COMPARATIVE EFFECTS OF CONCEPT MAPPING AND VEE MAPPING STRATEGIES ON STUDENTS' INTEREST IN BASIC SCIENCE AND TECHNOLOGY IN MAKURDI METROPOLIS, BENUE STATE

[1]Zam Juliana Afa, [2]Adejoh Musa James, [3]Jirgba, M. Christiana and [4]Atsuwe Bernard. A
[1-4]Department of Science Education, College of Agricultural and Science Education
Joseph Sarwuan Tarka Universty, Makurdi.
juliabam50@gmail.com, adejohmj@gmail.com and atsuwe.benard@uam.edu.ng

Abstract

This study compared the effects of Concept mapping and Vee mapping instructional strategies on Upper Basic students' interest in Basic Science and Technology. The study adopted quasi experimental pretest posttest non-randomized group design. The population of the study was 13872 Upper Basic II students from 26 Universal Basic Education (UBE) schools in Makurdi metropolis. A sample of 154 students was drawn from four UBE schools using multi-stage sampling procedure. The schools were randomly assigned to Experimental group I and Experimental group II of two classes each. Intact classes were maintained in all the schools. Lesson plans were prepared for both Experimental I and Experimental II groups respectively. To guide the study, three research questions were asked and answered using Mean and Standard Deviation while three hypotheses were formulated and tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). Data were collected using Basic Science and Technology Interest Inventory (BSTII). The reliability coefficient of BSTII was established using Cronbach Alpha and it yielded 0.79. Results revealed that students taught Basic science and Technology with both Concept mapping and Vee mapping instructional strategies improved in their mean interest ratings with students of Concept mapping performing higher than students of Vee mapping instructional strategy. Results also indicated that male students had higher mean interest ratings than their female counterparts. Based on the findings, it was recommended among others that teachers of Basic Science and Technology should make use of Concept mapping and Vee mapping instructional strategies especially Concept mapping instructional strategy during class room teaching and learning activities.

Key words: Comparative effects, Concept mapping, Vee mapping, Basic science and Technology and Interest.

Introduction

Science is defined by many authors in different ways. Science is viewed as knowledge of the world. It is the means through which the natural world or occurrences are understood. National Teachers Institution (2015) view science as an attempt by human beings to organize their experiences about nature into meaningful systems of explanations. Okeke (2017) perceived science as a systematic process of obtaining verifiable knowledge about nature and natural occurrences. Science therefore can

simply be defined as the study of our natural environment.

Natural environment refers to the total surrounding of the world that are largely divided into nations and countries. In the words of Adejoh and Ekele (2014), the development of any nation is dependent on the level and standard of science and technology practiced by that country. Nations all over the world Nigeria inclusive are striving hard to improve their science and technology. Even nations that have achieved the status of developed or civilized nations achieved it through deliberate and strategic efforts of improving their science and technology

Science education in addition to offering learning experiences in the core science subjects which enables the learners to experience the richness and excitement of the natural environment also provides the methodology for the transfer of these learning experiences to other learners. In view of the importance of science education, the National Policy on Education (F.R.N 2014) emphasis the teaching and learning of science and technology at all levels of education in Nigeria. At the basic education level the science that is taught and learnt is known as Basic Science and Technology.

Basic Science and Technology according to Nwafor and Aja (2017) is a subject that is devised and presented in such a way that learners gain the concept of the fundamental unity of science, the commonality of approach to solving problems of scientific nature and help learners to gain an understanding of the role and functions of science in everyday life and the world in which they live.

The relevance of Basic Science and Technology as a subject that builds a solid foundation for better future science learning cannot be over emphasized. Several efforts have been made to properly utilize the various components of the teaching and learning processes. The components of the teaching and learning process are the teacher, the learner, the materials and the methods of teaching. These efforts are made in terms of research in order to enhance better interest of students of Basic Science. For instance, Sambo, Kukwe, Mahmuda and Egarri (2014) did a comparative study of students' interest in Basic Science in Nasarawa state. The result of the study indicated that most students lost interest in Basic science as a result of the instructional strategies used by the Teachers among other factors. Nwosu and Ndanwu (2020) studied the interaction effects of gender and Concept mapping on students' interest Basic science. Result indicated no interaction effects on gender but interaction effects on teaching methods which means teaching methods infers with interest in Basic science. Ameyaw and Keyere (2019) conducted a study to compare the effect of concept and Vee mapping (CVM) and Concept Mapping (CM) and Vee Mapping (VM) on students' interest in studying photosynthesis. Results showed that CM and VM students had better interest rate than CVM. Government has also made efforts like the Sustainable Development Goals (S.D.Gs.) programs which are achievable policies that enhance effective teaching and learning Basic science, training and retraining of teachers through corporate institutions; yet the interest and subsequent achievement of Basic Science students have not reached the desired level

according to the Basic Education Certificate Examination Chief Examiners' report 2020. Efforts by Educational stakeholders towards improving the interest and subsequent achievement of students are centered on the teachers, whether it is about interpreting and implementing the curriculum or encouraging students to carry out activities that will enable them to achieve meaningful learning or the manipulation of resources and materials to create a conducive learning environment or determining the appropriate teaching strategy. With regards to teaching strategy, Adah (2016) states that a teaching method is a mode of organization of the instructional content, materials, manner of presentation to the learners and the activities that learners and teachers carry out. There are a number of methods of teaching which are available for the use of Basic Science teachers. These strategies are divided into two major groups; the traditional or teacher centered methods and the constructivist or students-centered method (Ajaja, 2017). Analysis of classroom activities shows that most of interactions in the classroom are likely to be taken up by teachers' talk whether giving instructions or directives, lecturing or correcting the learners. Research has revealed inappropriate teaching strategies as the major factor behind Basic Science students' persistent poor interest and achievement in the subject (Danjuma, 2015), Atadoga and Lakpini (2013) believe that the persistent lack of interest in Basic Science are attributed to instructional methods used by Basic Science teachers. This means that the instructional methods used by science teachers have a significance influence on the interest and subsequent achievement of students. This is why NERDC (2014) recommended child-centered instructional strategies for the teaching and learning of Basic Science and Technology.

Among the students-centered strategies also known as heuristic or constructivist strategies of teaching is concept mapping and Vee-mapping. Concept mapping is a teaching strategy that fosters understanding and enhances knowledge construction leading to the development of a good conceptual image in the mind of the learners. The strategy allows the teacher with the students to break down learning units into bits with linking words thereby creating a pictorial representation of what the students are to learn. Adeneye (2016) says that Concept Mapping (CM) is a teaching and learning strategy that establishes a bridge between how people acquire knowledge. Here, the learner needs to have sufficient knowledge and critical thinking to be able to connect what is mapped out in beats to be able to arrive at meaningful learning.

Closely related to Concept mapping instructional strategy is Vee-mapping instructional strategy. The instructional strategy is based on the philosophy that knowledge does not exist in a vacuum. It is a buildup of what is already known. Vee-mapping instructional strategy as defined by Ameyaw and Keyere (2019) is an instructional strategy for assisting learners to acquire knowledge explicitly. A Vee map is a visual means of relating the methodological aspect of an activity to the underlying conceptual component. Gaiya (2014) described Vee-mapping instructional strategy as an instructional strategy that enable learners to construct their own understanding of the knowledge claims and become acting

information processors. Meaningful learning implies that learners are able to relate concepts and prepositions that they already know. The Vee map therefore, aid learners in the linking process by acting as meta-cognitive tool that require students to make explicit connections between previously learnt information and newly acquired information. Calais (2019) believes that Vee-mapping strategy help learners to acquire knowledge explicitly thereby making them to become active information processors or generators.

Regardless of the instructional strategies employed by a teacher for instruction, there are other psychological conditions that determine the achievement of a learner. Prominent among these psychological traits is interest. Interest could be another reason why learners achieve below expectation. Interest as defined by Fosnot (2015) is a trait which deals with emotions. It guides the orientation that determines the vigor with which a learner tackles education. Interest is the feeling of intentness, concern or curiosity about something. Generally, interest is seen as the quality which arouse concern or curiosity that holds the learners' attention. Abakpa, Adeniran and Zam (2018) states that the degree and direction of interest of the learner determines the rate of achievement. This is because interest is a strong factor in learning Basic Science and technology. Adedipe (2015) affirms that regardless of the method of instruction employed, it is important that the Basic Science and Technology teacher arouse and sustain the interest of the learners. This results in the tendency to seek out and participate in activities of choice as against other activities. Instructional strategy when properly tailored is capable of arousing and sustaining the interest of the learners. If the instructional strategy does not suit the learners, they find it difficult to learn and even when they do, it is by rote memorization instead of internalizing the instruction which will enable them to achieve the higher level of learning which is problem-solving. This could cause the students to lose interest thereby making them to achieve low in Basic Science and Technology.

Gender is another relevant issue in the learning of science. Gender bias refers to the different treatment of individual based on gender. The treatment could be positive or negative and executed subtly. Interest of male and female students according to research has been yielding conflicting results. Some researchers found that male perform better in Basic Science than female (Ezerem, 2016; Adeyemi & Oladipo, 2018). While other researchers indicate that there is no difference in the interest among male and female Basic Science Students (Ajayi &Ogbeba, 2017, Ajayi, 2018). Hence, there is no clear direction with regards to whether male students have better interest ratings in Basic Science and Technology concepts than their female counterparts. Therefore, the current study sought to find out whether male and female students will improve equally through the use of Concept mapping and Vee mapping instructional strategies.

Statement of the Problem

Basic Science and Technology is the foundation of all sciences. It does not only make the learner scientifically literate but also forms the bedrock upon which all future science learning is built. However, the achievement of students in this subject has been found to be low in Basic Education

Certificate Examination (BECE 2019-2022) The low interest could be responsible for fewer numbers of students enrolling for higher science learning, even the ones that eventually find themselves in science classes may lack the solid foundation that is supposed to be built by Basic science and Technology to perform very well in science therefore making the students to lose interest in science consequently leading to poor achievement by the students.

In any teaching and learning process, the cardinal objective is to see that the learner is able to perform task and transfer the experience in solving problems in a new situation. This objective cannot be said to be fully achieved over the years. This may be connected to the strategy of teaching used by the Basic Science and Technology teachers, because a good learning is a product of a good strategy of teaching. Without good teaching strategy students may have seen Basic Science and Technology as abstract and a meaningless subject. It was in view of these that the present study sought to find out if students are taught with Concept and Vee mapping instructional strategies: it will improve their interest and in Basic science and Technology. Also, if male and female students will improve equally if taught using the strategies.

Purpose of the Study

The main objective of this study was to investigate the comparative effect of Concept mapping and Vee-mapping instructional strategies on the interest of students in Basic Science and Technology. Specifically, the study:

(i) Determined the interest ratings of students in Upper Basic II when taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies,

(ii) established the interest ratings of male students in Upper Basic II when taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies,

(iii) Ascertained the interest ratings of female students in Upper Basic II when taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies.

Research Questions

The following research questions guided the study;

(i) What are the mean interest ratings of Upper Basic II students taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies?

(ii) What are the mean interest ratings of male students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional Strategies?

(iii) What are the mean interest ratings of female students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies?

Hypotheses

The following hypotheses were formulated and tested at 0.05% level of significance.

(i) There is no significant difference in the mean interest ratings of Upper Basic II students taught Basic Science and Technology with Concept Mapping and Vee-Mapping instructional strategies.

(ii) There is no significant difference in the mean interest ratings of male students

in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies.

(iii) There is no significant difference in the mean interest ratings of female students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies.

Methodology

The design for this study was quasi-experimental, pre-test, post-test, non-randomized group design. The design is deemed fit because the subjects of the research were not randomized as in true experiments, but the subjects were used in intact classes in order to avoid disrupting the normal class activities. However, the classes were assigned into experimental group I and experimental group II. The target population of this study is all the 13872 (State Universal Basic Education Board, 2023) Upper Basic II students in Makurdi metropolis.

A sample of 154 upper Basic II students was used for this study comprising two groups, the experimental group I and the experimental group II using multi stage sampling techniques. The instrument use for data collection was Basic Science and Technology Interest Inventory (BSTII) and lesson plans developed by the researcher and validated by experts. A total of 40 Basic science students of UBE JSS Yaikyor were used. The reliability coefficient of BSTII was established at 0.79 using Cronbach alpha. Data was collected by the research assistants who being already teachers were trained on the use of Concept Mapping and Vee Mapping instructional strategies for one week. Pretest was administered before the treatment. After four weeks of treatment, a post test was administered. Both groups were treated separately. Mean and standard deviation were used to answer research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. ANCOVA was used to control the initial differences that may exist among the subjects of the study.

Results

Research Question One

What are the mean interest ratings of Upper Basic II students taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies?

Table 1: Means and Standard Deviation of Interest Ratings of Upper Basic II Students taught Basic Science and Technology with Concept Mapping and Vee Mapping Instructional Strategies

Groups	N	Pre-test $\overline{X}$	S.D	Post-test $\overline{X}$	S.D	Mean gain
Concept mapping	78	2.25	0.28	3.29	0.31	1.04
Vee Mapping	76	2.30	0.20	3.06	0.36	0.76
Mean diff.		-0.05		0.23		0.28
Total	154					

Table 1 shows that the mean and standard deviation for students taught using concept mapping strategy are 2.25 and 0.28 in the pretest, while that for the posttest is 3.29 and 0.31 respectively. However, the mean and standard deviation for the Vee mapping instructional strategy are 2.30 and 0.20 in the pretest, while that for the posttest is 3.06 and 0.36 respectively. Again, the mean gain for Concept mapping and Vee mapping are 1.04 and 0.76 respectively. The mean difference is 0.28 in favor of the concept mapping group. This indicates that the student in the Concept mapping showed more interest than those exposed to Vee mapping.

Research Question Two

What are the mean interest ratings of male students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies?

Table 2: Means and Standard Deviations of Interest Ratings of Male Students in Upper Basic II Taught Basic Science and Technology with Concept Mapping and Vee Mapping Instructional Strategies

Gender	N	Pre-test $\overline{X}$	S.D	Post-test $\overline{X}$	S.D	Mean gain
Male	39	2.17	0.31	3.37	0.24	1.19
Male	39	2.32	0.29	3.22	0.31	0.90
Mean diff.		-0.15		0.15		0.29
Total	78					

From Table 2, the mean and standard deviation for Concept mapping instructional strategy are 2.17 and 0.31 in the pretest, while that for the posttest is 3.37 and 0.24 respectively. However, the mean and standard deviation for the Vee mapping instructional strategy are 2.32 and 0.29 in the pretest, while that for the posttest is 3.22 and 0.31 respectively. Again, the mean gain for Concept mapping and Vee mapping are 1.19 and 0.90 respectively. The mean difference however, is 0.29 in favour of the concept mapping group. This indicates that student taught using Concept mapping showed more interest than those taught using Vee mapping.

Research Question Three

What are the mean interest ratings of female students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies?

Table 3: Means and Standard Deviations of Interest Ratings of Female Students Taught Basic Science and Technology with Concept Mapping and Vee Mapping Instructional Strategies

Gender	N	Pre-test $\overline{X}$	S.D	Post-test $\overline{X}$	S.D	Mean gain
Female	39	2.27	0.20	3.20	0.30	0.93
Female	37	2.34	0.21	2.91	0.35	0.56
Mean diff.		-0.07		0.29		0.37
Total	76					

From Table 3, the mean and standard deviation for Concept mapping instructional strategy are 2.27 and 0.20 in the pretest, while that for the posttest is 3.20 and 0.30 respectively. However, the mean and standard deviation for the Vee mapping instructional strategy are 2.34 and 0.21 in the pretest, while that for the posttest is 2.91 and 0.35 respectively. Also, the mean gain for Concept mapping and Vee mapping are 0.93 and 0.56 respectively. The mean difference however, is 0.37 in favour of the concept mapping group. This indicates that the student in the Concept mapping showed more interest than that of the Vee mapping.

Hypothesis One

There is no significant difference in the mean interest ratings of Upper Basic II students taught Basic Science and Technology with Concept mapping and Vee-mapping instructional strategies.

Table 4: Results of Analysis of Covariance (ANCOVA) on Interest Ratings of Upper Basic II Students Taught Basic Science and Technology with Concept Mapping and Vee mapping Instructional Strategies

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	885.071[a]	2	442.536	10.132	0.000	0.118
Intercept	6235.880	1	6235.880	142.769	0.000	0.486
PREVMCMINTER	38.871	1	38.871	0.890	0.347	0.006
GROUPINTEREST	**876.015**	**1**	**876.015**	**20.056**	**0.000**	**0.117**
Error	6595.370	151	43.678			
Total	628828	154				
Corrected Total	7480.440	153				

Table 4 shows that F (1,151)=20.056**;** P=0.000<0.05. This significant value is less than the alpha value of 0.05 level of significance. Hence, the null hypothesis was

rejected and this implies that there is a significant difference in the mean interest ratings scores of Upper Basic II students taught Basic Science and Technology with Concept mapping and Vee-mapping instructional strategies.

Hypothesis Two

There is no significant difference in the mean interest ratings of male students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies.

Table 5: Results of Analysis of Covariance (ANCOVA) of Interest Ratings of Male Students in Upper Basic II Taught Basic Science and Technology with Concept Mapping and Vee Mapping Instructional Strategies

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	220.096[a]	2	110.048	2.606	.050	.077
Intercept	3887.644	1	3887.644	174.816	.000	.595
PRECMINTR	56.390	1	56.390	4.582	.210	.021
GENDER	**205.127**	**1**	**205.127**	**1.569**	**.018**	**.072**
Error	2640.738	75	35.210			
Total	340915.000	78				
Corrected Total	2860.833	77				

Table 5 indicated that F (1,75) = 1.569; p= 0,018<0.05. This significant value is less than the alpha value of 0, 05 level of significance. This means the null hypothesis was rejected. This implies that there was a significant difference in the interest ratings scores of male students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies.

Hypothesis Three

There is no significant difference in the mean interest ratings of female students in Upper Basic II taught Basic Science and Technology with Concept mapping and Vee mapping instructional strategies.

Table 6: Analysis of Covariance of Mean Achievement of Female Students Taught Basic Science and Technology with Concept Mapping and Vee Mapping Instructional Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	746.594[a]	2	373.297	9.003	0.000	0.198
Intercept	1324.180	1	1324.180	31.936	0.000	0.304
PREVMINTR	105.187	1	105.187	2.537	0.116	0.034
GENDER	**718.586**	**1**	**718.586**	**17.331**	**0.000**	**0.192**
Error	3026.810	73	41.463			
Total	287913	76				
Corrected Total	3773.410	75				

Table 6 indicates that F (1, 73) = 17,331; p = 0.000<0.05. This significant value was less than the alpha value of 0.05 level of significance. Hence the null hypothesis was rejected. This implies that there was a significant difference in the mean interest ratings scores of female students in Upper Basic II taught Basic Science and Technology with Concept mapping and those taught with Vee mapping instructional strategies.

Discussion of Findings

The findings revealed that there was a significant difference in the mean interest ratings of the students taught with the two strategies and this led to the rejection of the null hypothesis. At post-test, the mean interest ratings of students taught Basic Science and Technology with CMIS was 65.83, while those taught using VMIS had a mean interest ratings score of 61.14. This result was further supported by test of hypothesis which shows a significant difference in the mean interest ratings scores of the groups (Tables 1 and 4). This means that both instructional strategies were significant in enhancing students' interest but CMIS was better. This result is in agreement with that of Sambo *et al.* (2014), Nwosu and Ndanwo (2020) and Ameyaw and Keyere (2019) whose separate studies found out that students' interest in Basic Science could be improved through appropriate instructional strategy. The findings are similar because they all agree to the importance of instructional strategy in enhancing students' interest.

The findings of this study show a significant difference in the mean interest ratings of male students taught Basic Science and Technology with CMIS and those taught with VMIS in favor of male students in CMIS students (Tables 2&5). This finding is not in line with Abakpa, Adeniran & Zam (2018) and Calais (2019) whose findings indicated that male VMIS students improved better than the male CMIS students. Also, the findings are at variance with Adeyemi and Oladipo (2016), Gaiya (2014) who found gender difference in the interest ratings of students of concept mapping and vee mapping instructional strategies. This could be that CMIS has better structures that appeal more to the interest of the students

The result of this study also shows that there is a significant difference in the mean interest ratings of female students taught Basic Science and Technology with CMIS and those taught with VMIS in favor of female CMIS students (Tables 3 & 6). This shows that female CMIS students had higher interest than their female in VMIS. The difference was significant thereby contradicting null Hypothesis 3. This finding does not agree with Nwafor and Aja (2017) who found no difference in the mean interest ratings of female students in CMIS and VMIS. The finding agrees with Ajayi and Ogbeba (2017) and Ajayi (2018) whose findings indicated that female CMIS students had better interest ratings than their female VMIS counterparts in Basic Science and Technology. The agreement in finding could be due to CMIS innate capacity to arouse and sustain students' interest in Basic science and Technology.

Conclusion

Based on the findings of this study, it is concluded that the use of Concept mapping and Vee mapping instructional strategies enhance students' interest with Concept mapping enhancing better interest in students. With

regards to gender, male CMIS students had higher interest rate. This implies that if Basic Science and Technology teachers use Concept mapping and Vee-mapping instructional strategies, they will enhance students' interest in Basic Science and Technology. In the same way, enhanced interest in Basic Science and Technology is capable of enhancing higher achievements by students. This in turn will solve the problem of students' low achievement in Basic Science and Technology.

Recommendations

Based on the findings of the study, the following recommendations were made**;**

I. Teachers of Basic Science and Technology should use concept mapping and vee-mapping instructional strategies during classroom activities to improve students' interest.

II. Teacher training institutions should prepare teachers in training with innovative teaching strategies especially Concept mapping and Vee-mapping instructional strategies to enable them use the strategies appropriately.

III. Educational stakeholders and professional bodies should organize workshops, refresher courses, seminars to update teachers in service on trends about innovative approaches to teaching like Concept mapping and Vee mapping instructional strategies among others.

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