KIU Journal of Humanities Copyright©2020
Kampala International University ISSN: *2415-0843*; 5(2): 223–235

Effects of Pictorial Organizer on Basic Science and Technology Perceived Difficult Concepts and Students' Achievement in Plateau State, Nigeria

SONIA ISHAKU LONGYIL
College of Education Gindiri, Plateau State, Nigeria

FELICIA O. AGBO
University of Jos, Nigeria

Abstract. The study adopted Survey and Quasi-experimental research designs, particularly the non-randomized pre-test post-test control group were used to investigate the effects of pictorial organizer on Basic science and Technology perceived difficult concepts and students' achievement in Plateau State. The population of the study comprised of 1,327 Junior secondary three in the study area. A sample of 162 Junior secondary three student from two public secondary school in Mangu local Government area of Plateau State were selected using simple random sampling technique. Two research questions and four hypotheses were used. Basic Science and Technology Meaningful Learning Test (BSTMLT) and Basic Science and Technology Achievement Test (BSTAT) were used as instruments for data collection with three (3) essay, one practical question and twenty (20) items and multiple choice items respectively developed by the researchers and were validated by experts. The respective reliability co-efficient values of .738 and .913 were computed using Kuder-Richardson formula 20. The data collected for the study were analysed using Spss version 24.0 through The method of simple percentage, mean, standard Deviation to answer the research questions. While t-test of Independent sample was used in testing the hypotheses at 0.05 level of significance. The results of the study showed that pictorial organizer had positive effects on junior secondary three (3) Basic science and Technology students perceived difficult concepts achievement mean scores than those taught with conventional teaching method. On the investigation on gender and school location, there was no significant difference in the achievement of male and female, urban and rural schools using pictorial organizer. This is to say that pictorial organizer has no influence on gender and school location of Basic science and Technology students' perceived difficult concept achievement. It was recommended among other recommendations that Pictorial organizer learning strategy can be used for the teaching of Basic science and Technology to enhance high achievement in both female, male, rural and urban areas.

Keywords: Basic science and Technology, Difficulty concepts, pictorial organizer and Students academic achievement

1. Introduction

Education in the formal sense refers to designs, strategies and processes intended to nurture and develop individuals in the society. This form of education is organised and practicalised within specialised institutions recognised for it. It is a process of imparting knowledge, skills and values to individuals for optimal performance and survival in the society. Nwokeocha (2012) and Obot (2015) defined education as a process that begins at birth and last till the moment of death. They also viewed education as the transmission of culture which each generation gives to the would-be successors in a meaningful structured processes, to assist them by developing in them the necessary skills for positive living in the society. This education could be in different field learning including science.

Basic science and Technology is the aspect of science a child comes across at the primary and junior secondary school level. Basic science prepares students at the junior secondary school level for the

study of core science subjects (physics, chemistry and biology) at the senior secondary level (Dawal 2015). This implies that for a student to be able to study science subjects at the senior secondary school level successfully, such a student has to be well grounded in Basic Science and Technology at the junior secondary school level. In view of this, Basic Science and Technology is given great emphasis in the Junior Secondary School curriculum. The major reasons why the Nigerian government introduced Basic science and Technology teaching in Nigerian secondary school are as follows: It provides students at the junior secondary school level a sound basis for continuing science education either in single science subjects or further integrated science; It enhances the scientific literary of the citizenry; It allows students to understand their environment in its totality rather than in fragments; It allows students to have a general view of the world of science; It serves as a unifying factor for the various science subjects. It is necessary for the learner to know these processes through the Integrated approach of learning science (FRN, 2014). For any nation to develop technologically, it should be able to effectively apply scientific knowledge and its principles in areas like health, agriculture, transportation, material and energy production, industry and communication in order to improve the quality of life of its people (Ikpenwa, 2005). This can be achieved by ensuring that primary school pupils and junior secondary one to three (JSI-JSIII) Basic science and Technology students are properly taught the basic scientific skills which include observation, communication, classification, measurement, inference, prediction, interpretation of data, experimentation, hypothesizing and formulation of models in science and technology. This will enable them live effectively within the global community.

Science is the systematic study of nature, organise body of knowledge in form of concepts, laws, theories and generalisation. It provides the basis for technological and industrial advancement which are both concerned with findings, workable solutions to practical human problems. Science generates knowledge by means of new discoveries that are often met with disbelief at first, but such knowledge eventually becomes widespread and common. Every school-age child knows the earth revolves around the Sun although this knowledge was rejected when it was first discovered. Most people have a basic understanding of natural processes such as how moisture evaporates then condenses and falls as rain or how oxygen travels through the body in the bloodstream. Science is the reason for the ever-increasing understanding that people have about the world around them.

Technology allows children and teenagers to be creative while also developing new skills and grasping an understanding of how things work. Technology education can provide students with a wealth of information and knowledge which they can use in the future to pursue a related career or simply as a subject of interest and intrigue. Technology is an increasingly significant part of the society children are growing up in today, so it is only natural that they should learn about the appliances and systems they rely on, on a daily basis. Technology like science, also inspires students to think and form questions based on what they see and learn; this will arouse learner's interest to gain further knowledge and understanding which they will then be able to pass on to others. Technology is an increasingly important aspect of modern school life and has dramatically changed the way teachers and students go about their daily activities.

Basic science and Technology curriculum can be delivered to bring about the desired development and its sustainability. However, the major challenges facing Basic science and Technology is the implementation of its curriculum due to poor monitoring and evaluation. Some topics covered in the Basic science and Technology curriculum in junior secondary three(JSIII) syllabus are: family traits, deforestation, desertification, erosion, bush burning, drug and drug abuse, body metabolism, sense organs, depletion of the ozone layer and its effects, reproductive health, non-living things: Elements, compounds and mixtures, resources from living-things, resources from non-living things: Soil and solid minerals, skill acquisition, the right and wrong application and implication of science and development, light energy, sound energy, magnetism, acids, base, salts and the ph scale to mention but a few. (Longyil 2018)

Pictorial organizer is a visual representation, a mind map or a pictograph. It may be in the form of charts, a map or a diagram. It engages learners with a combination of words and printed diagram and provides a visual aid to facilitate learning and instruction. Pictorial organizers form a powerful visual picture of information and allow the mind 'to see' undiscovered patterns and relationship between ideas (Nakiboglu, Kasmer, Gultekin & Donmez, 2010)

Pictorial organizers are used to develop higher order thinking skills as they encourage the use of critical thinking skills such as analysing abstract concepts while developing comprehension and expanding connections among ideas. Pictorial organizers are

also used to aid in organization and recall of information by organizing information visually student are able to recall it more readily. Memory of vocabulary words and content knowledge are equally enhanced by the use of pictorial organizers. Furthermore, the use of pictorial organizers is to promote autonomy. Pictorial organizers provide students with a means of breaking down procedures such as the writing process, into achievable steps, this motivates students to manage their own learning. Therefore, pictorial organizers can be used to teach difficult concepts perceived by JSIII Basic Science and Technology students for better achievement on the topics (Gil, Garcia and Joaquin,2003).

The word difficulty entails a situation where a learner is unable to comprehend the concepts to be taught, hence not being able to provide a conceptual understanding and meaning(meaningful) of the concepts in question. Difficulty arises when concepts in Basic Science and Technology demands a higher order of thinking that requires quantitative and qualitative analysis of the concept. Longyil (2018)

Evidence has shown that students in the sciences have difficulty in understanding some scientific concepts, this probably has contributed to poor performance in different categories of tests and examinations. Several reasons have also been found to be responsible for this. For example, Gongden, Gongden and Lohdip (2011) agreed that teacher and students' characteristics, examination pattern and science equipment were responsible for the poor performance of students in chemistry. It has also been observed that students' poor performance maybe due to difficulty in learning and perfecting the content and applying these when they are under examination condition. Gongden, Gongden and Lohdip (2011) furthermore, revealed that students' understanding of difficult concepts in the sciences in secondary schools, be due to lack of instructional materials which the students can see, touch, smell and hear in the process of learning (Tukur,2012). This implies that teaching is focused only on the traditional chalk and talk which leaves the student as passive recipients (Bakalyil, Danpe, Mark and Rinmark, 2008).

Related argument put forward by Behar and Polat (2007) concerns the many terms and symbols used in the teaching of various science concepts. Many such terms are new to the students and so cannot be linked to their cognitive structures which, according to Behar and Polat, may also cause information overload in the working memory. In addition, some terms are known by students, but in a different context and with a different meaning to that used in science. An example is the concept of 'work', confusion may result which adds to the perception of difficulty of the area of content.

Teachers therefore, should use different teaching strategies in teaching the students and the students should be allowed to source information themselves in terms of assignment and be involved in group discussion and micro teaching. These will make them to understand difficult concepts better Longyil (2018).

Academic achievements of a student in a particular subject or course is determined by short or long term goals acquired. According to Oxford Advanced Learners' Dictionary, to achieve means "to succeed in reaching a particular goal, status or standard especially by an effort for a long time". Achievement in Basic science and Technology goes to emphasize the effort or skills put in to acquire or achieve success.

Academic achievement may also be defined as the assessment outcome of a formal instruction in a cognitive domain within a defined subject matter that is explicitly taught (Ebel, 2009). The emphasis here is that academic achievement does not cover such domains as creativity, motivation or ethical sense. Learning achievement is the result or level of ability that has been achieved by students after attending a teaching- learning process within a certain time in the form of changes in behaviour, skills and knowledge and which is then measured, assessed and realised in numbers or statement. According to Cronbach (2001), the academic achievement of students in a normal classroom is not always the same. Some students perform very well and are regarded as high achievers, some averagely and are regarded as middle achievers while others perform very poorly and are known as low achievers. It has been correctly observed that no two individuals are exactly alike in their overall characteristics.

The concept of 'gender' could be discussed in terms of masculinity and feminity observed in an individual but the physical character of an individual may not be expressed psychologically or emotionally. For instance, careers or subjects that are feminine in nature such as catering are also practiced by boys while girls are studying Engineering and carpentry which was exclusive to boys previously Longyil (2018).

Some teachers are of the view that girls are intellectually incapable of competing with boys in science and mathematics as well as other difficult

tasks (Joseph, 2000). Some parents also discourage their girls from science and technology base careers saying that females who take up such careers may not be capable of managing their marital homes (Ifamuyiwa, 2003). The girls themselves feel discouraged by the attitude of teachers and parents and often suffer from low or conflicting self-esteem.

Studies such as Longyil (2010) have documented disparities in the learning of boys and girls in integrated science. The traditional idea that girls belong to the home and are to be trained for domestic activities, marriage and motherhood. While boys are to look outside for more challenging situations is not completely eradicated from the society despite advancement in literacy. This unfortunate situation prompted calls for a re-examination of current instructional approaches that will also provide equal learning opportunities for both male and female students and make for the intended change. The need to provide an empirical basis for those views necessitated the current study which experimented with pictorial organizer strategy teaching approach.The persistent poor achievement of students in science generally makes it imperative to keep searching for better teaching strategies for effective teaching and learning of scientific concepts especially at the junior secondary school level where the foundation is laid. Research reports by Inyang and Ekpenyong, (2000) Duguryil, (2004) Nwachukwu and Nwosu (2007) have revealed that the performance of graduates of Basic Science and Technology over the years leaves much to be desired in terms of their achievements in Basic Education and Certificate Examinations. Researchers and educators have used various teaching strategies such as demonstration, activity-based teaching, field trip methods in teaching Basic Science and technology, yet schools have continually graduated students with results that are not encouraging in the subject.

The need for more efficient approaches in teaching science subject like Basic Science and Technology has been the concern of many researchers. However, there is little or no proof that researchers of this type have been carried out in Mangu Local Government Area of Plateau state, hence the need for this study.

1.2 Research Questions

The study was guided by the following research questions:

- What are the topics in JSIII Basic Science and technology perceived by students to be difficult?
- Where are the pre-test and post-test achievement mean scores of the experimental and control groups in BSTMLT?

1.3 Hypotheses

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

- There is no significant difference between the pre-test achievement mean scores of the experimental and control groups in BSTMLT.
- There is no significant difference between the post-test achievement mean scores of the experimental and control groups in BSTMLT.
- There is no significant interaction effect of gender on the achievement of post-test mean scores of students taught using pictorial organizers on school location.

2. Methodology

The study adopted survey and quasi-experimental, non-equivalent pre-test post-test control group research designs. Survey design was adopted in this research study as a preliminary investigation to identify topics in Basic Science and Technology with concepts perceived by JSIII students as difficult in Mangu Local Government Area. Quasi-experimental is a design where researcher uses intact class and does not always try to provide full experimental and control group through randomization (Emaikwu, 2015). The experimental group was taught using pictorial organizers, while the control group used the conventional lecture method to investigate the effects of pictorial organizers on Basic science and Technology perceived difficult concepts and student achievement. The population of the study is all the junior secondary schools three [J S 3] Basic science and technology students in Mangu local government area of plateau state which is 1,327. One hundred and sixty-two [162] junior secondary three basic science and technology students out of which eighty- two form the sample for the experimental group and eighty formed the control group. The experimental group for school A was made up of twenty- one males and twenty-two females, while the experimental group for school B was made up of nineteen males and twenty females. The control group for school A was made up of twenty- four males and fifteen females, while the control group for school B was made up of twenty- two males and nineteen females [see table 1].

Table 1: Distribution of Students in Two Sampled Schools for the Study Based on Gender in Mangu LGA of Plateau Central Educational Zone. Two Arms Were Used Each in the Selected Schools

S/No	Name of School	Gender		Total	Grand Total
		Boys	Girls	Sample Size	
1.	School A				
	Experimental group	21	22	43	
	Control group	24	15	39	
	Total	45	37	82	82
2.	School B				
	Experimental group	19	20	39	
	Control group	22	19	41	
	Total	41	39	80	80
	Grand Total	**86**	**76**		**162**

Basic Science and Technology Meaningful Learning Test [BSTMLT] and Basic Science and Technology Achievement Test [BSTAT] Which were developed by the researcher and validated by experts with reliability coefficient of 0.738 and 0.913 were used to test the instruments respectively using Kuder-Richardson K-R formula 20. The instruments were objectives questions with 40 multiple choice of two, four and five options A,B A,B,C and D and A,B,C,D, and E. 4 essay questions to answer any two and one practical question to answer. Two research questions and three null hypotheses tested at 0.05 level of significance guided the study. Data collected was analysed using mean and standard deviations to answer the research questions while T-test and Analysis of Covariance [ANCOVA] were used in testing the hypothesis. T-test and ANCOVA were used in this study to test for continuous or ordinal data, random sample data, normality of data distributed in bell shape, adequacy of sampled size, homogeneity of variance and normality, homogeneity of variance random in dependent samples, relationship between dependent variables [Y] and covariates [X] and also to test the significant differences or control the initial differences between groups with the pre- test serving as covariates respectively. Result revealed that student taught using pictorial organizers achieved better than those taught the conventional teaching method of J S 3 basic science and technology students in Mangu Local Government Area of Plateau State, it also shows that the achievement of students taught using pictorial organizers approach is not in any manner affected by their gender and school location.

The BSTMLT mean score of students were subjected to a two-way Analysis of Covariance (ANCOVA) having two levels of gender (male, Female) and two levels of school location (urban, rural). The main effect of gender yielded male ($\bar{x}$=51.00; SD =17.45) ($\bar{x}$=51.33; SD =17.31), F(1,81)=1.49, p>0.05. This indicates that BSTMLT mean score of the male did not significantly differ from that of female; meaning that the interaction effect of male and female was statistically insignificant.

Also the main effect of school location revealed that urban ($\bar{x}$=51.25; SD=16.74), rural ($\bar{x}$=50.91, SD=18.53), F (1,81)= .984, p>0.05 since p-value (.287) is greater than 0.05 level of significance. The null hypothesis was accepted in dictating that there was no statistically significant interaction effect of school location and gender which means that the mean scores of urban school students in BSTMLT was not significantly different from that of rural schools.

The BSTAT mean score of students was also subjected to a two-way analysis of covariance (ANCOVA). The main effect of gender yielded male ($\bar{x}$= 42.54; SD= 16.18), female ($\bar{x}$= 43.50; SD=14.99), F (1,81)= 2.465, p>0.05. since p-value (.551) was greater than 0.05, this indicates that BSTAT mean scores of the male did not significantly differ from that of female, meaning that the interaction effect of male and female was significantly insignificant.

Also the main effect of school location revealed that urban ($\bar{x}$= 40.77; SD= 15.73), rural ($\bar{x}$=46.73; SD=14.76), F(1,81)=1.854, p>0.05. since the p-value (.177) was greater than 0.05 level of significance, the null hypothesis was accepted indicating that there was no statistically significant interaction effect of school location and gender which means that the mean scores of urban school students in students' BSTAT was not significantly different from that of rural schools.

3. Results

From Table 2(a), 57(38%) of the students strongly agreed that topics under the depletion of the ozone layer such as location of the ozone layer, hazards of

the depletion of the ozone layer to life on earth are very difficult to learn. 43(28.67%) of the students agreed that the topics are very difficult to learn. 37(24.67%) of the students disagreed that the topics are not very difficult to learn. And 13(8.67%) of the students strongly disagreed that the topics are not very difficult to learn. It means that 100(66.67%) students agreed that the topics are very difficult to learn. While, 50(33.34%) students disagreed that the topics are not very difficult to learn.

For the right and wrong application and implications of science and development, 60(40.00%) of the students strongly agreed that the topic was very difficult to learn. 55(36.67%) of the students agreed that the topic is very difficult to learn. 20(13.33%) of the students disagreed that the topic is not very difficult to learn. 15(10.00%) of the students strongly disagreed that the topic is not very difficult to learn. So, 115(76.67%) of the students agreed that the topic is very difficult to learn while 35(23.33%) of the students disagreed that the topic is not difficult to learn.

For sound energy, 59(39.33%) students strongly agreed that the topic is difficult to learn. 41(27.33%) students agreed that the topic is difficult to learn. 35(23.33%) students disagreed that the topic is not difficult to learn. 15(10.00%) students strongly disagreed that the topic is not very difficult to learn.

For Magnetism, 60(40.00%) of the students strongly agreed that the topic is very difficult to learn. 45(30.00%) students agreed that the topic is very difficult to learn. 22(14.67%) disagreed that the topic is not very difficult to learn. 23(15.33%) students strongly disagree that the topic is not very difficult to learn. So, 105(70.00%) students agreed that the topic is very difficult to learn while 45(30.00%) students disagreed that the topic is not very difficult to learn.

For Acid, Base, Salt and pH scale, 70(46.67%) students strongly agreed that the topic is very difficult to learn. 40(26.67%) agreed that the topic is very difficult to learn. 20(13.33%) students disagreed that the topic is not very difficult to learn and 20(13.33%) students strongly disagreed that the topic is not very difficult to learn. 110(73.33%) students agreed that the topic is very difficult to learn while, 40(26.67%) students disagreed that the topic is not very difficult to learn. From Table 2(a), the remaining topics in the JSIII basic science and technology syllabus were not perceived difficult by the students.

Table 2(a): Topics perceived to be difficult by JS III students under the abstract nature in the syllabus of Basic Science and Technology

S/No	Topic(s)	SA	A	D	SD	Decision
1.	Family traits (Genetics)	37	13	57	43	Disagreed
2.	Soil erosion	20	14	50	66	Disagreed
3.	Flooding	11	22	54	63	Disagreed
4.	Bush burning	30	25	48	47	Disagreed
5.	Deforestation	15	35	55	55	Disagreed
6.	Desertification	10	20	58	62	Disagree
7.	Depletion of the ozone layer and its effect	57	43	37	13	Agreed
8.	Drug abuse	25	15	54	56	Disagreed
9.	Metabolism in the human body	30	25	50	45	Disagreed
10.	Sense organs	36	24	40	50	Disagreed
11.	Reproductive health	28	32	45	45	Disagreed
12.	Non-living things: element, compounds and mixtures	11	15	60	64	Disagreed
13.	Resources from living things	20	25	40	65	Disagreed
14.	Resources from non-living things: soil	30	28	45	47	Disagreed
15.	Resources from non-living things: solid minerals	40	20	42	48	Disagreed
16.	Skill acquisition	38	10	50	52	Disagreed
17.	The right and wrong application and implications of science and development	60	55	20	15	Agreed
18.	Light energy	20	25	55	50	Disagreed
19.	Sound energy	59	41	35	15	Agreed
20.	Magnetism	60	45	22	23	Agreed
21.	Electrical energy	20	25	61	44	Disagreed
22.	Radioactivity	35	25	50	40	Disagreed
23.	Acid, base, salt, pH scale	70	40	20	20	Agreed

Table 2(b) shows that 62(41.33%) students strongly agreed that the topics of the Ozone layer, its location, hazards to life on earth are very difficult to learn. 52(34.67%) agreed that the topics are very difficult to learn. 13(8.67%) of the students disagreed that the topics are not very difficult to learn. 23(15.33%) students strongly disagreed that the topics are not very difficult to learn. 114(76.00%) students agreed that the topics are very difficult to learn while 36(24.00%) students disagreed that the topics are not very difficult to learn.

For the topics on the right and wrong applications and implications of science and development, 62(41.33%) students strongly agreed that the topics are very difficult to learn. 50(33.33%) agreed that the topics are very difficult to learn. 15(10.00%) disagreed that the topics are not very difficult to learn. 23(15.33%) strongly agreed that the topics are not very difficult to learn. In summary, 112(74.67%) students agreed that the topics are very difficult to learn while 38(25.33%) students disagreed that the topics are not very difficult to learn.

For the topic sound energy, 58(38.67%) and 56(37.33%) students strongly agreed and agreed respectively that the topic is very difficult to learn. 15(10.00%) and 21(14.00%) students disagreed and strongly disagreed respectively that the topic is not very difficult to learn.

For the topic magnetism, 60(40.00%) and 54(36.00%) students strongly agreed and agreed respectively that the topic is very difficult to learn while 12(8.00%) and 24(16.00%) students disagreed and strongly disagreed that the topic is not very difficult to learn.

For the topics Acid, Base, Salt and pH scale 70(46.67%) and 40(26.67%) students strongly agreed and agreed respectively that the topics are very difficult to learn while 20(13.33%) and 20(13.33%) disagreed and strongly disagreed that the topics are not very difficult to learn. So, 110(73.33%) of students agreed that the topics are very difficult to learn while 40(26.67%) of the students agreed that the topics are not very difficult to learn. The remaining topics under lack of well-equipped laboratory facilities are not perceived to be difficult by JSIII students because they all disagreed that topics are not very difficult to learn.

Table2(b): Lack of well-equipped laboratory facility in my school, makes me perceive some topic in JS III syllabus as difficult.

S/No	Topic(s)	SA	A	D	SD	Decision
1.	Family traits (Genetics)	20	19	60	51	Disagreed
2.	Soil erosion	15	21	61	53	Disagreed
3.	Flooding	08	30	50	62	Disagreed
4.	Bush burning	10	15	55	70	Disagreed
5.	Deforestation	22	30	50	48	Disagreed
6.	Desertification	19	25	60	46	Disagreed
7.	Depletion of the ozone layer and its effect	62	52	13	23	Agreed
8.	Drug abuse	31	20	40	59	Disagreed
9.	Metabolism in the human body	26	32	42	50	Disagreed
10.	Sense organs	18	26	46	60	Disagreed
11.	Reproductive health	16	24	55	55	Disagreed
12.	Non-living things: element, compounds and mixtures	19	20	51	60	Disagreed
13.	Resources from living things	20	25	53	52	Disagreed
14.	Resources from non-living things: soil	15	30	40	65	Disagreed
15.	Resources from non-living things: solid minerals	25	30	50	45	Disagreed
16.	Skill acquisition	30	25	51	44	Disagreed
17.	The right and wrong application and implications of science and development	62	50	15	23	Agreed
18.	Light energy	27	18	50	55	Disagreed
19.	Sound energy	58	56	15	21	Agreed
20.	Magnetism	60	54	12	24	Agreed
21.	Electrical energy	15	25	60	50	Disagreed
22.	Radioactivity	20	35	50	45	Disagreed
23.	Acid, base, salt, pH scale	70	40	20	20	Agreed

From Table 2c 65(43.33%) and 50(33.33%) students strongly agreed and agreed respectively that the topics depletion of the ozone layer such as location of the ozone layer, hazards of the depletion of the ozone layer to life on earth are very difficult to learn. 20(13.33%) and 15(10.00%) students disagreed and strongly disagreed respectively

that the topics are not very difficult to learn. 115(76.67%) students agreed that the topics are very difficult to learn. While 35(23.33%) of the students disagreed that the topics are not very difficult to learn. For the remaining topics under lack of well-trained Basic Science and Technology, students all disagreed that the topics are not perceived to be difficult by them.

Table 2(c): Lack of well-trained Basic Science and Technology teachers in my school makes me perceive some topics in JS III syllabus difficult

S/N	Topic(s)	SA	A	D	SD	Decision
1.	Family traits (Genetics)	20	15	55	60	Disagreed
2.	Soil erosion	25	19	50	56	Disagreed
3.	Flooding	10	13	57	70	Disagreed
4.	Bush burning	6	7	69	68	Disagreed
5.	Deforestation	15	10	70	55	Disagreed
6.	Desertification	12	18	63	57	Disagreed
7.	Depletion of the ozone layer and its effect	65	50	20	15	Agreed
8.	Drug abuse	18	25	59	48	Disagreed
9.	Metabolism in the human body	25	15	56	54	Disagreed
10.	Sense organs	10	30	55	55	Disagreed
11.	Reproductive health	15	16	50	69	Disagreed
12.	Non-living things: element, compounds and mixtures	23	19	60	48	Disagreed
13.	Resources from living things	40	10	50	50	Disagreed
14.	Resources from non-living things: soil	38	15	57	40	Disagreed
15.	Resources from non-living things: solid minerals	20	19	50	55	Disagreed
16.	Skill acquisition	15	25	40	70	Disagreed
17.	The right and wrong application and implications of science and development	70	55	15	10	Agreed
18.	Light energy	29	18	28	75	Disagreed
19.	Sound energy	60	65	9	16	Agreed
20.	Magnetism	68	69	6	7	Agreed
21.	Electrical energy	21	26	50	53	Disagreed
22.	Radioactivity	30	16	54	50	Disagreed
23.	Acid, base, salt, pH scale	70	56	13	11	Agreed

From Table 2d all the 150 (100%) JSIII Basic Science and Technology students from the 10 selected schools disagreed that because of the involvement of some mathematical calculations in JSIII Basic Science and Technology syllabus, some topics were not perceived to be difficult by them. This is because, at this level serious Mathematical calculations are not involved. Therefore, students of JSIII Basic Science and Technology only perceive some topics in the JSIII syllabus difficult due to the abstract nature of the topics, lack of well-equipped laboratory facilities and lack of well-trained Basic Science and Technology teachers.

Table 2(d): I perceived difficult topic in JS III Basic Science and Technology syllabus because of some mathematical calculations.

S/N	Topic(s)	SA	A	D	SD	Decision
1.	Family traits (Genetics)	22	25	28	75	Disagreed
2.	Soil erosion	10	32	53	55	Disagreed
3.	Flooding	12	20	60	58	Disagreed
4.	Bush burning	6	9	67	68	Disagreed
5.	Deforestation	20	15	45	70	Disagreed
6.	Desertification	30	15	46	59	Disagreed
7.	Depletion of the ozone layer and its effect	29	34	40	47	Disagreed
8.	Drug abuse	32	29	45	44	Disagreed
9.	Metabolism in the human body	38	20	49	43	Disagreed
10.	Sense organs	34	22	50	44	Disagreed
11.	Reproductive health	27	30	40	53	Disagreed
12.	Non-living things: element, compounds and mixtures	15	36	49	50	Disagreed
13.	Resources from living things	15	20	40	75	Disagreed
14.	Resources from non-living things: soil	19	22	50	59	Disagreed
15.	Resources from non-living things: solid minerals	15	25	55	55	Disagreed
16.	Skill acquisition	20	30	50	50	Disagreed
17.	The right and wrong application and implications of science and development	15	25	55	55	Disagreed
18.	Light energy	20	25	55	50	Disagreed
19.	Sound energy	20	15	60	55	Disagreed
20.	Magnetism	19	16	50	65	Disagreed
21.	Electrical energy	16	20	59	55	Disagreed
22.	Radioactivity	17	18	53	62	Disagreed
23.	Acid, base, salt, pH scale	15	20	51	64	Disagreed

The result of the analysis in Table 3 reveals that the mean difference of the pre-test and post-test experimental group was 54.22 while the mean difference of the pre-test and post-test control group was 33.19. Therefore, the mean difference between pre-test, post-test experimental group and pre-test-post-test control group was 21.03. This is to say that pre-test, post-test experimental group was higher than the pre-test, post-test control group, so the intervention worked.

Table 3: Pre-test and post-test mean scores of the experimental and control groups in BSTMLT

Group	Test	N	$\overline{X}$	SD	$\overline{X}$ Diff.
Experimental	Pre-test	82	2.48	7.876	
	Post-test	82	56.70	24.579	54.22
Control	Pre-test	80	2.49	6.576	
	Post-test	80	35.68	25.350	33.19

The BSTMLT mean score of students were subjected to a two-way analysis of variance (ANCOVA) having two levels of gender (male, female) and two levels of school location (urban, rural). The main effect of gender yielded

male ($\bar{x}$ = 51.00; SD = 17.45), female ($\bar{x}$ = 51.33; SD = 17.31), F (1, 81) = 1.49, p > 0.05. This indicates that BSTMLT mean score of the male did not significantly differ from that of female; meaning that the interaction effect of male and female was statistically insignificant.

Also, the main effect of school location revealed that urban ($\bar{x}$ = 51.25; SD = 16.74), rural ($\bar{x}$ = 50.91, SD = 18.53), F (1, 81) = .984, p > 0.05. since p-value (.287) is greater than 0.05 level of significance. The null hypothesis was accepted indicating that there was no statistically significant interaction effect of school location and gender which means that the mean scores of urban school students in BSTMLT was not significantly different from that of rural schools.

The BSTAT mean score of students were subjected to a two-way analysis of variance (ANOVA) having two levels of gender (male, female) and two levels of school location (urban, rural). The main effect of gender yielded male ($\bar{x}$ = 42.54; SD = 16.18), female ($\bar{x}$ = 43.50; SD = 14.99), F (1, 81) = 2.465, p > 0.05. Since p-value (.551) was greater than 0.05, this indicates that BSTAT mean scores of the male did not significantly differ from that of female; meaning that the interaction effect of male and female was significantly insignificant.

Also, the main effect of school location revealed that urban ($\bar{x}$ = 40.77; SD = 15.73), rural ($\bar{x}$ = 46.73; SD = 14.76), F (1, 81) = 1.854, p > 0.05. Since the p-value (.177) was greater than 0.05 level of significance, the null hypothesis was accepted indicating that there was no statistically significant interaction effect of school location and gender which means that the mean scores of urban school students in students' BSTAT was not significantly different from that of rural schools.

Table 4a: Summary of ANCOVA for Interaction Effects on Gender and School Location on BSTMLT Achievement Test

Group	Source	Sum of Squares	df	MS	F	p-value
Experimental	Corrected Model	6984.385[a]	3	2328.128	4.329	.007
z	Intercept	23800.709	1	238000.709	44.255	.000
	Location	.208	1	.208	.000	.984
	Gender	6.380	1	6.380	.012	.914
	Location * Gender	617.926	1	617.926	1.149	.287
	Error	41948.993	78	537.808		
	Total	312509.000	82			
	Corrected Total	48933.378	81			

a. R Squared = .143 (Adjusted R Squared = .110)
p > 0.05 for Location
p > 0.05 for Gender
p > 0.05 for Location* Gender

Table 4b: Summary of ANCOVA for Interaction Effects on Gender and School Location on BSTAT

Group	Source	Sum of Squares	df	MS	F	p-value
Experimental	Corrected Model	3499.094[q]	3	1166.365	3.470	.020
	Intercept	22406.530	1	22406.530	66.653	.000
	Location	623.225	1	623.225	1.854	.177
	Gender	828.730	1	828.730	2.465	.120
	Location * Gender	185.123	1	185.123	.551	.460
	Error	26220.857	78	336.165		
	Total	376430.000	82			
	Corrected Total	29719.951	81			

a. R Squared = .118 (Adjusted R Squared = .084)
p > 0.05 for Location
p > 0.05 for Gender
p > 0.05 for Location* Gender

4. Discussion

The findings on the difficult concepts perceived by JS III Basic Science and Technology students in the JS III syllabus revealed that some topics were perceived by the students to be difficult while some were not. The statistics revealed that topics that were perceived by the students to be difficult had 66.7% and 68.66%.
This is in line with the research work of Akinmade (1992) who said that some topics are perceived by teachers and students as difficult are due to lack of teaching facilities, lack of trained teachers and the abstract nature of such topics. The result revealed that the use of pictorial organizer teaching method is superior to the conventional method in facilitating achievement in Basic Science and Technology.

The findings on the pre-test and post-test analyses of the experimental group of students showed that there is statistically significant difference between the pre-test and post-test achievement mean scores of the experimental groups exposed to pictorial organizers. This finding agrees with that of Adewoye (2008), Okey and Roth (2009) and Agogo (2010) who compared the pre-test and post-test achievement mean scores of students in science, technology and mathematics and reported that students build a better understanding of the concepts and develop strong problem solving skills with interactive engagement teaching method than the traditional lecture method. It is also in line with the findings of Adetunji, Bamidele and Awodele (2013) who said that a significant difference existed among the three groups used to determine the effects of historical simulations as advance organizers in story-telling instructional strategy (SIS). Story-telling Instructional Strategy combined with cartoon Instructional Strategy (SCIS) were compared with Conventional Teacher Expository Method (CTEM) on the improvement of students' performance in Basic Science and Technology concepts. A significant difference existed among the three groups. Students taught using SIS and SCIS were statistically better in post-test than students taught using the CTEM. The finding also agrees with the work of Adebola (2011) who found out that the use of advance organizers is an effective strategy for teaching and learning mathematics at the senior secondary school level. It also agrees with the works carried out by Ajala (2006), and Ojeifo (2000) which revealed that the use of advance organizers by students had facilitating effects on their learning of the concepts they were taught; the students' learning was enhanced through the use of advance organizers. The findings also agree with the work of Josiah and time (2016) who found out that the effect of study questions as an advance organizer on the experimental group makes them to achieved more than the control group who were not taught with study questions as advance organizers in Basic Science.

The findings on gender and school location revealed that gender and school location has no effect on the achievement of students in Basic Science and Technology when exposed to pictorial organizers. This finding is in line with the finding of Nwala (2007), Akinbola (2009), Abakpa and Iji (2011) that there is no significant effect of gender on students' achievement in science and technology. The findings are however not in agreement with the findings of Abiam and Odok (2006). Akinsola (2007) and Vale (2009) who concluded that gender differences do exist in students' achievement in Basic Science and Technology and Mathematics. This is not in agreement with the research findings of Kissau (2006) and Bosede (2010) who carried out studies on the influence of sex, type of school and location on students' achievement. The results of the studies differed with one favouring males in urban location in private schools and other favouring females in rural locations in public schools.

5. Conclusion

The study concluded that the use of pictorial organizers enhances students' achievement in Basic Science and Technology than the lecture method. The strategy can be used in teaching the difficult concepts perceived by JS III Basic Science and Technology subject since there is a significant difference in their achievement, gender and school location has no significant effect on students' achievement when exposed pictorial organizers.

6. Recommendations

- Basic Science and Technology teachers should use pictorial organizers because the strategies provide opportunity for Basic Science and Technology Students to achieved better and meaningfully.
- Seminars and workshops should be organized for teachers, particularly during holidays, to expose them to the principles and implementation process of pictorial organizers.
- Authors and curriculum planners should include pictorial organizers strategies in the teaching of Basic Science and Technology in their text books and the curriculum respectively.

7. Suggestions for further studies

- A study on other types of advance organizers and their effects on achievement and motivation to learn Basic Science and Technology Should be carried out.
- The experiment can be replicated for long period to see the impact of pictorial organizers on cognition of the students using other research designs.
- The experiment can be taken with students of different levels of intelligence.

References.

Abakpa, B. O., & Iji, C. O. (2011). Effects of Mastery Learning Approach on Senior Secondary School Students' Achievement in Geometry. *Journal of the Science Teachers Association of Nigeria, 46* (1), 165–176.

Abiam, P. O., & Odok, J. K. (2006). Factors in Students' Achievement in Different Branches of Secondary School Mathematics instruction when used as advanced organizers. *American Journal of Scientific and Industrial Research*,*2*(1), 161–168. Retrieved 13 March, 2016 from: http://www.sci.hub/ARJSR.

Adebola, S. F. (2011). The Effects of Behavioural Objectives on Students' Achievement in Senior Secondary School Mathematics Instruction when used as advanced organizers. *American Journal of Scientific and Industrial Research, 1*(2), 110 – 115. Retrieved 19 December, 2017 from: http://www.sc.hub.org/AJSR.

Adetunji, A. A.; Bamidele, E. F.; & Awodele, B. A. (2013). Effects of Historical Simulations as Narrative and Graphic Advance Organizers on Nigerian Junior Secondary School Students' Learning Outcomes in Basic Science. *Mediterranean Journal of Social Sciences*, *4* (2), 743 –752.

Adewoye, R. O. (2008). A case for the development of indigenous training technology in Nigeria. *Nigeria Journal of Teaching Education, 5* (1 & 2), 18 – 25.

Agogo, P.O. (2010). *Topics in Primary Science Education in Nigeria.* Makurdi: Azeben Publishers.

Akinbola, A. O., & Afolabi, F. (2010). Constructivist Practices through Guided Discovery Approach. The effect on students' cognitive achievement in Nigerian senior secondary school physics. *Eurasian Journal of Physics and Chemistry Education*, *2* (1), 16 – 25.

Akinmade, C. T. O. (1992). Teaching difficult integrated science concepts to the gifted child. *Journal of the Science Teachers' Association of Nigeria, 27* (2), 84 – 97.

Akinsola, M. K. (2007). Factors inhibiting the learning of mathematics in Obemeata LGA of Lagos State. Ibadan: Horden Publishers (Nig.) Ltd.

Ajaja, P. O. (2006). A comparison of retention outcome of advanced organizer, discovery and invention methods of teaching biology in Nigeria secondary schools. *The Nigerian Journal of Education*, *4* (2), 229 – 240.

Bakalyil, B. A.; Danpe, A.K.D.; Mark, T.M., & Rinmark, K. R.H. (2008). ASEI movement. In Ugwuanyi, A.S Ochefu, A.A Moses and O. Godwin (Eds.).*Strengthening the teaching of mathematics and science in JSS teachers to improve the skills of teaching Mathematics and science adopting the JICA/SUBEB approach.*

Bosede, A. F. (2010). Influence of sex and location on relationship between students' problems and academic performance. *Journal of the Social Science*, *5*(4), 340 - 345

Cronbach, J. L. (2001). *Educational Psychology*. London: Rupert Hart-Davis.

Duguryil, Z. P. (2004). Students' achievement in JSSCE integrated science as a predictor to their performance in SSCE chemistry. Unpublished Master's Dissertation, University of Jos, Nigeria.

Ebel, R. L. (2009). *Essentials of Educational Measurement.* (3rd ed.). Eaglewood Cliffs. NT Prentice Hall.

Emaikwu, S.O. (2015). Fundementals of Research Methodology and statistics. Sellers Academic Press Ltd. Mauri: Benue State. ISBN: 978-3-659-29670.3

Federal Republic of Nigeria (FRN) (2014). *National Policy on Education.* Abuja, NERDC

Gil-Garcia, A. & Villegas, J. (2003). Engaging minds, enhancing comprehension and constructing knowledge through visual representations. Paper presented at a conference on Word Association for Case Method Research and Application (Bordeaux, France, June, 29 – July 2, 2003).

Gongden, J. J., Gongden, E. J., & Lohdip, Y.N. (2011). Assessment of the difficult areas of the senior secondary school 2 (two) Chemistry syllabus of the Nigeria Science Curriculum. *African Journal of Chemistry Education 1*(1), 48-61. Retrieve 15 June, 2016 from: www. ajol. Info\index. Php.

Ifamuyiwa, A. S. (2003). Girls' participation and achievements in secondary school further Mathematics in Ijebu-Ode, Ogun State, Nigeria. Standard for Science Technology and Mathematics Education Research: A Book for Reading. pp 97.

Ikpenwa, J. N. (2005). Career Development and Skills Acquisition. *International Journal of FAWE, Nigeria, 1* (3), 131–139.

Inyang, N. E. U., & Ekpenyong, H. (2000). Influence of ability and gender grouping on Senior Secondary School Chemistry students' achievement on the concept of redox reaction. *Journal of Science Teachers Association of Nigeria, 35* (1&2), 36 – 42.

Joseph, P.O. (2000). Difficulties faced by girls in the study of science, Mathematics and technology subjects. UNESCO International Science, Technology and Environmental Education. *Newsletter, 23* (3), 1 – 3.

Josiah, O, & Tine, A. (2016). Effect of study questions as advance organizers on students' achievement in basic science in Markurdi Local Government Area of Benue State. *International Journal of Education Technology Systems, 25(1), 57-65.*

Kissau, S. (2006). Gender difference in motivation to learn French. *Canadian Modern Language Review, 62* (3), 65 – 96.

Longyil, S. I. (2010) An analysis of the Performance of the final year NCE students from 2000-2009 in Integrated Science of Federal College of education Pankshin and College of Education, Gindiri. Unpublished Master's Thesis, University of Jos.

Nakiboglu, C., Kasmer, N., Gultekin, C., & Donmez, F. (2010). Graphic organizers are teaching and learning tools in a visual format. *Procedia-Social and Behavioral Sciences, 116*(2014), 4264 – 4269.

Nwachukwu, J. N.,& Nwosu, A. A. (2007). Effects of demonstration method on different levels of students' cognitive achievement in Senior Secondary Biology. *Journal of Science Teachers Association of Nigeria, 42* (1&2), 50 – 59.

Nwala, R. (2007). Gender Inequality in Higher Education: A Remedial Approach. *The Nigerian Teachers Today, 10* (1), 134 – 142.

Nwokeocha, S. (2012). *Sociology of Education for Universities and colleges of education*. Lenchen Avenue, South Africa: African Forum of Teaching Regulatory Authorities.

Obot, M. I. (2015). *Philosophy of Education: Introduction*. Calabar: University of Calabar Press.

Ojeifo, J. A. (2000). Effects of Advance and Post Organizers on Concept Attainment Junior Secondary School Students in social studies. Unpublished Doctoral Dissertation, Delta State University.

Okey, J. R., & Roth, C. H. (2009). *Mastering teaching in Bloomington*. National Centre for the Development of Training Materials in Teacher Education: Indiana University.

Vale, C. (2009). *Trends and Factors concerning Gender and Mathematics in Australia.* Retrieved from http/www.faqs.org/periodical.