East African Scholars Journal of Education, Humanities and Literature
Abbreviated Key Title: East African Scholars J Edu Humanit Lit
ISSN 2617-443X (Print) | ISSN 2617-7250 (Online) |
Published By East African Scholars Publisher, Kenya
OPEN ACCESS
Volume-2 | Issue-10 | Oct-2019 | DOI: 10.36349/EASJEHL.2019.v02i10.017

Research Article

Effect of Multiple Intelligence Instructional Strategy on Upper Basic Iii Science Students' Achievement in Radioactivity in Nasarawa State, Nigeria

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Abstract: This study investigated the effect of Multiple Intelligence (MI) instructional strategy on the achievement of upper basic III science students from Keffi Education Zone of Nasarawa State, Nigeria in Radioactivity. It adopted a non-randomized, pretest-posttest, control group quasi-experimental research design. The population of the study comprised 2,106 students from public coeducational schools in Keffi Education Zone. The sample for this study consists of 78 upper basic III science students drawn from two public coeducational schools in the Zone. Radioactivity Achievement Test (RAT) was used as instrument for data collection. The reliability of RAT after validation by experts was determined using K-R_{20} formula and the reliability coefficient obtained was 0.83. Pretest was administered to the two groups after which the experimental group was exposed to treatment for four weeks through MI strategy and the control group was taught with Discussion method for the same period of time. Post-test was later administered to the two groups after the treatment. Descriptive statistics of means and Standard Deviations were used to answer the two research questions raised while Analysis of Covariance (ANCOVA) was used to test the corresponding formulated hypotheses at 0.05 alpha level of significance. The findings of the study revealed that Multiple Intelligence instructional strategy had significant effect on upper basic III Science students' achievement in Radioactivity. Based on the findings of this study, it was recommended that; Basic Science teachers should adopt Multiple Intelligence instructional strategies for teaching Radioactivity as this will enable them to cater for the diverse learning styles of students in order to improve their cognitive achievement in the concepts. Students should also be encouraged to work collaboratively in order to improve their achievement in Radioactivity and possibly other Basic Science concepts.

Keywords: Achievement, Multiple Intelligence, Instructional Strategy and Radioactivity.

INTRODUCTION

Science education is a veritable instrument for social change which brings about socio-economic development and empowerment throughout the world. The application of scientific knowledge to real life problems is the most powerful instrument for enabling society to face global challenges and innovations in education. And it is the empowerment of students toward self-reliant and industrial skills that are needed for survival especially in this era of global economic crisis (Eze, 2010).

Basic Science education can do much to provide a sound foundation for later learning, as well as help students become comfortable with using science and scientific thinking in their daily lives, whether in a career or as consumers and citizens (Osokoya, 2013; Bukunola & Idowu, 2012; Oludipe, 2012). It has been discovered through research that Basic Science is the pivot upon which all other sciences and technology are built, It is often called 'the bedrock of Science' because it is the foundation on which all other sciences such as Biology, Physics, Chemistry, Astronomy, Geology and applied Sciences such as Medicine and Physiology are built upon (Kabutu, Oloyede & Bandele, 2015; Osokoya, 2013).

It is in realization of the importance of science education and Basic Science in particular as a bedrock for sustainable development in any nation that educators and researchers are highly challenged to discover more authentic pedagogical strategies that will enhance the teaching and learning of Basic Science and the development of students' overall potentials, also to assess and report students' achievement more appropriately (Bukunola & Idowu, 2012; Oludipe, 2012). There are many active learning methods that have been used in the Basic Science classrooms

Quick Response Code

Journal homepage:
http://www.easpublisher.com/easjehl/

Article History
Received: 13.09.2019
Accepted: 28.09.2019
Published: 15.10.2019

nowadays that are student centered such as; experimentation, discovery, concept-mapping and so on. Despite the utilization of these methods, students to a large extent still show sign of low skill acquisition and low concepts understanding (Kabutu, Oloyede & Bandele, 2015). This indicates that there are latent-potentials in students which these methods sometimes are not able to develop.

Multiple intelligence (MI) theory has been adopted in many settings (Ali, Soosan & Hamze, 2013) as one of the theories that guide teachers in improving their performance. MI serves as a framework that helps teachers design instruction and provide varied learning experiences tailored for each learner by fostering his/her preferences to improve overall performance. It challenges students to understand the world around them and create connections between their lives and their interests (Al-Nakhbi & Barza, 2016; Yalmanci & Gozum, 2013). Implementing Ml learning theory may also help to ensure effective implementation of inclusive instructional models because of how it involves integrating different strategies according to students' different learning styles and abilities (Ali, Soosan & Hamze, 2013).

Teachers' ability to meet all students' needs is an important factor in achieving high standards in education (Konstantinou-Katzi, Tsolaki, Meletiou-Mavrotheris & Koutselini, 2012). In order to meet the varying needs of all students and help them to meet up with the established standards, teachers must differentiate their instructions by adapting materials, instructional procedures, and means of assessment to suite the different learners. Teachers can modify the curriculum and maximize the learning opportunity for each student in the classroom (Hillier, 2011). In addition, giving students some choice can be a great motivation for students to participate and learn because it allows them to work in their own comfort zone.

Multiple Intelligence Theory

MI theory presents an alternative to the definition of intelligence as a single entity. Gardner (2006[a]) argues that the intelligence quotient (IQ), measures a narrow range of verbal/linguistic and logical/mathematical abilities and argues that the human cognitive architecture is not so limited. He holds that human intelligence can be divided into eight categories and that every person has a different level of development in each type of intelligence.

The Eight Intelligences Are:

Verbal/linguistic intelligence: The ability to use word effectively.
Logical/mathematical intelligence: The ability to use numbers effectively.
Visual/spatial intelligence: The ability to recognize visual works accurately.
Bodily/kinesthetic: The ability to use the body to express the ideas and feelings.
Musical Intelligence: The ability to recognize rhythm and express musical.
Interpersonal Intelligence: The ability to understand others feeling, motivations and intentions and reply effectively.
Intrapersonal Intelligence: The self-knowledge and the ability to adapt the actions depending on this knowledge.
Naturalist Intelligence: The ability to recognize the different species in the environment (Gardner, 1993).

Gardner's MI theory is based on the premise that everyone has specific and distinct intelligences (Gangi, 2011). MI instructional strategy recognizes that each student possesses these intelligences, but they are not always developed well or effectively. This technique asks the question in what ways are students smart? rather than, are they smart? Teachers can activate the less-pronounced intelligences in students by carefully diversifying the strategies. Child centred teaching, open-ended projects, cross-curricular activities, independent study, learning centre activities, multi model work, group projects, discovery learning are some of the techniques that embrace Gardner's theory of multiple intelligence teaching Al-Nakhbi & Barza, 2016; Ali, Soosan & Hamze, 2013).

Each element of intelligence is separate, and can combine with others to provide solutions to problems. Thus, for a teacher to employ the MI Theory, he first needs to identify the intelligences of his students (Gardner, 2006[a]). When the teachers recognize the student's intelligence, they will be able to tailor their teaching strategies to take those strengths into account. For example, a student with a powerful intrapersonal intelligence level will learn better alone and in a quiet environment, while a student with a strong interpersonal element will learn better in groups. So, students learn in different ways. The learning method that works best for one student may not work for another (Yalmanci & Gozum, 2013). Therefore, teachers should accommodate students' learning needs by incorporating varied teaching methods based on an assessment of students' MI. Science teachers may benefit from using MI strategies in such a way that each student would receive, understand, and interact with new information through his or her own capability. Scientific concepts become more meaningful to the student when teachers provide a variety of activities that tap into students' learning potential. Gangi (2011) observed that MI approach helps teachers to provide appropriate teaching strategies in diverse classrooms and support every learner by giving them the opportunity to learn and demonstrate their understanding by using their strengths.

Researchers (Samuel, 2019; Al-Nakhbi & Barza, 2016; Okoli, Akuezuilo & Okoli, 2015; Emendu

& Udogu, 2013; Ali, Soosan & Hamze, 2013; Yalmanci & Gozum, 2013) concluded that implementing MI strategies assisted teachers in creating more innovative lesson plans and in meeting student needs, which in turn led to higher academic achievement in Science as well as improvements in emotional well-being and that students taught using MI methods have better acquisition and retention of knowledge. They concluded that student levels of motivation and engagement increase when the environment is rightly adapted. Moreover, students taught using MI and project-based methods demonstrated increased creative thinking, problem solving, and academic risk taking.

Gender remains an important factor to be considered in the determination of students' academic achievement. Gender has been identified as a major factor that affects students' achievement in science and mathematics examinations and technological endeavors (Omiko, 2017). Oni (2014) posited that in Nigeria, women are marginalized while men are given greater opportunities to advance based on their science background and this factor has been found to offer males an unfair advantage over their female counterparts. Alabi (2014) reported that women are hindered from progressing through discrimination on the basis of gender, early marriage and child bearing and as a result, they are deprived sound education, job opportunities and incapacitated. They are rendered passive generally in the society. Some researchers (Oludipe, 2012; Kola & Taiwo, 2013) in their various studies have observed that there is no significant difference between male and female achievement while on the other hand, some (Onuekusi & Ogomaka, 2013; Amoo; 2013; Igoegwu & Okonkwo, 2012) found out that a significant difference did exist between the achievement of male and female students in favour of the male students. Nevertheless, there is no specific study on the effect of MI instructional strategies and gender on upper basic III Science students' achievement in Radioactivity in Nasarawa State; hence the need for this study.

Statement of the Problem

Despite efforts made through researches into the strategies that could improve achievement of students in Basic Science concepts, persisted students' underachievement in external examinations is reoccurring and this is attributed to some factors such as; students' weakness in comprehending Basic Science concepts, instructional approaches utilized by teachers, lack of manipulative skills by students, students' unreadiness and so on. There is therefore need to try new approaches in Basic Science teaching that will enhance students' achievement profile and promote cognitive acceleration that will guarantee productivity to face global challenges. The problem of this study therefore is; what is the effect of MI instructional strategy on upper basic III Science students' achievement in Radioactivity in Nasarawa State?

The purpose of this study was to determine the effect of MI instructional strategy on upper basic III students' achievement in Radioactivity in Nasarawa State, Nigeria. Specifically, the study sought to find out;

- the effect of MI instructional strategies on upper basic III science students' achievement in Radioactivity.
- the effect of MI instructional strategies on upper basic III male and female science students' achievement in Radioactivity.

Research Questions

The Following Research Questions Guided The Study;

- What are the mean achievement scores of upper basic III Science students taught Radioactivity using MI instructional strategy and those taught with Discussion method?
- What are the mean achievement scores of upper basic III male and female Science students taught Radioactivity using MI instructional strategy?

Hypotheses

H_{O1}: There is no significant difference between the mean achievement scores of upper Basic III Science students taught Radioactivity using MI instructional strategy and those taught using the Discussion method.

H_{O2}: There is no significant difference between the mean achievement scores of upper Basic III male and female Science students taught Radioactivity using MI instructional strategy.

METHODOLOGY

Research Design

This study adopted a non-randomized, pretest-posttest, control group quasi-experimental research 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 which were already organized.

Population, Sample and Sampling Techniques

The population of the study comprised 2,372 students made up of 1,345 males and 1,027 females from public coeducational schools in Keffi Education Zone. The sample for this study consists of 78 (45 males and 33 females) upper basic III students drawn from two public coeducational schools in the Zone. In each of the two sampled schools, one intact class each was randomly assigned to the experimental or control group through a flip coin. The head of the coin was assigned as the experimental group while the tail became the control group. 35 (19 males and16 females) students participated as the experimental group (Multiple Intelligence) and 43 (25 males and 18

females) students were involved in the control group (Discussion method).

Instrumentation

Radioactivity Achievement Test (RAT) was used as the only instrument for data collection. RAT was a 20 item instrument with options A – D that tested the students' knowledge, comprehension and application of some subtopics in Radioactivity. The items were allotted 1mark each making a total score of 20marks. The test was validated by three experts in Science Education from Nasarawa State University, Keffi. The validity index of 0.80 obtained implies that the instrument was valid, it was trial-tested and the reliability coefficient of 0.83 was obtained using K-R_{20} formula implying that the instrument was reliable.

Experimental Procedure

Before the commencement of the experiment, a two-week intensive training programme was organized for the research assistants who were the Basic Science teachers from the intact classes sampled. The experimental group teacher was enlightened on the multiple intelligence theory, the multiple intelligence lesson plans on Radioactivity; how to incorporate the multiple intelligence instructional strategy into the lessons and the general requirements of the research. The teacher for the control group was also briefed on the requirements of the research and the use of Discussion method and the lesson plans on Radioactivity. At the end of the training, the researcher organized a micro teaching session for the research assistants to ensure that they have mastery of instructions and materials.

A pretest test was administered one week prior to the experiment using RAT. The experimental group was taught using multiple intelligence instructional strategy 80 minutes once a week for four weeks. The instructional strategies addressed six multiple intelligences namely; verbal-linguistics, logical-mathematical, inter-personal, bodily-kinesthetic, visual-spatial and intra-personal intelligences. Elements of some innovative strategies such as Active learning, Problem-based learning, Self- Assessment and Authentic instruction were interwoven in the instructional package used for the experimental group as reflected on the lesson plans adopted by the research assistant. The experimental group was taught using charts. These visual aids that appeal to the sense of sight made the instruction authentic and addressed visual-spatial intelligence. The students were assigned different tasks which appeal to the sense of touch (bodily-kinesthetic). The students were also grouped in 'fives' and different sub-topics were assigned to them in order to enhance their critical thinking and skills. Finally, the students were allowed to evaluate themselves through self-assessment. The control group was taught using the Discussion method (as prescribed by the curriculum for teaching the concepts). A week after the experiment, a post-test (reshuffled RAT) was administered to the two groups. Data were collected and collated.

Data Analysis

Descriptive statistics of means and Standard Deviations were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance. The adoption of ANCOVA was to take care of error due to initial difference in the abilities of the participating students.

Result

Research Question one

What are the mean achievement scores of upper basic III Science students taught Radioactivity using MI instructional strategy and those taught with Discussion method?

Data to answer this research question is represented in Table 1.

Table 1Means Achievement Scores and Standard Deviations of Students in the Experimental and Control Groups Using RAT

Group	Type of test	No of students	X	SD	Mean Gain
Experimental (MI)	Pre-test	35	8.17	2.71	
	Post-test	35	20.43	4.51	12.26
Control (DM)	Pre-test	43	6.29	3.98	
	Post-test	43	15.77	4.01	9.48

Table 1 shows that the achievement mean gain score of the upper basic III science students exposed to Multiple Intelligence Instructional Strategy is 12.26 and those exposed to Discussion Method is 9.48. The standard deviations show that the groups' achievement scores were sparsely distributed around the mean.

Research Question Two

What are the mean achievement scores of upper basic III male and female Science students taught Radioactivity using MI instructional strategy?

Data to answer this research question is represented in Table 2.

Table 2 Means Achievement Scores and Standard Deviations of Male and Female Students in the Experimental and Control Groups Using RAT

Group	Gender	Type of test	No of Students	X	SD	Mean Gain
Experimental (MI)	Male	Pretest	19	6.53	2.11	12.35
		Posttest	19	18.88	4.51	
	Female	Pretest	16	5.78	2.74	10.51
		Posttest	16	16.29	4.21	
Control (EM)	Male	Pretest	25	6.01	2.15	8.54
		Posttest	25	14.55	3.02	
	Female	Pretest	18	5.22	2.61	8.65
		Posttest	18	13.87	2.87	

Table 2 shows that the achievement mean gain score of male students in the experimental group (MI) was 12.35 and that of the female was 10.51. The achievement mean gain scores of male and female students in the control group (DM) 8.54 and 8.65 respectively. The standard deviations show that the groups' achievement scores were sparsely distributed around the mean.

Hypothesis One

There is no significant difference between the mean achievement scores of upper basic III Science students taught Radioactivity using MI instructional Strategy and those taught using Discussion Method.

Data to test this hypothesis is represented in Table 3.

Table 3 Result of Analysis of Covariance on Students' Achievement in the Experimental and Control group.

Source	Type III Sum of squares	Df	Mean square	F	Sig.	Result
Corrected model	952.115	2	238.119	61.154	0.000	S
Intercept	326.127	1	326.127	27.121	0.001	S
Pretest	75.109	1	75.109	61.201	0.001	S
Group*	40.776	1	40.776	97.821	0.001	S
Error	135.019	73				
Total	1529.146	78				

Significant at P<0.05

From Table 3, $F_{(1,73)} = 97.821$, P = 0.001 < 0.05. This shows that there was a significant difference in the mean achievement scores of upper basic III Science students exposed to Multiple Instructional strategy and those exposed to Discussion Method. Therefore, the null hypothesis of no significant difference was rejected.

Hypothesis Two

There is no significant difference between the mean achievement scores of upper basic III male and female Science students taught Radioactivity using MI instructional strategies.

Data to test this hypothesis is represented in Table 4.

Table 4 Result of Analysis of Covariance on Male and Female Students Using RAT

Source	Type III Sum of squares	Df	Mean square	F	Sig.	Result
Corrected model	417.211	2	417.211	97.227	0.001	S
Intercept	278.167	1	278.167	62.910	0.002	S
Pretest	110.561	1	110.561	59.116	0.001	S
Gender*	87.217	1	87.217	198.007	0.001	S
Error	295.653	73				
Total	1303.264	78				

Significant at P<0.05

From Table 4, $F_{(1,73)} = 198.007$, P = 0.001 < 0.05. This shows that there was a significant difference in the mean achievement scores of male and female upper basic III Science students exposed to Multiple Intelligence instructional strategy. Hence, the male students achieved higher than their female counterparts. Therefore, the null hypothesis of no significant difference was rejected.

DISCUSSION

Finding of the study revealed a significant difference between the achievement of upper basic III students taught Radioactivity using Multiple

Intelligence instructional strategies and those taught using Discussion Method. This is in agreement with the findings of (Samuel, 2019; AL-Nakhbi & Barza, 2016; Yalmanci & Gozum, 2013; Emendu & Udogu, 2013; Ali, Soosan & Hamze, 2013; Okoli & Akuezuilo) who in their separate studies found that the adoption of the Multiple Intelligence instructional strategies greatly improves students' achievement. The reason for the improved achievement is because the teacher adopted various instructional approaches that appealed to the students' various intelligences, addressing their diverse learning styles and consequently increase their motivation to learn. Students were given opportunities to actively participate in the class by interacting freely with the teacher and their peers, learning in groups and assessing their performances themselves which improved their verbal-linguistic, logical-mathematical, interpersonal and intrapersonal intelligences, 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.

Finding of the study also shows that a significant difference exists in the achievement of male and female upper basic III students taught Radioactivity using Multiple Intelligence Instructional Strategy. This is contradictory to the findings of (Oludipe, 2012; Kola &Taiwo, 2013) who in their different studies found that there is no significant difference between male and female achievement. But in agreement to the findings of (Onuekusi & Ogomaka, 2013; Amoo, 2013; Igoegwu & Okonkwo, 2012) who in their different researches found out that a significant difference exist between the achievement of male and female students in favour of the male students. The reason could be that male students were more actively involved which increased their enthusiasm since greater autonomy for learners is associated with greater gains as compared to their female counterparts.

CONCLUSION

The findings of the study revealed that Multiple Intelligence instructional strategy had significant effect on upper basic III Science students' achievement in Radioactivity. The implication of the findings as emanated from Gardner's theory of Multiple Intelligence is that different kinds of abilities exist in the learners. Hence, teachers have the challenge of enriching their learners' lives by identifying, developing and celebrating their diverse attributes through well-structured instructions.

Recommendations

Based On the Findings of This Study, the Following Recommendations Were Made;

- Basic Science teachers should adopt Multiple Intelligence instructional strategies during instruction as this will enable them cater for the diverse learning styles of their students in order to improve their cognitive achievement in Radioactivity and possibly other Basic Science concepts.
- Students should be encouraged to work collaboratively as this which will help them to improve their achievement in Radioactivity.

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