

Effect of Multiple Intelligence- Based Instructional Technique (MIBIT) On Students' Interest in the Learning of Difficult Biology Concepts

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Abstract: *The study determined the effect of Multiple Intelligence Based Instructional Technique (MIBIT) on students' achievement and interest in the learning of difficult biology concepts. Two research questions were asked and two research hypotheses were formulated and tested at 0.05 level of significance. The research design was a quasi – experimental study. The sample was made up of seventy four (74) senior secondary one (SS1) students from two randomly selected co-educational secondary schools from Aguata Education Zone of Anambra state. The Biology Interest Scale (BIS) was the instrument used for data collection. Cronbach Alpha was used to determine the reliability of BIS which yielded the coefficient of internal consistent of 0.85. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at $p < 0.05$. The result of the findings indicated that MIBIT promotes academic interest in difficult biology concepts. Gender was discovered to have no significant influence on students' academic interest. No interaction effect existed between MIBIT and gender on students' overall interest. Conclusion from the findings led to various recommendations, some of which are that biology teachers should adopt the MIBIT in the teaching of difficult biology concepts in order to cater for the diverse learning styles of students in their classroom and promote students' interest. Curriculum designers should integrate MIBIT in the curriculum and teachers should be sponsored to workshops and seminars on how to improve their teaching skills using MIBIT.*

I. Introduction

Science is a core subject taught in schools all over the world, and science educators believe that any nation that hopes to develop must not neglect teaching of science in its schools (Ogunleye, 1999; Fafunwa, 2004). The core science subjects include Biology, Chemistry and Physics. Of all the disciplines in Nigerian secondary schools, biology is the most popular; this is because almost all the students in every school select it as their core science subject, (Federal Republic of Nigeria (FRN) 1998).

Biology is a branch of science that deals with the study of living things and it is taught in senior secondary schools. Odigie (2001) explained that biology is the prerequisite subject for many fields of learning that contributes immensely to the technological growth of the nation. This includes: medicine, forestry, agriculture, biotechnology, nursing among others. The study of biology equips students with knowledge and skills that will enable them to make a useful living in the society. This is in line with the broad goals of secondary education which is to prepare individuals for useful living within the society (Federal Republic of Nigeria (FRN), 2004).

Some researchers (Ogunleye, 2000; Ajagun, 2001) have observed that failure rate in science generally and biology in particular at senior school certificate examinations has been persistently high. Bassey and Essien (2005) stated that despite the importance of Biology in national development and its popularity among students, performance in this subject has not been encouraging. Umeoduagu (2000) blamed under achievement in science on conceptual difficulty. Study reports also indicate that students generally experience difficulties in sciences including biology which most students consider simple because of its low mathematical content (Agwanyang, 2004; Anyibi, 2004). Certain scientific concepts have been tagged 'difficult concepts' simply because either the teachers find them difficult to teach or the learners find them difficult to learn.

Difficult biology concepts are those concepts in biology which the students are not finding easy to learn. This implies that the students lack the framework to deepen their understanding of these concepts. It is an observed fact that some concepts in biology curricula are very difficult for students to comprehend. Some of the concepts include Homeostasis, Genetics, Evolution, Nervous Co-ordination, Ecology, Cellular respiration among others (Okebukola, 2005; Nzelum, 2010). Among the reasons advanced for this difficulty in mastery of these concepts are poor handling of the concepts by the teachers, ineffective methods of teaching these concepts

and lack of interest. Instructional practices which do not consider the learners characteristics is bound to fail (Kimball, White, Milanowski & Borman, 2004).

Literature has revealed extensively the nature of interest and the situation of performance in biology. Interest is seen by Harbor Peters (2001) as the zeal or willingness to participate in any activity from which one derives some pleasure. Interest is an important variable in learning because when one is interested in an activity, he is likely to be more deeply involved in that activity. Interest is a disposition or feeling which prompts a person to spontaneous activity e.g. paying attention to school work or any other activity, (Dandekar & Makhiji, 2002). Interest is a powerful source of human motivation which is capable of arousing and sustaining concentrated effort (Bhatia, 2003). Njoku (2003) opined that interest is a response to liking or disliking to an event, an actively or an object or person. It concerns an individual's preferences for particular type of activity. Njoku (2003) argued that interest and motivation are components of attitude which can be influenced by reinforcement, learning and experience. The implication is that reinforcement or incentive can arouse interest or create motivation to participate in certain kinds of activities. Conversely; negative reinforcement can inhibit one's interest to participate in an activity which may result into a dislike to an activity. One is likely to do well in a discipline of interest. The ability to identify students' interest in science plays an important role in improving existing curriculum to meet their needs, (Ayelet & Anat, 2007). According to (Dandekar & Makhiji, 2002); the quality and effectiveness of educational procedure and programmes, effort and achievement goals, and outcomes are determined largely by interest of pupils, teachers, parents and administration. This statement by Dandekar and Makhiji (2002) demonstrate the importance of interest in teaching-learning process. It also reminds teachers of their roles to arouse students' interest during classroom activities so that students can be stimulated to learn.

This study therefore investigated if multiple intelligence based instructional approach could be used to improve students' interest in difficult biology concepts.

Intelligence is defined as the capacity to solve problems or to fashion out products that are valued in one or more cultural settings (Gardner & Hatch, 1989). Multiple intelligence – based instructional approach is an educational approach which gives great considerations to individual differences among learners. It is an approach in which a teacher employs various intelligence identified in Howard Gardner's theory of multiple intelligences to achieve the objectives of the lesson. It emphasizes on the multiplicity of instructional techniques in order to address students' intelligence. The theory of multiple intelligence was proposed by Howard Gardner in 1983 as a model of intelligence that differentiates intelligence into various specific (primarily sensory) modalities. It pre - supposes that all humans possess a number of distinct intelligences which manifest themselves in different skills and competencies and they represent different ways to learn and demonstrate understanding (Christon & Kennedy, 1999). This new outlook on intelligence differs greatly from the traditional view which usually recognizes only two intelligences – verbal and computational. The traditional teaching approach is more of lecture method which does not consider much of the learners' characteristics and is teacher centred approach. Multiple intelligence pluralizes the traditional concept of intelligence from logical and linguistic problem - solving to a set of abilities, talents of mental skills called intelligence. Armstrong (2000) reported that Gardner's official words for describing different ways individuals are is "smart", that is, how their natural talents are manifested and how they learn best. These intelligences are verbal – linguistic intelligence (word smart), Visual – Spatial intelligence (picture smart), logical – mathematical intelligence (number and reasoning smart) and bodily kinesthetic intelligence (body smart). Others are musical – rhythmic intelligence (music smart), inter-personal intelligence (people smart), intra – personal intelligence (self smart) and naturalist intelligence (nature smart).

Verbal – linguistic intelligence: It deals with the ability to think in words and to use spoken and written words or languages to express ideas, appreciate meaning and accomplish other goals (Somora, 2003).

Logical – mathematical intelligence: This area has to do with logic, abstractions, inductive and deductive reasoning and use of numbers.

Visual Spatial intelligence: Lawan (2001) described the visual spatial intelligence as the ability to think in pictures, to create mental image and to transform visual or spatial ideas into imaginative and expressing creations.

Bodily – kinesthetic: Simcoe (1996) described the bodily kinesthetic as the ability to use one's body in part or whole to solve problems or fashion out products. It can equally be said to be the ability to use the body effectively, like a dancer or surgeon in part or whole to solve problems or fashion out products.

Musical - rhythmic intelligence: According to the Firelight User Network (FUN) (2000), it enables individuals to be sensitive to non- verbal sounds and to discern rhythmic, pitch, timbre and tone.

Inter-personal intelligence: This has to do with interaction with others.

Intra-personal intelligence: being able to understand one's own interest and goals. According to Somora (2003), intra-personal intelligence refers to the ability to understand oneself, recognize one's feelings strengths and weaknesses and to use the information and direct one's life.

Naturalistic intelligence: This area has to do with nature, nurturing and relating information to one's natural surroundings. The capacity to recognize and classify natural species (Flora and Fauna) in one's environment is what Gardner describes as naturalist intelligence (FUN, 2000).

Gardner claims that the eight intelligences very rarely operate independently. Armstrong (1994, 2000) advocated that teachers applying the multiple intelligence approach in their classroom should present their lesson using a wide variety of instructional techniques involving the use of words, numbers and logic, music, group activities, physical activities, pictures, self reflection and the physical surrounding in order to adequately cater for the diverse learning preferences of the students. It is therefore important that teachers should assess their students' learning in ways that will give them the opportunity to use their well developed intelligence and do well. Students could write reports, give oral presentations using visual aids prepared by them, present graphic designs, concept maps, models, independent projects and creative tasks.

The following instructional techniques adopted by Armstrong (2000) and Patterson (2002) which address the intelligence(s) indicated were adopted in the present study. These are project- based learning, collaborative learning, active learning, authentic instruction and self assessment.

Project- based learning (bodily-kinesthetic intelligence) – Udo (2008) considered project approach as an example of activity technique. To him, it is a student – centered approach where the student has some control over the teaching process and directs more or less the instructional activities with the teacher providing adequate guidance. Collaborative learning (inter-personal intelligence) - is also called co- operative learning and occurs whenever students interact in pairs or groups. Active learning (Verbal- linguistic and Logical – mathematical intelligence) According to Bonwell and Elson (2003), active learning is an instructional technique by which students are actively engaged in the learning process. Authentic instruction (visual – spatial intelligence) - is an approach to learning that intends to make learning more meaningful by increasing connections between the classroom and the real world (Calaveras, 2000). Self assessment (intra- personal) - is a technique by which a learner assesses his or her own achievement and progress.

Multiple intelligence theory believes that all students can learn and that no one is of low intelligence because everyone is gifted in at least one intelligence category (Patterson, 2002). The studies of some researchers like Carver, Price and Wilken (2000), Price and Wilken (2000); Geimer, Getz, Pochert and Pullam (2000); Janes, Koutsophanagos, Mason and Villaranda (2000);) Carver, George, Mitofsky, and Peter (2001)Patterson (2002) and Somora (2003); revealed that the multiple intelligence approach improves achievement and retention of learning in arts subjects in many industrialized countries. Using such an educational approach for teaching difficult concepts in biology will most likely produce results capable of checking the problem of low achievement in biology. It is logical to say that if there is poor academic achievement in any educational system or subject area, then little/insufficient learning has taken place in that educational system or subject area since according to Igbokwe (1999), it is only what is learnt that is expressed as academic achievement. Learning therefore plays complementary roles in determining academic achievements in any subject area or discipline.

Gender issue was considered in the study as a factor in biology academic achievement because gender effect on achievement is not finally determined. Gender generated a lot of concern for science educators in achievement for instance, Egbo (2005) found that females achieved better than males in the science subjects while Igbokwe (2001) and Nworgu (2004) found that males achieved better in science. On the other hand Anaekwe's (1997), Ono's (2001); Iweka's (2006) and Ugwuadu's (2011) findings showed that there was no significant difference in science achievement between male and female students. There is no consensus as to whether gender influences achievement in science or not. The present study therefore is challenged with the dearth of research studies on the applicability of Multiple Intelligence Based Instructional Approach on students' achievement and interest in the teaching and learning of difficult biology concepts due to gender.

Statement of the Problem

Generally, various researchers in biology have shown that students perform poorly in biology examinations (Ogunleye ,2000; Ajagun, 2001; Obianyo ,2001; Nwagbo & Obiekwe 2010). Also, available statistics from the West African Examination Council (WAEC, 2010; WAEC, 2011; WAEC, 2012) recorded very poor performance at SSC examinations in biology because of poor grasp of difficult biology concepts among other factors. It has also been noted that one of the reasons for this poor grasp of difficult biology concepts is attributed to poor approaches used in teaching the subject by the biology teachers (Ali, 1998). Research reports on the status of science in schools in Nigeria showed that science classroom activities are still

dominated by teacher-centred methods (lecture method) which have been found to be ineffective in promoting science learning at primary and secondary levels (Njoku, 2004). Despite the fact that various methods such as discovery, guided inquiry and expository method among others have also been in use, the WAEC Chief examiners' annual reports and comments still show that students' performance in biology have not improved appreciably (WAEC, 2012). This then calls for the exploration of the effect of multiple intelligence based instructional approach (MIBIA) on students' achievement and interest in the learning of difficult biology concepts.

Purpose of the Study

The purpose of this study was to determine the effect of multiple intelligence- based instructional approach on students' achievement and interest in the learning of difficult biology concepts. Specifically, the study was designed to:

- (1) determine the pretest and posttest mean achievement scores of students taught difficult biology concepts using Multiple Intelligence - Based Instructional Techniques (MIBIT) and those taught using lecture method.
- (2) determine the mean achievement scores of male and female students taught difficult biology concepts using MIBIT and those taught using lecture method.

Research Questions

The following research questions were asked to guide the study.

- (1) What are the pre and post test mean achievement scores of students taught difficult biology concepts using MIBIT and those taught using lecture method?
- (2) What are the mean achievement scores of male and female students taught difficult biology concepts using MIBIT and those taught using lecture method?

Hypotheses

The following null hypotheses were formulated for the study and tested at 0.05 level of significance:

- 1: There is no significant difference between the pretest and posttest mean achievement scores of students taught difficult biology concepts using multiple intelligence based instructional technique (MIBIT) and those taught using the lecture method.
- 2: There is no significant difference between the mean achievement scores of male and female students taught difficult biology concepts using MIBIT and those taught using lecture method.

Design of the Study

The study adopted a quasi – experimental design. Specifically, the study adopted a non-randomized pretest-posttest, control group design. This non –equivalent control group design was considered appropriate for this study because participants were not randomly assigned to the two groups rather treatment was randomly assigned to intact classes or groups, which were already organized.

Area of the Study

The area of this study is Aguata Education Zone in Anambra State. Aguata Education Zone consists of three Local Government Areas (L.G.A.) namely: Aguata , Orumba South , and Orumba North L.G.A. The area is blessed with good arable lands; hence the people are predominantly farmers but even at that. The people valued education. As at the present a good number of them are venturing into education. There are two tertiary institutions and fifty public secondary schools in the zone. This study is better carried out here because multiple intelligence will help address the diverse intelligences in the people and help them to identify their intelligence profile and straighten them.

Population of the Study

The population of the study was all the Senior Secondary one (SSI) students in the 39 co-educational secondary schools in Aguata education zone of Anambra State. The population size is one thousand, six hundred and fifty three (1,653) students made up of eight hundred and seven (807) males and eight hundred and forty six (846) females.

Sample and Sampling Technique

The sample for the study consists of seventy four (74) Senior Secondary one (SS1) students drawn from two schools out of thirty nine (39) co-educational secondary schools in Aguata Education Zone. Simple random sampling technique was used to select two out of thirty nine co-educational secondary schools in Aguata Education Zone and a flip of a coin was used to choose the experimental group and the other the control

group. In each of the two schools, one intact class was randomly sampled. The experimental group had intact class size of 17 males and 15 females while control group had intact class size of 33 males and 9 females. All the students in each of the two intact classes were used for the study.

Instrument for Data Collection

Biology Achievement Test (BAT) was the instrument used for data collection. The BAT consists of 40 items multiple choice test with five items drawn from the concepts of excretion, growth, local biome community and major biomes which were identified as difficult concepts in biology by the students. The BAT was used for the pretest and the post test. The selection of the items was based on a well planned test- blue print to ensure even coverage of the content.

12 items (30%) were drawn from excretion, 12 items (30%) from growth, 8 items (20%) from local biomes community and, 8 items (20%) from major biome. The weighting was based on the scope of the content area as stipulated in their curriculum

Validation of the Instrument

The Biology Achievement Test (BAT) was validated by a specialist in educational measurement and evaluation and a specialist in science education (biology) all at Nnamdi Azikiwe University Awka.

Reliability of the Instrument

To estimate the reliability of the instrument, the test-retest was used to determine the reliability of the BAT. The BAT was administered on 30 SSI students in one of the secondary schools in Imo State outside the research area which has homogenous culture as the research area. Two weeks later the same test was administered to the same subjects. The scripts were marked and the two sets of scores of the students were correlated using Pearson Product Moment correlation Technique which yielded a reliability correlation index of 0.92.

Procedure

Questionnaire for difficult biology concepts were given to 60 SS1 students from six secondary schools (two from each L.G.A.) in Aguata Education Zone. Sixty copies of the questionnaire were given to SS1 students for 2011/2012 session during their third term revision week (i.e when they have covered the whole curriculum for SSI class.) These students are presently in SS2 class in this 2012/ 2013 session and are not part of the population of the study. The six schools were selected by simple random sampling. The questionnaire was used to elicit from the respondents the difficult biology concepts and their analysis revealed the difficult concepts which were used for the study.

A two-week intensive training programme was organized for the participating teachers (Research assistants) from the sampled schools teaching biology for SS 1. The experimental group teacher was given detailed explanations on the multiple intelligence theory, the multiple intelligence lesson plans, how to incorporate the multiple intelligence techniques into the lessons and the general requirements of the research. The control group teacher was briefed on the general requirements of the research since he will be required to use the lecture method lesson plans to teach without incorporating multiple intelligence techniques like collaborative method, use of authentic instruction, self assessment. By the end of the training, the researcher organized a micro teaching session for the participating teachers to ensure that they have mastered the instructional techniques expected of them. Other experimental conditions that were taken to avoid invalidity were:

Prior to the commencement of the experiment, the two schools chosen were assigned to experimental and control groups respectively by simple flip of a coin. The researcher, with the aid of two research assistants (class teachers), first of all subjected the two randomly selected intact groups to a pre-testing exercise with the BAT. Thereafter, the experimental group was subjected to the treatment and control group to lecture method the actual experiment was conducted by the trained research assistants that is the class teachers and the control group was also taught by the class teacher, while the researcher observed their classes and took notes of classroom processes. Experimental group was taught using multiple intelligence based approach and the control group was taught using lecture method. The treatment for this study was multiple intelligence lesson plans. The lesson plans incorporated five multiple intelligence based instructional techniques: active learning, project based learning, collaborative, authentic instruction and self assessment of themselves. These instructional techniques addressed six multiple intelligences namely; verbal- linguistic, logical- mathematical, inter-personal, bodily-kinesthetic, visual- spatial and intra-personal intelligences. The experimental group was taught using life specimens, models, maps, real objects and charts. These visual aids that appeal to the sense of sight made instruction authentic and addressed visual-spatial intelligence. The students were given projects and assigned different tasks which appeal to the sense of touch (bodily- kinesthetic). The students were grouped in 'fives',

different topics were assigned to them in order to enhance critical thinking and skills. Finally the students were allowed to evaluate themselves through self assessment. Each lesson lasted for 90 minutes. This study lasted for six weeks using the normal school timetable 90 minutes. At the end, the same test (BAT) was given to both the experimental and control groups.

Method of Data Analysis

The research questions were answered using mean and standard deviation. The hypotheses were tested at 0.05 level of significance using Analysis of Co-variance (ANCOVA). The adoption was to take care of error due to initial difference in ability among the research participants.

II. Result

Research Question 1

What are the pre test and post test mean achievement scores of students taught difficult biology concepts using MIBIT and those taught using lecture method?

Table 1: Mean (x) and Standard Deviation (SD) of Scores of Students in the Experimental and Control groups.

Group	N	Pretest Scores		Posttest Scores		Mean Gain Scores
		\bar{X}	SD	\bar{X}	SD	
MIBIT (Exp)	32	49.60	9.80	65.34	11.90	15.74
Lecture method (Control)	42	42.30	6.70	44.00	8.28	1.70

The data presented on Table 1 show that the experimental group (MIBIT) had a mean achievement pretest score of 49.60 with a standard deviation of 9.80 and a mean achievement posttest score of 65.34 with a standard deviation of 11.90. On the other hand the control group (lecture method) had a mean achievement pretest score of 42.30 with a standard deviation of 6.70 and a mean achievement posttest score of 44.00 with SD of 8.28. It was observed from the table that the mean gain of the experimental group (15.74) was higher than the mean gain score of the control group (1.70). This means that the group that was taught using MIBIT (experimental group) performed better than the group that was taught using lecture method (control group). The SD of the posttest scores of MIBIT was 11.90 while that of the lecture method was 8.28. That means that the control group had scores which are more clustered around the mean than that of the experimental group.

Research Question 2

What are the mean achievement scores of male and female students taught difficult biology concepts using MIBIT and those taught using lecture method?

Table 2: Mean (x) and standard deviations (SD) of male and female students post test in experimental and control groups.

Group	Gender	N	Pretest Scores		Posttest Scores		Mean Gain Scores
			\bar{X}	SD	\bar{X}	SD	
MIBIT (Experimental)	Male	17	50.00	8.80	67.94	11.92	17.94
	Female	15	49.10	9.00	62.40	11.59	13.30
Lecture method (Control)	Male	33	41.20	6.80	44.58	8.72	3.38
	Female	9	42.00	5.90	41.89	6.41	-0.11

From Table 2, the mean achievement posttest score of the male students in the experimental group, numbering 17 was 67.94 with a SD of 11.92, while their female counterparts numbering 15, had a mean achievement score of 62.40 with standard deviation of 11.59. In the experimental group the male mean gain (17.94) was slightly higher than that of the female mean gain score (13.30) which means that the male students performed slightly better than the female students. From the standard deviation of the male students of the experimental group (11.92) and that of the female students (11.59), it means that female students had scores which were more clustered around the mean while their male counterparts had scores which were more widely spread apart.

On the other hand the mean achievement posttest score of male students in the control group was 44.58 with SD of 8.72 while their female counterparts had a mean achievement posttest score of 41.89 with SD of 6.41. It was also observed from the control group that the males' mean gain score (3.38) was slightly higher than the females' mean gain scores (0.11). The SD (6.41) of the female students were more clustered around the mean while their male counterparts (8.72) had scores which were more widely spread apart

Hypothesis 1

There is no significant difference between the mean achievement scores of students taught difficult biology concepts using MIBIT and those taught using lecture method.

Table 3: Analysis of Covariance (ANCOVA) of Students’ Achievement Score by Instructional Technique (Ins. Tech.) Gender and Interaction.

Source	Dependent Variable	Type III Sum Of Squares	DF	Mean Squares	F-Cal	F-Crit	Sign.	Decision
Corrected model	Posttest achievement scores	9349.1159	5	1869.823	20.722	3.92	.000	S
Intercept	Posttest achievement scores	1278.356	1	1278.356	14.167		.000	
PRTA	Posttest achievement scores	767.707	1	767.707	8.508		.005	
INSTECH	Posttest achievement scores	6641.153	1	6641.153	73.598		.000	
Gender	Posttest achievement scores	47.211	1	47.211	.523	3.92	.472	NS
INSTECH. GENDER (Interaction effect)	Posttest achievement scores	11.277	1	11.277	.125	3.92	.725	NS
Error	Posttest achievement Scores	6135.980	68	90.235				
Total		225157.000	74	3042.66				

The ANCOVA of students’ overall achievement scores presented on Table 3 show the effect of MIBIT in teaching of difficult biology concepts at 0.05 level of significance. The F- calculated was 73.598 against the F-critical value of 3.92 for 1 df for numerator and 74 df for denominator at the 0.05 level of significance. Since the calculated F-value 73.598 exceeded the F - critical value 3.92 the null hypothesis of no significant difference was rejected. Therefore it was concluded that there was a significant difference in the mean achievement scores of biology students taught difficult biology concepts using MIBIT and those taught using lecture method. The result was also supported by a value of 0.000 level of significance for the F-cal which was less than the 0.05 level of significance (F-cal at df 1, 74, =73.598, p<0.05). This means that MIBIT (treatment condition) was a significant factor that influenced biology students’ overall achievement in difficult biology concepts studied.

Hypothesis 2 : There is no significant difference between the mean achievement scores of male and female students taught difficult biology concepts using MIBIT. In Table 3 the calculated F- value for gender was 0.523, as against the critical value of 3.92 at 1 df for numerator and 74 for denominator at 0.05 level of significance. Since the value of F-cal (0.523) was less than the F-critical (3.92), the null hypothesis was accepted (F-cal.at df: 1, 74=0.523, p>0.05). Similarly, the significance value of 0.472 is greater than 0.05 level of significance on which the hypothesis was stated. Therefore the null hypothesis of no significant difference was upheld.

III. Discussion Of The Results

The Effect of Multiple intelligence based-instructional techniques on Students’ Achievement in Difficult Biology Concepts.

Treatment effect (MIBIT) was a significant factor in students’ overall cognitive achievement in difficult biology concepts since F-cal 73.59 is greater than F-critical (3.92) at 1, 74 df, p<0.05. This is because the experimental group (MIBIT) mean 65.34 performed much better than the control group (lecture method), mean 44.00. Analysis of the results of the achievements tests shown on Tables 1 and 2 showed that the experimental group had higher achievement scores than the control group. The analysis of covariance of the post –test scores presented on Table 3 confirmed that the difference between the achievement mean scores of students in both groups in the post-test was significant. This significant difference is attributed to the treatment.

This finding indicates that the multiple intelligence-based instructional techniques have a positive effect on students' cognitive achievement in difficult biology concepts.

This finding shows that the multiple intelligence-based instructional techniques has positive effect on students' cognitive achievement is in line with that of Carver, Price and Wilken (2000); Geimer, Getz, Pochert and Pullam (2000); Janes, Koutsophanagos, Mason and Villaranda (2000); George, Mitofsky, and Peter (2001); who in their separate studies found that the adoption of the multiple intelligence theory as an instructional framework greatly improves students' academic achievement. This finding could be explained by the fact that the teachers' adoption of various instructional techniques appeal to the students' various intelligences, addressing their diverse learning styles and consequently increase their motivation to learn. In order words, giving students' opportunity to participate actively in the class by interacting freely with the teacher and their peers, learn in groups and assess their performances themselves improves their verbal-linguistic, logical-mathematical, interpersonal and intrapersonal intelligences as well as their self-esteem, enthusiasm and their willingness to take ownership and responsibility for their learning. These in turn lead to a considerable improvement in their cognitive achievement.

The Influence of Gender on Achievement

Although gender was not a significant factor in the students' overall cognitive achievement in difficult biology concepts studied since $F_{cal} 0.53$ was less than $F_{critical} (3.92)$, at 1.74 df $p < 0.05$, the male students with mean 67.94 out- performed their female counterparts (62.40)

The study has shown that gender was not a significant factor in the students' overall cognitive achievement in difficult biology concepts. Male students however, recorded greater mean achievement score than their female counterparts. This means that all the students benefitted equally irrespective of gender differences. In other words gender is not a strong determinant of students' academic achievement. The present findings was in line with Anaekwe's (1997), Ono's (2001); Iweka's (2006) and Ugwuadu's (2011) findings that there was no significant difference in science achievement between male and female students.

Contrary to the findings were the reports of Nworgu (2004) and Egbunonu (2011). While Nworgu's study showed a significant gender difference on students' achievement in favour of males.

IV. Conclusion

The study showed that MIBIT had significant effect on the students' overall achievement in difficult biology concepts. The experimental group taught with MIBIT had higher mean achievement score in the difficult biology units used in the study. Also, the influence of gender on the students' achievement in difficult biology concepts studied was not significant, although the male students tended to be superior to the female counterparts.

V. Recommendations

Based on the findings of this study, the following recommendations have been proffered:

1. The study recommended the need for curriculum developers to develop appropriate curriculum that will make provision for the teacher to adopt various activities that will appeal to each students' learning style or intelligence to enable them learn effectively.
2. Teachers, especially those teaching biology should always adopt the MIBIT, namely, active learning, collaborative learning, self -assessment, project based learning and authentic instruction which will enable them to cater for the diverse learning styles of students in their classroom and hence, improve their cognitive achievement and interest of learning difficult biology concepts.
3. Ministries of Education, both State and Federal should organize workshops and seminars and sponsor teachers to attend in service courses on how to improve their teaching skills using five MIBIT found by this study to be effective in promoting students' cognitive achievement and interest.
4. Biology teachers should pay attention to the issue of gender –related differences in the classroom. Such gender – related differences which are known not to be innate could be minimized if not eliminated through curricular restructuring or use of appropriate teaching techniques such as MIBIT.
5. Students should be serious to embrace this activity- oriented and student- centred approach which will enable them carry out independent or group work, such as assignment and project given to them by the biology teachers and also make their instructions authentic by relating what they have learnt to their personal experiences or real world situation.

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