Texila International Journal of Academic research
ISSN: 2520-3088
DOI: 10.21522/TIJAR.2014.07.02.Art009

Effect of Inquiry-Based Teaching Method on Students Achievement and Retention of Concepts in Integrated Science in Senior High School

Mohammed Issaka
Texila American University
E-mail: irshadmohammed788@gmail.com

Abstract

This study purposely investigated the impact of using inquiry-based teaching method on students' academic achievement and retention of concept in integrated science against the traditional method in some selected senior high schools in the Obuasi Municipality. The study also investigated the difference in the mean achievement score between male and female students taught integrated science using inquiry -based method.

The sample for the study was 292 students in SHS two from Christ the King Catholic Senior High School and Obuasi Secondary Technical in the Obuasi Municipality. The sample were obtained through random sample technique.

The experimental group received instructions in integrated science using inquiry-based method of teaching whereas the control group were taught with the traditional method.

The data were collected through the use of pretest- posttest research design and were analyze according to the research question for the study. The main research question for the study was: What is the effect of inquiry-based method of teaching on students' achievement and retention of concepts in integrated science?

The results from the study indicates that the students in the experimental group performed better than the students in the control group.

The findings also show that students who were instructed with inquiry-based method have higher retention capacity than their counterpart students who were exposed to traditional method.

There was a slightly gender disparity in the achievement and retention capacity of both male and female students taught integrated science with inquiry-based method in favour of the male. This means that inquiry-based method is very rewarding to students in terms of achievement and retention regardless of gender.

Keywords: *inquiry-based method, integrated science, achievement, retention.*

Introduction

Globally, it is recognized that science is very important subject in the development of every nation. The compulsory nature of integrated science in the curriculum of pre-tertiary education system in Ghana confirms its usefulness in the development of individuals in the country. The development of a country rest on science and technology in the world of work. (Shadreck & Mambanda, 2012; Anamuah-Mensah, August 2004). Integrated science competency is a key determiner of individual student's post-secondary education and career options and much attention is given to it by stakeholders of education in the country. In Ghana for instance, students must obtain a pass mark in integrated science before they can get admission to any tertiary institution.

Stressing on its importance Azure (2015) observed that Science education is needed in Ghana to produce the necessary human resource and skilled labour force to manage our local industries and educational institutions. The study of integrated science helps us to understand our natural world and also to approach challenges we face in life and our workplace in a more systematic and logical manner. Integrated Science education in Ghanaian educational system is the conscious effort to raise the level of scientific literacy of all students and equip them with relevant basic scientific knowledge needed for their own living and also contribute

to the country's development. (Teaching syllabus for integrated science, 2010).

Despite its usefulness in determine students' post-secondary education in Ghana, students don't pay much attention to this subject. In the year 2018, the performance of students in integrated science drop from 52.89 percent in 2017 to 50.49 percent in 2018. In 2019, there was slight increase in their performance. This shows that there is more work to be done to improve students' performance in integrated science. The chief examiner has over the years reported students woefully failing in some of these topics in integrated science. Topics such as Magnetism, Animal Production, rock, hydrocarbons, acid base and salt and hereditary and inheritance have been yearly reported. (Chief Examiners report 2016, 2017 and 2018).

Due to its usefulness the method of teaching the subject should be of great importance to science educators. O'Connor (2000) observed that the use of inappropriate teaching methods contributes to the low participation and performance of students in science.

The methods employed by teachers in teaching science have a great impact on the understanding and interest developed by students in the subject. Sree (2010) opined that the method of teaching each subject play a pivotal role in enhancing the efficiency of the practitioners. Teaching involve both methodology and pedagogy and the teacher is supposed to select appropriate method which will effectively engage the learners in the teaching and learning process.

Tytler's (2003) was of the view that several studies have indicated that there is "a general problems with the teaching of science within secondary schools" (p.274), where much attention is focused on "the factual information, driven by textbook use and tests, lack of small group activity, negotiation of low level cognitive demand, and the concentration of conceptual activity in a minority of target students" (Tytler, 2003, p.274). Emphasizing on this Azure (2015) found out that students in senior high schools were not made to performed science practical activities in integrated science as suggested by the science curriculum. This has contributed to poor attitude shown by students towards science.

Wood and Gentile (2003) were of the view that educators are beginning to recognize that there are better ways to learn than the traditional methods. The traditional method of teaching is passive rather than active. It does not enhance critical thinking and collaborative problem solving since students are made to act as spectators and passive recipient of information. Science educators have from to time emphasize the need to produce students who are skilled in solving basic problems within their immediate environment through analysis and experimentation and adopting a scientific way of life based on pragmatic observation and investigation of phenomena. They also stress the need to encouraging students to develop interest and high motivation towards science. To achieve this, students should be expose to skills in creating their own knowledge in order to understand scientific concept rather than providing them with set of rules and already prepared concepts without understanding them. Students should be exposed to several strategies of solving problems and also providing them a conducive learning environment where they can learn through inquiry and so doing student are placed at the centre of the learning process.

Educators came up with inquiry based instructional strategy which employs active participation of learners in the teaching and learning process and also placed the learners at the centre of the teaching and learning process where the student is made to interact with teaching and learning materials (TLMs) and also asks questions to discover scientific concepts, facts, or principles with or without any teacher support.

Objectives of the study

The purpose of this study was to examine the effects of inquiry-based method of teaching science on the academic achievement and retention of students in integrated science in Senior high schools in Obuasi Municipality. The study will specifically:

1. Find the difference in the mean achievement scores between students taught integrated science using inquiry-based method and those taught integrated science using traditional method.
2. Find the difference in the mean achievement score between male and female students taught integrated science using inquiry -based method.
3. Find the difference in the mean retention scores between students taught integrated

science using inquiry-based method and those taught integrated science using traditional method.
4. Find the difference in the mean retention score between male and female students taught integrated science using inquiry - based method.

Research Questions

1. What is the difference in the mean achievement scores between students taught integrated science using inquiry-based method and those taught integrated science using traditional method?
2. What is the difference in the mean achievement score between male and female students taught integrated science using inquiry -based method?
3. What is the difference in the mean retention scores between students taught integrated science using inquiry-based method and those taught integrated science using traditional method?
4. What is the difference in the mean retention score between male and female students taught integrated science using inquiry - based method?

Significance of the Study

The study will help improve students' achievement in Integrated Science through showing high motivation and better attendance. This is because inquiry-based method ensures active involvement of students in the teaching and learning process and as students are made to practice what they learn, they develop interest and understanding in the lesson and be willing to attend class always.

It will also help Teachers see the need to use Inquiry Based Method in teaching Integrated Science. Most teachers still prefer the traditional method of teaching science to that of inquiry-based method despite its recommendations by several researchers.

It will be useful to the educational training institutions on the need to train teachers who will be able to use Inquiry-based method in teaching science. Teachers will be willing to use the inquiry-based method in teaching if it is incorporated into the teacher training program. Teachers will see it the need to use inquiry-based method in teacher integrated science.

Delimitations of the Study

There are several concepts in Integrated Science but this study only focusses on rocks, acid bases and salts, magnetism and inheritance and variations. These are the topics the chief examiner always reports students having difficulties in them in integrated science.

Limitations of the Study

The main limitation to this study was that the student initially resisted to the inquiry process and objected to their role as explorers. They were used to having the teacher as the main source of information and knowledge giver and they were to receive and read their textbook. They were not familiar with the teaching model in which the teacher asks questions and the students explore and search for the answers, supporting it with evidence and communicating their findings.

Also, there was the need to train teachers in extensive professional development in inquiry-based method of teaching and only two science teachers were willing to undergo such for the study.

Literature Review

The theory underpinning this study is constructivism. The constructivist maintain that learners construct their own knowledge and understanding of the world through experience by constantly asking questions or through inquiry. Basically, the concept of constructivism means encouraging learners to use active approach in experimentation and problem solving to generate more knowledge, discuss their findings and then reflect on the new ideas they have come across with their previous knowledge. Pr˚ucha, Walterov´a and Mareˇs, (2009) observed that the inquiry-based instruction is supported mainly by the cognitive constructivism that uses the didactic approaches based on the assumption that the constructive cognition is happening in the form of the cognized subject connecting the fragments of information from the outside to the meaningful structures, reconstructing the existing structures and performing the mental operations with them conditioned by a suitable level of the pupil's cognitive development (Pr˚ucha, Walterov´a and Mareˇs, 2009, p. 131). There it is very important for the students to take active part in their

cognitive development. The teachers can motivate them by engaging them through the questions they posed to them or giving them the opportunity to part in the formulation of the questions.

The inquiry based- instructions is closely related with thinking and development and it starting points is the knowledge provided by cognitive science. According to Dost´al (2015) this cognitive science is based in the cognitive psychology which creates cognitive models for the problem solving.

Consequently, the constructivist school is the one where the child knows and comes to the schools in order to think about their own knowledge, to organize it, deepen it, enrich it and develop it — in the group where the teacher ensures that every pupil can achieve the highest possible level (cognitive, social, operational) during the participation and contribution of each one of them. (Tonucci, 1994).

The ultimate purpose of constructivism is the learning and the process of constructing it. These processes have to do with engaging the students through discussions, project activities, exercises group works, presentations and by given them tasks which reflect their real world. The students then become motivated with common purpose of reaching the goal. The teacher become the architect of the thinking process; he/she enables it. (Dost´al 2015). He/she creates and assign "good" problems that stimulate investigation, and creation of the group activities which model and enable the process of knowledge construction.

The teacher who now acts as a facilitator makes sure he/she understands the previous knowledge of their students and then prepare activities to help learners promote learning.

According to Khalid and Azeem (2012) the constructivism assumes the role of the teacher as a facilitator who guides learners to create knowledge and understanding instead of producing series of facts.

In a constructivist classroom, the teacher assists the learners through inquiry-based learning activities and problem solving with which the students investigate on a problem, discuss their ideas share their ideas to the group and then contemplate on their new ideas in a collaborative learning environment. The constructivist theory has several benefits to both the teacher and the learner and one of such advantage is that it changes the learner from being a passive recipient of information to an active participant in the learning process. The teacher has the responsibility of guiding the learners to construct their own understanding and knowledge instead of becoming passive recipient of information from the teacher or the textbook. The teacher also has the responsibility of translating what is to be learned into a form relevant to the learner's current state of understanding. (khalid & Azeem, 2012).

This theory capitalizes on learning through inquiry and problem solving through critical and creative thinking. Asselin, Branch and Oberg (2003) were of the view that students' inquirers are encouraged to explore new ideas and understandings through personal discoveries and explorations as well as interactions with objects and with other people.

Olorundare (1992) was of the view that constructivism revolves around the tenets that individuals construct meanings in their attempt to make sense of the world around them. It is therefore very important for the classroom teacher to give access to the students to explore the classroom environment and also guides the students through problem solving and inquiry-based learning activities where students together investigation on a problem and come out with ideas to solve it. This environment must be full of educational materials that will compel the students to learn. The integrated science teacher must make available teaching and learning materials in the classroom environment.

A typical example of a structured inquiry-based learning approach is the learning Cycle Model from Piaget theory of cognitive learning (Bevevino, Denge, &Adams, 1999). Several versions of this learning cycle can be found in the science curricula with the phases ranging in number from 3E, 4E, 5E to 7E. The number of phases does not matter to this study every learning cycle has at its core the same purpose. This study will employ 5E learning by Bybee et al, (2006). It involves the instruction of five discrete elements:

i. Engagement: the prior knowledge of the students is review and also link them to the new concepts through the use of short activities that promote curiosity. The teacher makes connections between past and presents learning experiences. Students are

mentally engaging in the concept, process, or skills to be learned.

ii. Exploration: the teacher involves the students in the topic providing them the opportunity to build their own knowledge through investigating and researching and manipulating of the materials. Student build a set of common experience as they work in groups and this prompt sharing and communicating. At this stage, the teacher acts as a facilitator guiding the students focus and the students actively learn through inquiry-based learning process.

iii. Explanation: this face focus students' attention on particular aspect of their engagement and exploration experiences and provides students opportunity to demonstrate their findings, their conceptual understanding through discussion and presentations. It also provides the teacher the opportunity to introduce the concept, terms and explanations.

iv. Elaboration: After the discussion and explanations about the main ideas and terms for their learning tasks, it is important to involve students in further experiences that extends the concepts and process or skills. Students are encouraged to apply the concept to new situations.

v. Evaluation: At this stage the students are given the opportunity to demonstrate their understanding of the concept. The teacher can administer assessments to determine each student understanding of the concept learned.

Llewellyn 2016 identifies the following roles of the teacher in the structured inquiry.

i. Provides step-by step sequential procedures to be followed
ii. Provides material and supplies as listed in activity sheet or lab.
iii. Assigns role to students on rotating basis
iv. Acts as coach by ensuring all students are on task and understand the procedure
v. Encourage students to work as a group
vi. Ask probing questions and answers questions when appropriate
vii. Provides follow up and going further questions and inquires.

Inquiry- based science teaching methods

There are five inquiry-based teaching methods (Shamsudin and Abdullah, 2013). These are simulation, field study, demonstration, project, and experimentation.

i. **Simulation**

This inquiry-based science teaching consists of role play, model and games. During simulation, learners interact in a way where they become the test subject in the experiment. This strategy fits well with the principle of constructivism and effective way to assist students understands a concept. (Shamsudin and Abdullah, 2013).

According to Perry and et al (2009) simulation using model is a form of experimental learning and these instructional strategies enable the teacher to place the students in the world he/she created. Also, from the findings of Undo and Etiubons (2011) those students who were taught using computer-based science simulation attained better scores than those who were taught using traditional instructional method.

ii. Field study

This is an academic study which takes place in a natural setting other than in the classrooms or laboratory (Noel, 2007). Students normally study concepts through observation, discussions, picture taken as well as analysis of the data collected. These data collected can be in the form of specimen audio, video and pictures. This strategy does not allow active involvement of students but also help students develop an understanding and experience and the process of learning in a natural setting.

Harder (2010) opined that student and teachers found field study activity enjoyable because learning becomes more real and more challenging than those done inside the classroom and also help develop in the student the skills of gathering data through audio recording, picture taken, video recording and collection of specimens for science activities.

iii. Demonstration

McFarland (2005) observed that demonstration is very useful in promoting students learning through proving the truth of something through evidence.

It is true that it can be a tedious task for the teacher. For instance, the teacher has put in a lot of works design set up and think on the best way to carry out the demonstration, but the end results can be extremely positive. (Shamsudin and Abdullah, 2013).

Mc Farland (2005) also opined that through demonstration the classroom interaction tends to be less unidirectional as the students begin to get involved and ask several questions about science except using demonstration as a teaching method replaces the teacher as a source of knowledge and the teacher becomes more creative while students learn to respect the diverse of other students.

iv. Project Work

This inquiry-based science education focuses on the work given by the teacher for teacher students to carry out in groups. Hiang (2005) suggested that there should not be more than three students to a group and the group should invent a project for the discovery content purpose.

Project work has several benefits to the students it allows for more meaning understanding of science concepts among students and enhances academic performance. According to Kanter and Kontantopoulos (2009) project work enable teachers to develop their science content knowledge as well as their science pedagogical content knowledge as they prepare and facilitate students work.

v. Experimentation

Experimentation is core of doing investigation in science classroom. (Shamsudin and Abdullah, 2013). Experiment encourages students' interest in learning science as they get the opportunities to manipulate objects test hypothesis and work together to solve or prove something exciting. Students are able to see or relate concepts better and contribute to sound science concepts.

According to Demeo (2005) experiments help produce more mature type of science education when students are allowed to manipulate things in the experiment. It also makes science become practical for the students instead of always reading scientific theories and contents.

Integrated Science Education in Ghana

In Ghana science education is administered under the purview of Ministry of Education. The ministry is responsible for the formulation of national science education objectives. The ministry of education oversees all the activities of Ghana education service which is responsible for pre-tertiary education in Ghana.

The Ghanaian integrated science curriculum follows the "spiral approach" treating the same themes at different times and greater depths within each educational level. The integrated science curriculum is the replacement of what is used to be called 'nature study'.

At both primary and junior high school level, pupils are made to study integrated science. They learn basic scientific ideas and concepts and how to develop the spirit of curiosity and open mindedness. The main teaching philosophy is inquiry-based which is aimed at providing the learner the opportunity to expand, change, enhance and modify the ways in which they view the world. (GES new science syllabus). It also enforces the teacher to use learner-centered approach in in teaching and learning process which the learner is physically and cognitively present in the knowledge acquiring process in a in a rich and rigorous inquiry-driven environment.

The Ghana science education philosophy at the basic level view science learning as 'an active contextualized process of constructing knowledge based on learners' experiences rather than acquiring it'. Learners are view as information constructors who operate as researchers and the teachers serve as facilitators by providing the enabling environment that promotes the construction of learners' own knowledge based on their previous experiences.

At Senior high school level, the integrated science curriculum comprises the general science and the agricultural science and the environment. The content of the Senior high school integrated science covers basic sciences and these includes Health, Agriculture and industry and it is expected that every student passes this subject before gaining admission into any tertiary institution in Ghana.

The SHS integrated science syllabus covers a three-year period with each year work organized

under five themes. These themes are Diversity of Matter, Cycles, Systems, Energy and Interaction of Matter. The above five themes also form the five sections of the syllabus for each of the three years‟ work. These themes consist of topics from biology, physics, chemistry and agricultural science.

Materials and Methods

The study employed a quasi-experimental non-randomized pre-test, post-test control group design. This design was adopted because it was not possible to have complete randomization of subjects as this will disturb school organization. According to Vanderstoep and Johnson (2009), quasi-experimental design is an empirical study used to estimate the causal impact of an intervention on its target population. Therefore, intact classes were randomly assigned to experimental and control groups.

In this study, the target population consists of 1200 SHS Two Gold students from Christ the King Catholic Senior High School and Obuasi Secondary Technical Senior High School in the Obuasi municipality.

In determining the sample size for the study, the table for determining sample size from a given population suggested by Krejcie and Morgan 19 was used.

A total of 292 students were selected from the target population. This comprises 77 boys and 69 girls from the two senior high schools in the municipality. There are 146 students in the experimental group and 146 students in the control group. Four intact classes from each of the two sampled school were selected using simple random sampling. They were assigned randomly to experimental and control groups. The experimental group comprised four intact class while the control group also comprised four intact classes. The researcher used Integrated Science Achievement Test (ISAT), semi- structured interview guide and observation to collect data needed to answer the research questions guiding the study. The test items were constructed from the topics that were taught in the class during the interventional process.

Intact classes were assigned to both the experimental and the control groups after which the Integrated Science Achievement Test (ISAT) was administered as pre-test this took one week before the actual teaching began. During the treatment period the experimental group were taught some selected topics in integrated science using inquiry-based method. The control group was also taught the same topics using traditional method. The actual teaching took four weeks to cover all the selected concepts.

After the treatment the pre-test were reshuffled and administered as post-test to both groups. The post-test was marked by the research assistants with the marking scheme prepared by the researcher. The researcher then allowed a gap of four weeks and reshuffled the post-test and re-administered it again to ascertain if the knowledge gain was retained. This was to measure the retention of concepts learned during the intervention period. The retention test was scored analyzed.

Results

The data collected for the study was analyzed and interpreted based on the research questions formulated. Table 3-7 presents the results on the research questions.

Table 1. Analysis of students' data

Treatment Group	N	Frequency	Percentage
Experimental group	146	146	50
Control group	146	146	50
Total	292	292	100

The results in the table 1 shows the number of students in the study. The experimental group were 146 indicating 50% and the control group were also 146 indicating 50% of the treatment group.

Table 2. Analysis of the sex of the experimental group

Sex	N	Frequency	percentage
Male	77	77	52.7
Female	69	69	47.3
Total	146	146	100

The table 2 above shows that the male in the experimental group is 77 corresponding to 52.7% and the female were 69 indicating 47.3% of experimental group**.**

Research question 1: What is the difference in the mean achievement scores between students taught using inquiry-based method and those taught integrated science using traditional method.

Table 3. Mean achievement and standard deviation scores of students in the pre-test.

Treatment Group	N	Mean	Standard deviation
Experimental group	146	10.79	1.42
Control group	146	10.79	1.39
Mean difference		0.07	

The table above shows that the pre-test means scores for the experimental and the groups were 10.79 and 10.72 respectively with their standard deviation scores of 1.42 and 1.39 respectively. The mean difference is 0.07.

Table 4. Mean achievement and standard deviation scores of students taught integrated science using inquiry-based method and those taught using traditional method

Treatment Group	N	Mean	Standard deviation
Experimental group	146	24.18	13.3
Control group	146	16.35	2.27
Mean difference		7.83	

The table above shows that the post-test means scores for the experimental and the control group were 24.18 and 16.35 respectively with standard deviation scores of 13.39 and 2.27 respectively. The mean difference is 7.83. The overall mean difference between the two groups was 7.76 in favour of the experimental group. This implies that the experimental group who were taught with inquiry-based method have achieved better than the control group who were taught with the traditional method.

Research question 2: What is the difference in the mean achievement score between male and female students taught integrated science using inquiry -based method?

Table 5. Mean achievement and standard deviation scores of male and female students in the pre-test

Treatment Group	N	Mean	Standard deviation
Male	77	10.60	1.11
Female	69	10.25	1.69
Mean difference		0.35	

The results in the table above shows that the pre-test mean scores for male and females were 10.60 and 10.25 respectively. With standard deviation scores of 1.11 and 1.69 respectively. Their mean difference is 0.35.

Table 6. Mean achievement and standard deviation scores of male and female students taught integrated science using inquiry-based method. Post-test

Treatment Group	N	Mean	Standard deviation
Male	146	77	24.47
Female	146	69	23.88
Mean difference		0.59	

The results in the above table shows that the post-test mean scores for male and female taught integrated science using inquiry-based method was 24.47 and 23.88 respectively with standard deviation of 1.77 and 1.61 respectively. Their mean difference was 0.59. The overall mean difference for both sexes was 0.24 in favor of the male males which is very small. This means that the male achieved slightly higher than their female counterparts in integrated using inquiry-based method.

Research question 3: What is the difference in the mean retention scores between students taught using inquiry-based method and those taught integrated science using traditional method?

Table 6. Mean retention and standard deviation scores of students taught using inquiry-based method

Treatment Group	N	Mean	Standard deviation
Experimental group	146	24.33	**1.77**
Control group	146	14.32	**2.32**
Mean difference		10.10	

The results in table 6 shows that the retention tests score for both the experimental and control group was 24.33 and 14.23 respectively with standard deviation of 1.77 and 2.32 respectively. From table 3, the pre-test mean score for both the experimental and control group were 10.79 and 10.72 respectively. The overall mean difference between the two groups was 10.03 in favour of the experimental group. This means that the experimental group has higher retention rate than the control group.

Research question 4: What is the difference in the mean retention score between male and female students taught integrated science using inquiry -based method?

Table 7. Mean retention and standard deviation scores of male and female students taught using inquiry-based method

Treatment Group	N	Mean	Standard deviation
Male	77	24.65	1.70
Female	69	24.22	1.63
Mean difference		0.43	

The results in table 7 shows that the retention tests score for both the male and female was 24.65 and 24.22 respectively with standard deviation of 1.70 and 1.63 respectively. From table 5, the pre-test mean score for both male and female were 10.60 and 10.25 respectively. The overall mean difference between the two groups was 0.08 in favour of the male. This means that the male students' retention capacity is slightly higher than their female counterpart in integrated science when using inquiry-based method in teaching.

Discussion of Findings

The results of this study show that students taught integrated science with inquiry- based method achieved better than their counterpart students taught using traditional method. This finding agrees with Wonkyi and Adu (2016) who found out that students exposed to inquiry-based method performed better circle theorem in mathematics than their counterpart students who were exposed to traditional method in circle theorem. Also, the findings agree with Riordan

and Noyce (2001) who found out that students taught using inquiry-based programs as their primary mathematics curriculum performed significantly better than students taught using traditional approach. The likely explanation for this outcome might be connected to the fact students taught with inquiry-based method had the opportunity to construct their own understanding of the concept taught in the class so deep learning occurred. According to Khalid and Azeem (2012) the constructivism assumes the role of the teacher as a facilitator who guides learners to create knowledge and understanding instead of producing series of facts.

It was also found out that students exposed to inquiry-based method have higher retention capacity than their counterpart students who were exposed to traditional method. This finding agrees with Ali (2012) who found that students have higher retention capacity when they are actively engaged in solving problems through hands-on activities than when they become passive learners as obtained in the use of traditional method. This outcome can be attributed to the fact students had the opportunity to understand and reflect on what was taught in the class therefore they were able to retain and reproduce what was taught in the class.

Again, the study revealed that the male students achieved slightly higher than their female counterparts using inquiry-based method. This difference is very small that it has no impact or significant. This finding agrees with the findings of Oluwatosin (2015) who found out that there was no significant statistical difference between male and female students taught chemistry with inquiry method. Also, Omokaadejo (2014) found that there is no significant difference between male and female SS2 students in their Chemistry academic performances implying that both gender benefit from the inquiry teaching method.

According to this finding it means achievement in integrated science does not depend on gender. Inquiry-based method can therefore be used to bridge the gap i*n achievement between male and their female counterpart.*

Also, the findings of this study show that there is no significant difference between gender and retentions. This means that both male and female students can retain what is taught in integrated science using inquiry-based method.

Conclusion

The use of inquiry-based method enhanced students' achievement and retention in integrated science than traditional method. There was a slightly gender disparity in the achievement and retention capacity of both male and female students taught integrated science with inquiry-based method in favour of the male. This means that inquiry-based method is very rewarding to students in terms of achievement and retention regardless of gender. Also, there was no effect on interaction between the method and gender in students' achievement and retention in integrated science. This therefore implies there is no need for separate method for both male and female since inquiry-based method could be successfully used for both.

Acknowledgements

To Allah be the glory, Honour and praises. I thank Almighty Allah for giving me knowledge and strength to undertake this study successfully. I would like to express my sincere gratitude to my mother, Madam Ayishetu Yusuf for her daily prayer and encouragement. Many thanks to my wife and brothers especially Nurudeen Abass for lovely support and caring. Finally, I would like thank all the workers of Texila American University for their wonderful support.

References

[1] Akpan, O. E. (1992). Towards creative science teaching and learning in West African schools. Cape Coast: Catholic Mission Press.

[2] Asselin, M., Branch, J. & Oberg, D. (Eds). 2003. Achieving information literacy standards for school library programs in Canada. O.N: Canadian School Library Association. (atas talian)
http://ednet.edc.gov.ab.calk-12/curriculum/by

[3] Azure, J.A. (2015). Senior High School Students' views on the teaching and learning of integrated science in Ghana. Journal of Science Education and Research, 1(2), 49-61

[4] Bybee, R. W., Taylor, J.A., Gardner A., Scotter, P. V., Powell, J.C., Westbrook, A. & Landes, N. (2006). The BScs 5e instructional model: origins and effectiveness. Office of Science Education National Institutes of Health. 1-80.

[5] Cooper, J. M. (1990) (Ed.). Classroom teaching skills. Toronto: D. C. Heath and Company.
[6] CRDD (2010) *Integrated science Syllabus for Senior High School*. Curriculum Research and Development Division.
[7] Demeo, S. (2005). Gazing A Hand: A Foulcaltion View of the Teaching of Manipulative Skills to
[8] Introductory Chemistry students in the United States and the Potential for Transforming Laboratory Instruction. Retrieved April 5, 2012, from http://onlinelibrary.wiley.com/doi/10.1111/j.1467-873X.2005.00330.x/pdf
[9] Hiang, P. S. (2005). Pedagogy of Science. Kuala Lumpur: Percetakan Sentosa (K. L) Sdn.Bhd
[10] K.Adu-Gyamfi (2014) Using activity method to enhance students' performance in energy transformation.
[11] K.J. Sree (2010) Methods of Teaching Science Discovery Publishing House.
[12] Khalid, A., & Azeem, M. (2012). Constructivist vs. traditional: Effective instructional approach in teacher education. International Journal of Humanities and Social Science, 2(5), 170–177.
[13] Davar, M. (2012) Teaching of Science PHI Learning Limited
[14] McFarland, E. (2005). Using Demonstration in Teaching Physics. La Physique Au Canada, 87-89
[15] Mensah, S. K. E. (1992). Source book for science tutors' professional studies.
[16] Shamsudin, M. N and Abdullah, N. "Strategies of Teaching Science Using an Inquiry based Science
[17] Education (IBSE) by Novice Chemistry Teachers", Procedia - Social and Behavioral Sciences, vol. 90, no.10, (2013), pp.583-592.
[18] O'Oconnor, J. P. (2002). Teachers are the problem in SMT, not girls. Retrieved on January 9, 2009 from http://www.adea.org
[19] Okoroafo, S. (2014). Gender difference in secondary school students' academic achievement in Science. *Australian Science Teachers Journal,* 23(6), 23-25.
[20] Oluwatosin V. A. (2015). effect of hands-on activities on senior secondary chemistry students' achievement in chemistry. Benue State. *achievement in Basic Science*. Unpublished M.Ed Dissertation, Tai Solarin University of Education, Ogun State, Nigeria.
[21] Olorundare, A. S. (2014). *Correlates of poor academic performance of secondary school students in the sciences in Nigeria*. Paper presented at the International Institute for Capacity Building in Higher Education, Virginia State University, Virginia, USA. 20th – 31st June, 2014.
[22] PR˚UCHA, Jan, Eli˘ska WALTEROVA and Ji˘ ´ r´ı MARES. ˘ Pedagogick´y slovn´ık. Praha: Port´al, 2009. 395p. ISBN 978-80-7367-649.
[23] Shadreck, M. & Mambanda, I. (2012). Science teacher quality and effectiveness: Gweru Urban junior secondary school students' point of view. Asian social science, 8(8), 121-135.
[24] Tytler, R. (2003). A Window for a Purpose: Developing a framework for describing effective science teaching and learning. *Research in Science Education, 33*. pp. 273---298. Kluwer Academic Publishers
[25] Perry, J. N. (2009). What is Simulation? Retrieved February 18, 2011, from Saskatoon: http://olc.spsd.sk.cs/DE/PD/INSTR/strats/simui/index.html
[26] Udo, M. E. (2011). Computer-Based Science Simulations, Guided-Discovery and students' Performance in Chemistry.
[27] Wood, W.B & Gentile, J.M. (2003). Teaching in a Research Context. Science, 302:1510.
[28] Yager, R.E. (1991). *What research says to the science teacher, volume seven. The science and technology, society movement.* Washington D.C. National Science Teachers Association
[29] Yara, O, P., 2009. Students' attitude towards mathematics and academic achievement in some selected secondary schools in South Western Nigeria. European Journal of Scientific Research, 36 (3): 336-341.