain level of performance. Differing attitudes towards intellectual activities among people affects their structures of attitude. Therefore, a teachers' attitude towards teaching has a great influence on the way the teaching /learning process will be conducted.

Teachers who place a lot of emphasis on what they could do to motivate the learners with an explicit attempt to build on their intellectual ability, do so effectively, by becoming emotionally involved in the learner's affairs while in and out of school (Embeywa, 1987). Mulei (1985) is of view that there is a strong

relationship between the teachers' academic background and learners' achievement through the use of inquiry based teaching. In most cases learners taught by teachers of higher academic qualification retain knowledge acquired for a longer time since such teachers organize the classroom setting in such a way that learners can make their own independent choices. This therefore means that teachers' creative ability is central in fostering learners' intellectual growth, curiosity, exploration and the desire to learn (Gross, 1990 and Scheindler, 2002).

Learning is a function of teachers' perception of learners (Downie, 1967). According to Dubey (1985) and Harvey (1994), they emphasize that how a teacher conducts a classroom session depends on how best he/she regards the learners' personality and social background. They stress that teachers with the required positive qualities produce the desired results while those without these qualities fail to motivate the learners to produce the desired results. According to Trumble (1980), teacher's attitude and morale towards teaching determines the kind of instructional methods and resources he/she employs in relation to the objectives of the school project work. The instructional method and resources a teacher uses depict his/her personality in terms of alertness, creativity, and training and experience (Downie, 1983). Use of inquiry based teaching in teaching biology in secondary schools in Kenya requires teachers who have the required positive qualities.

## **2.6 Learning Resources and usage of IBT on Achievements in Biology**

Learning resources are aids employed by the teacher to enhance the effectiveness of instruction (Embeywa, 1991). They are either commercially produced or improvised by individual teacher in the school (Twoli and Maundu, 1998). Locally available resources are those objects or materials found within the school environment, which aid in effective teaching and learning when used effectively. They have the characteristic of holding the attention of the learners as they reinforce verbal messages by providing multi-media approach.

The use of learning resources depends on the teacher's ability and willingness to use them. Research done by SMASSE (1999) indicated little or no usage of resources even when such resources were available. In his study on the acquisition of science concepts and skills by Kenyan pupils, Keraro (2002) noted that appropriate utilization of resources leads to meaningful learning as the learners are put in a position of effectively engaging their senses. Samson (2005) stressed that effective teaching and learning depends on a combination of factors, which include: personality of the teachers', learners' characteristics, instructional support, availability and utilization of the instructional resources. White (1998) found out that effective use of learning materials improves the manipulative skills of the learners. Koballa (2006) observed that when learning materials are properly utilized, they improve learning, improves the competence of the teacher and makes learning more meaningful to the learners. When the resources are not effectively utilized, the learners may tend to dislike the subject. It can also lead to

misconception of ideas, may cause confusion and make the learner to dislike the subject and fail to gain motivation that arouse his/her interest of the subject (Amadalo, 1993). Ineffective use and underutilization of the resources also lead to poor performance in the sciences.

Effective utilization of resources leads to effective instruction which in effect improves the quality of learning (Amadalo, 1998). The learner therefore acquires the necessary knowledge, skills, values and attitudes. Pearson and Nelson (1997) observed that 65% of what is seen and heard is retained in the mind for a long period. They further observed that when instruction media is utilized, learning is improved by 20% and that time to explain a concept is reduced by 25%. Furthermore, the use of multimedia stimulates interest, motivation, active thinking, promote realism and concreteness of concepts among the learners. It is the intention of this study to explore the impact of the availability of learning resources on the use of inquiry based teaching.

## **2.7 Theoretical Framework**

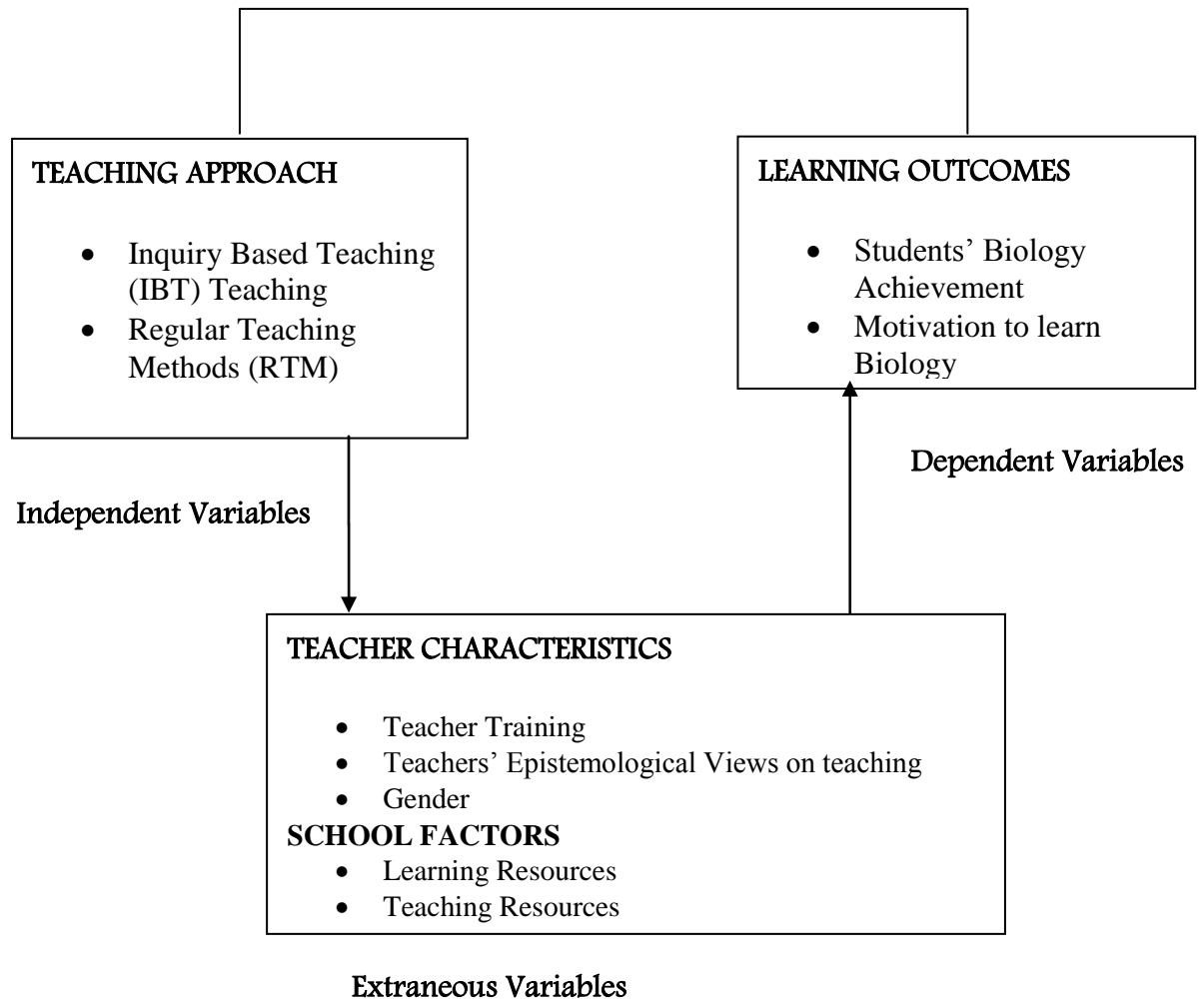
The theoretical framework that guided this study was based on Bybee's 5E learning cycle model which is an Inquiry-Based Teaching (IBT) approach model (Llewellyn, 2005). The 5 E learning cycle model sequences learning experiences so that students have the opportunity to construct their understanding of a concept during the teaching and learning process (Bybee, 2002). The model leads students through five phases of learning that are easily described using words that begin with the letter E: Engagement, Exploration, Explanation, Elaboration and Evaluation. In the engagement phase the teacher captures

students' interest and makes them curious about the topic and concepts to be learnt. This phase provides an opportunity for the teacher to find out what students already know or think they know about the topic and concepts to be developed (Bybee, 2002). In the exploration phase students interact with materials and ideas through classroom and small group discussions (Llewellyn, 2005). This helps the students to acquire a common set of experiences so that they can compare results and ideas with their classmates. In the explanation phase students are provided an opportunity to connect their prior experiences with current learning and to make conceptual sense of the main ideas. This phase also provides the opportunity for the introduction of formal language, scientific terms and content information that might make students' prior experiences easier to describe. In the elaboration phase students' are provided with the opportunity to apply introduced concepts to new experiences (Llewellyn, 2005). This phase helps students to make conceptual connections between new and prior experiences, connect ideas and deepen their understanding of concepts and processes. In the evaluation phase that is centrally placed in the model and takes place virtually in every phase of the 5E learning cycle model provides a summative assessment of what students know (Bybee, 2002).

## **2.8 Conceptual Framework**

The conceptual framework of this study shows the relationships between variables. In an ideal situation, the teaching approach would affect the students' achievement in Biology. In practical situations the students' achievement will be influenced by various factors

which include, teacher training, teachers' epistemological views on teaching, learning and teaching resources as shown in Figure 1 below.



**Figure 1. Conceptual framework**



## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

The areas considered in this section include the research design applied; the target population; sampling design and sampling techniques; research instruments used for data collection; procedure followed in collecting data and methods used in data analysis.

#### **3.2 Research design**

This study is meant to determine the effect of inquiry based teaching (IBT) approach on Biology mean achievement scores of secondary school students. Therefore the study is designed as an experiment where the teaching approach is the independent variable while the mean achievement scores in biology is the dependent variable. Inquiry based teaching (IBT) approach is the experimental variable while the regular teaching method (RTM) is the control condition.

Therefore this study will adapt the Solomon Four Non-Equivalent Control Group Design as a Quasi-Experiment. This means that there is no randomization because secondary school students in Kenya are found in intact groups of classes and the school management in the school where the study is to be conducted will not allow randomization of students for the purpose of this study. It is also unethical to randomize students for the purpose of this study. The Solomon Four Non-Equivalent Control Group Design is strong enough to compare the effect of a treatment and can control all major threats to internal validity.

In this study, classes were assigned to the two groups by purposive sampling technique. Where O1 and O2 were pre-test; O3, O4, O5, O6 were the post-test; X was the treatment where students were taught using Inquiry-Based Teaching (IBT) approach.

- i) Group I is the experimental group which received the pre-test, treatment X and the posttest.
- ii) Group II is the control group the received a pre-test, followed by the control condition and then the post-test. This group will help to see whether or not history, maturation, testing, and regression were a threat to internal validity.
- iii) Group III received the treatment X and post-test but did not receive the pre-test. This group helped to establish whether or not testing effects were a threat to internal validity. The difference if any between O2 and O5 were attributed to testing effects. However, if O2 and O5 were equal then the internal validity was not affected by testing effects.
- iv) Group IV received the post-test. This group helped to establish whether or not the changes in the post-test scores of the experimental group were a function of the combined effects of history and maturation by comparing O6 with O1 and O3. If all the scores were equal, history and maturation was not a threat to internal validity.

Classes in the experimental groups I and III were taught using IBT approach while those in the control groups II and IV were taught using the Regular Teaching Methods (RTM). The instrument used (BAT) in this study has been assessed by a team of experts for content validity while a reliability coefficient of 0.79 was attained at pilot testing

The intervening variables that will be controlled in this study include: The teacher characteristics (professional qualifications, teaching experience and readiness to practice IBT approach); students' characteristics (age and ability) and teaching and learning resources and facilities (laboratory, apparatus, syllabuses and textbooks). To control for teachers' training and experience as sources of internal invalidity, only trained teacher with more than two years of teaching experience were chosen. To control for the teacher's readiness to implement inquiry based learning approach, the teachers were trained on how to use inquiry based approach. Form 1 students of approximately the same age were used to avoid the threat of maturity to internal validity.

### **3.3 Target Population**

The target population in this study was form one students in Nairobi Muslim Academy .Form one students were considered appropriate for this study because they have just started their secondary school curriculum had not yet adjusted well to the new curriculum and are likely to be affected greatly in terms of attitude, motivation and academic achievement by the teaching strategies put in place

### **3.4 Sample and Sample Procedures**

Purposive sampling was appropriate where the researcher had previous knowledge of the population and had a specific purpose for the study and therefore used personal judgment to select a sample (Fraenkel and Wallen, 2002). The researcher therefore used her knowledge of the target population to judge whether or not students in the school were a suitable sample.

The school had four form one classes, simple random sampling technique was used to select classes for the four groups of study. A four sided dice was used with each side labeled as follows: 1(T) and 3 (Experimental Group); 2(T) and 4 (Control Group) to select both the experimental and control groups. Where T indicates the group that was subjected to pretest.

### **3.5 Data Collection Instrument**

The BAT is the instrument that will be used in this study to measure students' mean achievement score in biology. It will consist of ten multiple choice questions and ten fill in the gap questions a maximum score of 20 based on “**Cell Physiology**”, a topic that is taught at form one as prescribed in the Secondary Education Syllabus Volume Two (KIE, 2002). A table of specification was used to sample both the content of cell physiology and the three cognitive levels during the construction of the test items.

Items based on knowledge cognitive level required students to memorize and recall information and there were five items in this category with a total score of 4. Items based on comprehension cognitive level required students to demonstrate understanding of concepts and there were twelve items in this category with a total score of 12. The items based on application cognitive level required students to use prior information to solve unfamiliar problems and in this category were four items with a total score of 4.

The BAT instrument was evaluated by experts who are trained biology teachers with a teaching experience of over 15 years and also had experience as biology examiners to ascertain its content validity. They ascertained that the BAT test items were based on the content and specific objectives of cell physiology as prescribed in the Secondary School

Biology Syllabus (KIE, 2002). The experts also ascertained that the BAT items were accurately categorized into knowledge, comprehension, and application cognitive domain levels. To ascertain reliability of the BAT instrument, the test was pilot-tested using one school in Langata district that was not part of the study but had comparable characteristics as the sample schools.

### **3.6 Data Collection Procedures**

Research authorization and permit to conduct this study was granted by the Department of psychology of The University of Nairobi. Before the commencement of the study the researcher visited the study school to determine the workability of schedule of activities. This involved determining extent of syllabus coverage in biology at form one, allocation of Biology lessons in the master time table and the schools' calendar of events for the second school term of 2015. At the commencement of the study a BAT pre-test was administered to students in Groups 1 and 2. Group 1 is the experimental group while Group 2 is the control group.

At the end of the experimental treatment which lasted four weeks, a BAT post-test was administered to students in all the four groups. Both the pre-test and post-test were administered under similar conditions in both experimental and control classes and were supervised by the researcher and the regular teacher. The pre-tests and post-tests were scored by the researcher using a marking scheme prepared and validated by the team of experts in biology. The team of experts then validated the scoring of the BAT pre-test and posttest.

### **3.7 The Development and use of (IBT) Instructional Materials**

The instructional materials and the content used in the class instruction have been developed in line with the revised KICD (2002) biology syllabus. A guiding manual has been developed for the teachers involved in the implementation of IBT approach to use throughout the treatment period. The teachers of the experimental groups were trained on how to use the manual as well as how to enact IBT approach on a different topic other than cell physiology for two days to make them conversant with Inquiry-Based Teaching (IBT) approach. After the training period the pre-test was administered to groups I and II. A total of 20 lessons were taught in both the experimental and control groups during this study as recommended in the KICD (2002) biology syllabus. After the treatment period a post-test was administered to all the groups.

## CHAPTER FOUR

### FINDINGS

#### 4.0 Introduction

This chapter contains discussions on the research findings on the influence of inquiry based teaching on academic performance in biology: a case study of Nairobi Muslim academy. The findings are organized along the research objectives. The specific objectives were:

- a) To determine if Inquiry Based Teaching (IBT) approach results in improved scores in Biology
- b) To determine if there is a difference in academic achievement regarding regular and IBT approach to teaching
- c) To determine if there is a difference in academic achievement process depending on the gender of the teacher
- d) To determine teacher's perception regarding IBT approach
- e) To make recommendations as to policy regarding teaching methods and academic performance

This chapter presents the results from data analysis captured by the use of research instruments namely; the Biology Achievement Test (BAT) where BAT 1 was used in the pre-test while BAT 2 was used in the post test, Teachers questionnaire and the observation schedule.

#### **4.1 To determine if IBT approach results improved scores in Biology**

The groups were given both the pre-test and the posttest. Thus the testing effects across all the groups had been nullified and the post-tests of each of the experimental groups could be compared with that of the control groups to detect the effects of treatment. The mean scores of the two groups are shown on Table 4. The results on Table 4 show that the mean scores of the experimental groups 1 and 3 were higher than those of the control groups 2 and 4. The results of the mean scores on SPAT are represented in a bar graph in Figure 4.

**Table 4.1 Inquiry Based Teaching (IBT) approach and improved scores**

<b>Statements</b>	<b>Mean</b>	<b>Std. Dev.</b>
Pre-test	3.005	.541
Post-test	4.253	.874

The study above shows that pre-test results had a mean of 3.005 and standard deviation of .541. On the other hand, post-test results showed a mean of 4.253 and standard deviation .874. It is therefore clear from the study above that Inquiry Based Teaching (IBT) approach results to improved scores as indicated with a mean of 4.253 and standard deviation of 874.

The learners exposed to Inquiry Based Teaching (IBT) performed better than those taught using the traditional methods. This implies that the use of Inquiry Based Teaching (IBT) is superior to other traditional methods like lecture and class discussions. A study conducted by Wambugu (2008) showed that students who were given a chance to master the concepts of Biology outperformed those who had not. The findings of this study shows that the students exposed to Inquiry Based Teaching (IBT) had significant high scores compared to those who had not been exposed to this method and therefore concurs with the findings of the previous research.

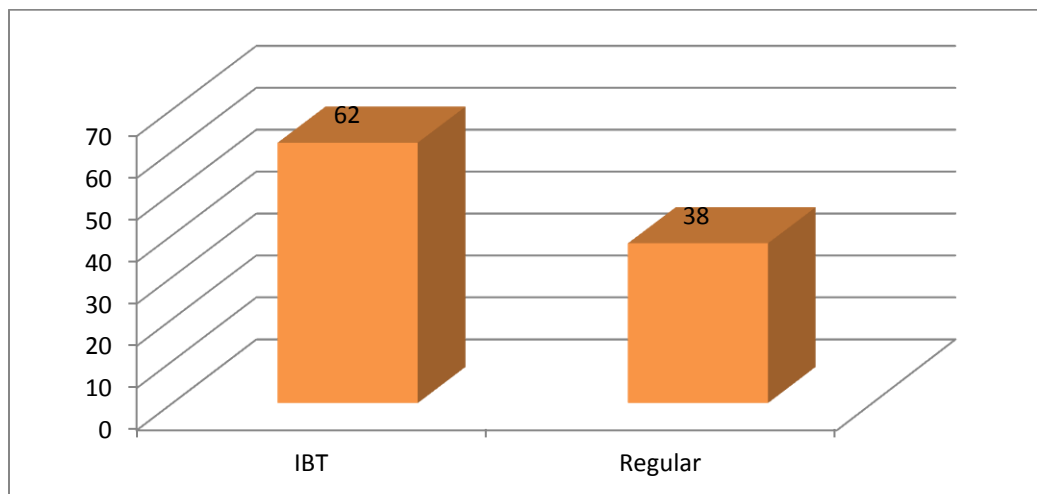


In their study on the use of Inquiry Based Teaching (IBT) in agriculture in Kenyan secondary schools, Kibet and Kathuri (2005) observed that the use of Inquiry Based Teaching (IBT) yielded better results among the learners. They noted that this method has the advantage of allowing learner to conceptualize the knowledge learnt. Noting that the features of the Inquiry Based Teaching (IBT) are essential, Samson (2008) observed that this method allows the learners to apply Biology knowledge using locally available resources, which leads to better understanding and motivating the learners.

#### **4.2 To determine if there is a difference in academic achievement regarding regular and IBT approach to teaching**

The results were recorded in figure 4.1 below

**Figure 4.1 Difference in academic achievement**



The study shows that the respondents agreed with 62% to the idea that there is a difference in academic achievement regarding regular and IBT approach to teaching. Those that disagreed were represented by 38%.

It is therefore clear that there is a difference in academic achievement regarding regular and IBT approach to teaching with 62%. This was attributed to the idea that inquiry approach is thought to motivate learners more strongly. Bransford et al. (2000) provide a comprehensive review of cognition research. They discuss studies which find that motivation affects the amount of time and energy that people are willing to devote to learning. Further they suggest that tasks must be challenging but at the proper level of difficulty to remain motivating if they are too easy students will be bored, while if they are too hard, students will become frustrated. As Ciardello (2003) argues, learners will be better stimulated and motivated to learn by sparking their curiosity. Thus by confronting students with a state of perplexity, students are prompted to seek questions and evidence that will help them resolve the discrepancy or problem. Learners are also motivated when they can see the usefulness and relevance of what they are learning especially in their local community (Bransford et al., 2003). The implications for IBL are clear: students can be strongly motivated by complex, personally relevant questions.

#### **4.3 To determine if there is a difference in academic achievement process depending on the gender of the teacher**

This section shows the results of data concerning teachers' gender, the usage of the Inquiry Based Teaching (IBT) and its influence on the learners' performance in Biology.

Table 4.2 shows the gender distributions of the respondents

**Table 4.2 Gender Distribution**

	Frequency	%
Male	1	25
Female	3	75
Total	4	100

Table 4.4 shows that the teaching of Biology in form one at Nairobi Muslim is dominated by female who form 75% (n=3) while male teachers represent only 25% (n=1). This shows a huge gender disparity where male are underrepresented.

To test the level at which the gender of the teachers influenced the usage of the Inquiry Based Teaching (IBT) when teaching Biology, teachers were asked in the questionnaire their view on how the usage of Inquiry Based Teaching (IBT) is affected by the gender of the teachers. They were to tick their level of agreement as either very often, often, rarely or not at all. Their responses were then decoded such that the response of very often was given a score of four, often a score of three, less often a score of two and rarely a score of one.

#### **4.3.1 Male and Female teachers mean scores in Biology**

The researcher had to establish the difference in scores between male and female teachers as indicated in table 4.3 below.

**Table 4.3 Male and Female teachers mean scores in Biology**

<b>Statements</b>	<b>Mean</b>	<b>Std. Dev.</b>
Male Teachers	4.225	.4644
Female teachers	3.890	.3911

The study above shows that the mean score for male teachers was 4.225 and a standard deviation of .4644. On the other hand, female teachers had a mean of score of 3.890 and a standard deviation of .3911

These study findings were in line with findings in the Netherlands, for instance, Cole, Catherine (5<sup>th</sup>September 2007) found that teacher gender has no effect on student achievement, attitudes or behavior regardless of student gender, ethnic background or socioeconomic status. Thus the evidence that increasing the presence of female teachers will improve girls' learning outcomes is at best limited.

With respect to the positive relationship between the presence of female teachers and improved school participation for girls the argument is that the presence of a female teacher may help alleviate parental concerns about influence of teacher's characteristics' on the effective use of inquiry based method and well-being of their daughters in traditional gender-segregated societies and encourage them to send daughters to school UNESCO (2000).

Contradicting the above findings Thomas Dee (2006) who investigated the effect of teacher's gender using National Education Longitudinal Survey (NELS) data on 8<sup>th</sup> graders from US and found that same gender teachers had a positive effect for example girls do better in school when taught by women and boys do better when taught by men. Dee also found that effect of teacher's gender varies depending on the subject: for girls to

benefit of being assigned to a female teacher are concentrated in history. A study by Michaelowa, (2001) using data from Francophone sub-Saharan Africa similarly finds support for the same-gender effect Michaelowa, (2001).

Contradicting these studies, however a larger sample based study in the US shows that regardless of student's gender, students taught by women perform better than those taught by men Krieg, (2005). In accordance with Krieg, based on findings from the Southern and Eastern Africa Consortium for Monitoring Education Quality (SEACMEQ), a recent (UNESCO 2000) finds that children in female teacher's classroom tend to perform better. But a large study in Pakistan presents findings that contradict the studies above.

#### **4.4 Teachers' Perception on IBT**

This section presents the findings on the influence of teachers' perception on IBT and its effects on learners' achievement in Biology. It has three sections that address teachers' academic qualifications, teachers' age and gender.

To test teachers' view on the impact of the usage of Inquiry Based Teaching (IBT) and its impact on learners achievement in Biology, the teachers were asked through a questionnaire their level of agreement on the extent to which the usage of Inquiry Based Teaching (IBT) impacts on learners achievement. They were to tick their level of agreement as either very often, often, rarely or not at all. Their responses were then decoded such that the response of very often was given a score of four, often a score of three, less often a score of two and rarely a score of one. The weighted average mean score of their level of agreement was then calculated. A mean score of two and below

implied that the usage of Inquiry Based Teaching (IBT) did not have any impact on learners' achievement in Biology. A mean score of two and above showed that teachers thought that the usage of Inquiry Based Teaching (IBT) impacted positively on learners' achievement in Biology. The views were then converted to percentage score for ease of comparison. This was done by getting the weighted mean score divided by the maximum possible value of four and then multiplied by one hundred. A score of fifty and above showed the teachers' level of agreement that the usage of Inquiry Based Teaching (IBT) had on learners' achievement in the subject. A score of below fifty percentages would imply that teachers don't consider the usage of Inquiry Based Teaching (IBT) to have any positive impact on learners' achievement. The frequency of their responses is summarized in Table 4.2

**Table 4.4 Teachers' Perception on IBT**

	Always		Often		Rarely		Never		Mean score	% score
	F	%	F	%	F	%	F	%		
Diploma	9	37.5	7	29.2	5	20.8	3	12.5	2.92	73.00
BSc	4	66.7	2	33.3	0	0.0	0	0.0	3.67	91.75

Table 4.2 shows that Diploma holders had a mean of 2.92 out of the possible score of four which represents 73.0% level of agreement. This implies that 73.00% of diploma teacher holders consider Inquiry Based Teaching (IBT) to have positive effect on learners' achievement in Biology. Those with a Bachelor of Science had a mean of 3.67 representing 91.75% indicating that 91.75% of the teachers in this category think

that the usage of Inquiry Based Teaching (IBT) has positive impact on learners' achievement in Biology.

To further test if the teacher's perception on use of Inquiry Based Teaching (IBT) had any effect on learners' achievement in Biology, their views were subjected to Chi-square testing so as indicated in Table 4.3.

**Table 4.5: Chi-Square Analysis of Teachers' Perception on use of IBT**

To further test if the teachers view on the usage of Inquiry Based Teaching (IBT) had any effect on learners' achievement in Biology, their views were subjected to Chi-square testing so as indicated in Table 4.3.

Table 4.6 Chi-Square Analysis of Teachers' usage of (IBT)

<i>Qualification</i>	<i>Calculated <math>\chi^2</math></i>	<i>Table <math>\chi^2</math></i>	<i>Level significant</i>	<i>Decision</i>
Diploma	32.332	35.172	.005	accept
BSc	14.563	11.070	.005	reject

Table 4.3 shows that the calculated value of Chi-square for teachers with diploma, BED science are 32.332 and 14.563 respectively indicating that there is no relationship between teachers' academic qualifications and use the Inquiry Based Teaching (IBT) and learners achievement in Biology is accepted. These are the teachers who have undergone training in methodology of teaching Biology in various colleges and universities.

The fact that they have been trained might imply that these teachers are comfortable using this method. However, the calculated value of Chi square is greater than the

tabled value for teachers with Bachelor of education science indicates that teachers have the academic knowledge of the subject but have not well been trained in pedagogy which indicated that the used of Inquiry Based Teaching (IBT) may affect the learner's achievement. It therefore means that the teacher training institutions prepares teachers adequately for the job or the teachers learn from the field how to use the Inquiry Based Teaching (IBT).



## **CHAPTER FIVE**

### **DISCUSSION, CONCLUSION AND RECOMMENDATIONS**

#### **5.0 Introduction**

This chapter gives discussions, conclusions and recommendations of the findings of the study. The appropriate measures to be undertaken are suggested so as to enhance the teaching of Biology in Kenya secondary schools. Appropriate recommendations were made as per the research objectives.

#### **5.1: DISCUSSION**

The purpose of the study was to explore learning gain looking at biology using Inquiry Based Teaching (IBT) approach. The findings indicate there was improved performance where IBT was the mode of instruction as compared to the regular modes of instruction. This means that IBT has an impact on learning. With regards to the gender of the teacher there was no significant effect on learning thus performance remained equivalent comparing the two genders. Looking at the teacher's perception the teachers are aware of the approach and its significance as well as its enabling gain score perspective. However they state that it is time consuming.

#### **5.2 Conclusions**

The results of the study show that the learners who were exposed to Inquiry Based Teaching (IBT) were likely to perform better than those who were taught using regular teaching method. Classroom teachers should therefore consider preparing learning environments which facilitate use of IBT. Such environment will enable students take charge of their learning process leading improved performance.

There is therefore need for more research to determine competencies required for IBT among teachers as well as determining groups of learners who will best benefit from IBT. There is need for policy in Kenya that demands the incorporation of IBT in schools.

### **5.3. Recommendations**

The following recommendations are based on the conclusions of the findings of the study in relation to the research objectives and the testing of the hypotheses.

The study found out teachers' perception on the usage of Inquiry Based Teaching (IBT) was commendable and that they are aware IBT has an impact on learners' achievement in Biology. Teachers with professional qualifications had no problem in the usage of the Inquiry Based Teaching (IBT) but those who lacked skills in pedagogy are influenced in the use of the Inquiry Based Teaching (IBT). This study recommends the professional development be given in form of in service to equip teachers with current pedagogical skills of IBT. It is further recommended that teacher trainers to continue training teachers of both gender and teachers of all age groups. Since there are very few female Biology teachers, there is a call to train more female teachers in this area so that they can be a role model especially to the girl child.

The study found out that the usage of the Inquiry Based Teaching (IBT) by the teachers is no influenced by the age or gender of the learners. However, its usage is influenced by the attitude have learners have on IBT in teaching of Biology. This

study recommends that teachers should put deliberate effort in changing the attitude that learners have on the subject and on the Inquiry Based Teaching (IBT). Teachers should encourage learners with negative attitude towards Biology to change this attitude so that they can take the subject up to the form four levels.

The study found out that there is a significant difference in achievement between the learners exposed to Inquiry Based Teaching (IBT) and those that were not. This study therefore recommends that teachers should frequently use the Inquiry Based Teaching (IBT) as it exposes learners to the required process skills that are required in the study of Biology.

#### **5.4 Recommendations for further research**

This study focused on the impact of Inquiry Based Teaching (IBT) on learners' achievement in Biology in Nairobi Muslim academy which is a girl's only school. The researcher recommends a similar study be conducted in boy's only and mixed schools.

The study also focused on impact of IBT on learner's achievement in Biology and not other science subjects. The researcher recommends that a similar study be conducted in other science subjects.

The study also focused on one topic which is covered in form one. It is suggested that another study be done covering all the four levels in secondary education.

The study focused on the use of the Inquiry Based Teaching (IBT) in the study of Biology. It is recommended that another study be carried out to investigate the impact of other instructional methods that are applied by biology teachers.

In addition a further study is conducted on provision of required instructional resources necessary for use in the Inquiry Based Teaching (IBT) of teaching Biology in all the classes. Finally, there is need to carry out a longitudinal study on learners achievements in all levels and in all the science subjects.

The Ministry of Education should make a policy on the use of Inquiry Based Teaching (IBT) in the secondary schools.

### **5.5 Implications of the study**

For a country geared towards industrialization and achievement of its national vision 2030, use of proper methods of instruction becomes critical in helping the nation to train the required human resources. Since Biology plays a key role in this endeavor, it is imperative for the Biology teachers to be sensitized to on the need to use the Inquiry Based Teaching (IBT) as this is one of the instructional techniques that yields better results

Furthermore, the performance of students at the Kenya Certificate of Secondary Education KCSE has been low over the years. Use of this method will be necessary in improving learners' performance

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## APPENDIX

### APPENDIX I: QUESTIONNAIRE FOR TEACHERS

#### Instructions

This questionnaire is designed to gather information for this study on the impact of project method in the teaching and learning of biology. The information gathered will only be reported in terms of general information and your views will not be linked to you or your school. Confidentiality is guaranteed throughout this study, and so do not write your name or that of the school in the questionnaire.

#### Part I: Teachers Attributes

1. What is your gender? Male ( ) Female ( )
2. What is your age bracket in years?
  - a) Below 25
  - b) 25-30
  - c) 31-35 ( )
  - d) 36-40
  - e) 41-45
  - f) Above 45
3. What are your academic qualifications?
  - a). Diploma
  - b) BSc
  - c) BSc with PGDE
  - d) Bed
  - e) M.Ed
  - f) Other

(Specify).....
4. What is your experience in years as aBiology teacher?

#### Part II: Instructional Techniques

5. Indicate by ticking in the appropriate column how regular you use each of the following methods of instructions.

Key: Very Often (VO); Often (O); Less Often (LO); Not at All (NA)

Teaching Method	VO	O	LO	NA
Lecture				
Questioning				
Demonstration				
Experimentation				
Projects				
Individualized Instructions				
Group work				
Trips/excursions				
Peer teaching				
Remedial classes				
Discovery method				
Problem solving				
Films				

6. Inquiry Based Teaching (IBT) approach and academic performance in Biology subject area as a science

**Part III: Determinants of Instructional Techniques**

5. How do the following school factors affect your use of project method?

	of school ( Boys, Girls, Mixed)				
	egory ( boarding, day, day &boarding				
	of school ( number of streams)				
	Class size				
	hool setting ( rural or urban)				
	ilability of physics laboratory				
	Motivation of teachers				
	Availability of resources				