EFFECTS OF CONCEPT – MAPPING STRATEGY ON ACADEMIC ACHIEVEMENT AND RETENTION AMONG GEOGRAPHY STUDENTS IN SCIENCE SECONDARY SCHOOLS JIGAWA STATE, NIGERIA

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Abstract

This study investigated the effects of concept mapping teaching strategy on Science Secondary students academic achievement and retention in geography – particularly weather and climate concept in Jigawa state, Nigeria four objectives, research questions and hypotheses were formulated to guide the study. The study was quasi experimental design, specifically posttest and posttest were used using SSII intact classes from four (4) science schools in the state, two schools for boys and two schools for girls were used for experimental and control groups. Simple random sampling technique was used to select the four schools comprising of 166 students using balloting method. The instruments used (GAT) for both posttest and posttest was adopted from validated by expert in different specialization including psychometricians and geography teachers in terms of content, face and construct validation, however, pilot testing was conducted to determine the reliability of the instrument which was subjected to split half method and (PPMC) was used to compute the reliability index at (r=0.93) indicating high reliability. The findings revealed among others that there is a significance difference between experimental and control groups in favour of experimental group indicating that concept mapping is effective strategy for teaching weather and climate concept in science secondary schools.

Keywords: Concept mapping teaching strategy, Academic achievement, Retention, Weather and Climate Concept

Introduction

The account of the origin of what we today call science vary depending on one's cultural or academic perspective. Historians of ancient science for instance, study the "Science" (The systematic knowledge of nature) of Babylonia, Egypt, India, China and Greece. The Science of today is generally conceived as the source of knowledge which discover factual information defined by different writers/authors in the field, however, the application of the factual information based on the discovery is the technological aspect therefore, science and technology are the two sides of a coin. Ogunleye (2012) viewed Science as a dynamic human activity concerned with understanding the workings of our world. This help man to know more about the universe without the application of science, it would have been difficult for man to explore the other planets of the universe.

Okoro (2013) viewed Science as a systematic investigation of nature with a view to understand study and harnessing them to serve human needs. Ezeh (2013) revealed that the process and product of science are acquired through education in a specialized area of education such as science education. Aina (2013) viewed Science education as the study of science subjects such as; biology, chemistry, physics, mathematics and geography inclusive. This study is concerned with geography as science education subject.

Geography literally means earth's description which derived from Latin "Geographia" or the science that deals with the distribution and arrangement of all elements of the earth's surface. Aina (2011) viewed

geography as an interdisciplinary field of study that influences agriculture, industry, commerce, economic development, space craft, arithrapology, environmental studies, navigation security and national development. The internal logic of geographic study has tended to split the subject into physical and human occupancy of a particular area, while physical geography which is a science analyzing the physical makeup of the Earth's surface which include landforms concept, environmental, weather and climate concept among others.

Iwena (2008), views weather as the condition of the lower atmosphere of a place over a short period, which is always very brief within a day and changes regularly. While climate is defined as the average weather condition of a place over a long period of time usually about 35 years. Parameter or Element of weather and climate and changes includes temperature, precipitation, cloud cover, wind and pressure (Iwena, 2012) Therefore, this study is concerned with weather and climate concept of physical geography taught in schools, colleges and Universities benchmarks. The teaching of weather and climate remain an essential component that develops the skills of observation, measurement, recording, experimenting and making inferences of geographic data among students (Oladifo, 2012, Aderogba, 2010 and Abdulkarim, 2011). The information obtained from weather and climate has much relevance on physical and human activities as the temperature and rainfall affect us directly or indirectly (iwena 2012). However, despite the effect of the weather and climate as a
critical factor that directly or indirectly affect humanity, a critical review of geography students results through some period revealed unimpressive Achievement during WAEC 2017 and 2018 examination results, pointed out by the Chief examiner . This consequently generates low academic achievement of geography students.

Studies revealed that the problems of teaching and learning geography especially at science secondary schools level still persist (Okafor, 2016, Ngoko, 2010) and (Atadoga Lakpini 2013) ascertained that major problems found in teaching of science subjects in Nigerian Science schools is that, science concept is presented to learners dogmatically thus, students find it difficult to relate to real world of work supporting this, (Ogunleye and Babajide, 2011) revealed that science teachers have been using conventionally (talk and chalk) method in where no chance will be given to learners in teaching and learning activities.
Scholars have outline the strategies for teaching science subject including geography for instance Obeka (2013) revealed the inquiry and demonstration methods among the most, effective strategies of teaching because students' cognitive achievement, interest and retention of environmental concepts of geography are attained and facilitated faster, Mahmud (2010) revealed that discovery method enhances academic achievement of students in genetics concept.

Cheema and Murza (2013), Egbo (2014), Auta (2015) Adebisi (2017) among others recommended the use of concept mapping respectively. Concept mapping strategy was used in this study for teaching the experimental groups while talk and chalk method for the controls for a period of six (6) weeks. Makoba (2016) concept mapping as a learner centered instructional strategy is also a theoretically based on psychological theory of meaningful learning proferred by David Ausubel (1968). The theory proposes that children actively construct knowledge in social context. This study will investigate the effect of concept mapping teaching strategy on students' academic achievement and retention.

Academic achievement according to Lucy (2015) is a measure of what a person has accomplished after he might have exposed to educational program. Ezeudu (2013) and Okoye (2012) ascertain that active participation of students during teaching and learning increases students' academic achievement and retention. Obeka (2010) revealed that student's retention in science is relatively low. But with the use of innovative teaching strategy like concept-mapping students achievement and retention could be improved. Supporting this, Ezeudu (2013) and Okoye (2012) ascertain that active participation of students during teaching and learning increases

students' academic achievement and retention in respect of Gender differences. Gender refers to the socially culturally constructed characteristics and roles which are ascribed to males and females in society (Okeke, 2018). Some students found male students performing on average, better than female counterpart; some found female performing better than their male counterpart while others found no significance difference (Nwanekezi, 2018).

Statement of the Problem

The achievement and retention of geography students in SSCE over the past few years in the study area has not been impressive. On the various studies cited (OKofor, 2016, Rilwan, Akahomen & Gbakeji, 2014; Abdulkarim 2013; Aderogba, 2012). it was observed that the problems of teaching and learning geography more especially at science senior secondary school level of jigawa still persist. Weather and climate concept has been identified by the researchers as one the most difficult aspects of geography in which students have been woefully performing This is evident in the six years analysis of students' achievement in the subject as reported by Chief examiners of West African Examination Council (2017- 2022). This poor performance in geography has been attributed to lack of in-depth knowledge of the subject matter and application of inappropriate teaching methods as well as usage of new techniques of teaching. Researchers such as Aderogba (2012), Okafor (2016) have revealed that poor academic performance of students in Geography has been linked to poor teachers' performance in terms of accomplishing the teaching task, which have been attributed to instructional strategy.

However, many instructional approaches have been proffered by Psychologist like Bruner, Piaget, Gagne, and Ausubel for improved achievement, in science subject. Despite various innovations on the use of effective activity based teaching strategy, the poor achievement and retention of students still persists in geography at secondary school level. To reduce this drawback, the researcher tried to use concept mapping instructional strategy and see its effectiveness toward improving the situation. The problem of the study therefore is to investigated how effective is concept mapping strategy in improving students', academic achievement and retention of weather and climate in science senior secondary school jigawa State. Also would concept mapping strategy has gender influence on the students, academic achievement and retention?

Objectives of the Study

In specific terms, the objectives of the study based on Academic Achievement are to

1. Find out the mean difference scores between the Experimental and control groups geography students in science schools, Jigawa state
2. Find out the mean difference scores between Male and female geography students in the Experimental group in Science schools, Jigawa State.
3. Investigate the mean difference of retention scores between Experimental and control groups in science schools, Jigawa state.
4. Investigate the mean difference of retention scores between Male and Female geography students in the experimental group in science schools, Jigawa state.

Research Questions

The study tend to answer the following questions

1. What is the mean difference scores between the experimental and control groups geography students Academic Achievement in Science Schools, Jigawa State?
2. Is there any mean difference scores between male and female geography students Academic Achievement in the Experimental group is science schools, Jigawa state.
3. What is the mean difference of retention scores between experimental and control groups geography students Academic Achievement in science schools, Jigawa State?

4. Is there any mean difference of retention scores between Male and female geography students academic achievement in the experimental group in science schools, Jigawa state

Null Hypotheses

The following null hypotheses were tested at P-value ≤ 0.05

Ho_1: There is no mean significance difference between the experimental and control groups geography students academic Achievement in Science Schools, Jigawa State.

Ho_2: There is no mean significance difference between Male and female geography students Academic Achievement in the Experiment group in science schools, Jigawa State.

Ho_3: There is no mean significance difference of retention between experimental and control groups geography students Academic Achievement in Science Schools, Jigawa State.

Ho_4: There is no mean significance difference of retention between male and female geography students Academic Achievement in Science Schools, Jigawa State.

Methodology

This study employed quasi-experimental research design. Specifically, pretest, posttest and post-posttest non equivalent control group design. Intact classes were used to avoid disruption of normal lessons. During first week of the study, pre-test using Geography Achievement Test (GAT) was administered to both the experimental and the control groups to ascertain their performance at the beginning of the study so as to ensure equivalent, after which they were exposed to treatment for six (6) weeks and at the end of which post-test and post-post test (retention) was administered using (GAT) to determine students' academic achievement and Retention.

The population of the study comprised of 1264 SSII geography students in Jigawa State science Secondary Schools including 803 males and 461 females within an average of 17 years, (Jigawa State Science Board 2023). However, the sample sizes used in this study are four (4) Science Schools, two (2) for boys and two (2) for girls in the state which were randomly selected using hat and draw method without replacement. SSII intact classes were used and two schools (one for boys and one for Girls) were assigned experimental groups and two (one for boys and one for Girls) were also assigned as control with the following table;

Table 3.1 Showing Sample of the study

Schools	Male	Female	Total
Experimental Schools	45	40	85
Control Schools	43	38	81
Total	**88**	**78**	**166**

Instrumentation

The instrument used in the study was geography Achievement Test which was adapted from previous WAEC past question papers related to weather and climate concepts (WCAT) and used for pretest, posttest and posttest test (retention) academic achievement. The instrument consisted of 30 objectives (multiple types) test items each with four alternatives (A-D).

The validity of the instrument geography achievement test (GAT) was determined by experts (psychometricians) Geography teachers, linguistics and geography educators in terms of face, content and construct validation, and finally all observations made were incorporated into the final draft with rational/face

logical validity index r= 80%. A pilot test was conducted to establish the reliability of the instrument using test retest method. Test retest method was used and finally subjected to person product moment correlation (PPMC) to ascertain internal consistency with a reliability index (r= 0.93) indicating high reliability.

Results and Discussion

The research questions raised were answered using descriptive statistic; (Mean and standard deviations), however the corresponding null hypotheses were analyzed using inferential statistic (z-test).

RQ_1 – What is the mean difference scores between the experimental and control groups geography students Academic Achievement in Science in Science Schools Jigawa State.

Table 1a: Showing Mean difference and standard deviation of posttest between experimental and control groups.

Groups	N	$\bar{X}$	S.D	M.D
Experimental	85	23.55	5.77	7.74
Control	81	15.81	5.21	

Table 1a the mean difference between the Experimental and control groups is 7.74 while the control group has a S.D of 5.21 indicating their responses in the posttest are closely related.

Ho_1: There is no significance mean difference between the experimental and control groups geography students Academic Achievement in Science Schools, Jigawa State.

Table 2b: Z – test Analysis of posttest scores between the experimental and control group

Groups	N	Mean	S.D z- value	P- Value
Experimental	85	23.55	5.77	9.04
Control	81	15.81	5.21	

$P \leq 0.05$

Table 2b the z – value of 9.04, with P = 0.00 at $P \leq$ 0.05 indicating a significance difference between the two groups therefore null hypothesis is rejected.

RQ_2 – Is there any significance mean difference between male and female geography students Academic Achievement in the experimental group in science schools, Jigawa State?

Table 2a Showing mean and standard deviation between male and female in the experimental group.

Gender	N	$\bar{X}$	S.D	M.D
Male	45	24.60	6.06	2.22
Female	40	22.38	5.26	

Table 2a the mean difference between the male and female in the experimental group is 2.22 while the female group has a S.D of 5.26 indicating their responses on the test are closely related.

Ho_2: There is no significance mean difference between male and female geography students Academic Achievement in the Experimental group in Science Schools, Jigawa State.

Table 2b: Z – Test Analysis of posttest scores between male and female in the experimental group.

Gender	N	Mean	S.D	z- value	P- Value
Male	45	24.60	6.06	1.80	0.15
Female	40	22.38	5.26		

$P \leq 0.05$

Table.2b indicating Z – value of 1.80, P- value 0.15 at $\leq$ 0.05 indicating a significant difference between the two groups therefore null hypothesis is rejected.

RQ3 – What is the mean difference of retention scores between experimental and control groups geography students Academic Achievement in Science Schools, Jigawa State

Table 3a Showing mean and standard deviation of post post –test scores between experimental and control groups.

Group	M.D	N	$\bar{X}$	S.D
Experimental	85	20.42	5.61	9.70
Control	81	10.72	4.63	

Table 3a the mean difference between Experiment and control groups is 9.70 in favour of experimental group while the S.D. The control group has a S.D of 4.63 indicating their responses in the post-post test are closely related.

H_{O3}: There is no significance mean difference of retention between experimental and control groups geography students academic achievement in Science Schools, Jigawa State.

Table 3b: Z- test Analysis of post posttest scores between the Experimental and control groups

Groups	N	$\bar{X}$	S.D	Z- value	P- Value
Experimental	85	20.42	5.61	12.12	0.00
Control	81	10.42	4.63		

$P \leq 0.05$

In Table 3b, Z – value of 12.12 with P = 0.00 at 0.05 indicating a significant difference between the two groups therefore the null hypothesis is rejected.

RQ_4 – Is there any mean significance difference of retention scores between male and female geography students Academic Achievement in the experimental group in Science Schools, Jigawa State.

Table 4.4a Showing mean and standard deviation between male and female in the experimental group.

Source	**N**	**$\bar{X}$**	**S.D**	**M.D**
Male	45	21.40	6.13	2.10
Female	40	19.30	4.78	

Table 4a the mean difference between male and female retention scores is 2.10 in favour of male students while the female students S.D is 4.78 indicating their responses on the test are closely related.

H_{O4}: There is no mean significance difference of retention between Male and Female Geography students Academic Achievement in Science Schools, Jigawa State.

Table 4b Z- test Analysis of retention scores between male and female in the experiment groups

Groups	**N**	**$\bar{X}$**	**S.D**	**Z- value**	**P- Value**
Male	45	21.40	6.13	1.74	0.09
Female	40	19.30	4.78		

$P \leq 0.05$

In Table 4b, the Z- value of 1.74 with P= 0.09 at 0.05 indicating a significant difference between Male and Female in the experimental group, therefore the null hypothesis is rejected.

Discussion of the Findings

The first findings also revealed significant difference between the mean achievement scores of students taught using concept mapping teaching strategy and those taught using conventional lecture method in favor of experimental group. The finding agreed with the earlier findings of Chang, Ying Liu,Chen,and Huang (2017), Okafor (2016), Akeju Kalhour (2016), Lawal, Aminu and Gambo (2016),Yakubu (2016), Adebisi (2017) Meheux (2017), Nwanekez and Ariagai (2018), and Doris (2018) who in their study reported that, concept mapping teaching strategy improve academic achievement of learners. However the findings goes contrary to Abdulkarim and Hassan (2013) and Auta (2015) who investigated the effect of using Concept Mapping and revealed no significant difference in the academic achievement between the experimental and control group.

The second findings disclosed significant difference between the mean achievement scores of male and female students taught using concept mapping teaching strategy. The finding is in line with the earlier findings of Lawal, Aminu and Gambo (2016), Ariaga and Nwanekezi (2018) who investigated the influence of concept mapping method on the academic performance and found significant difference in the mean score of male and female in favor of male's students, male students scored significantly higher than female. However, the findings goes contrary to the findings of Olatoye, Aderogba and Aanu (2011), Ezeudu (2013) and Abdulkarim and Hassan, 2013) who revealed that there was no gender influence on students' concept-mapping ability and their achievement in the subject indicating that concept mapping is gender friendly.

The third result of this study revealed that students taught using concept mapping teaching strategy have higher retention scores than those students taught using conventional method of teaching. The finding is in line with the findings of Chang, Ying Liu,Chen,and Huang (2017), Okafor (2016), Yakubu (2016), Chang,Ying Liu, Chen, and Huang (2017), who revealed that concept mapping instructional strategy, improve learner retention ability of science concept. On contrary, Wushishi, Danjuma and Usman (2013) investigated the effects of two modes of concept mapping instructional strategies on secondary school students' retention level in mathematics and found no significant difference in the retention level of experimental and control group.

The fouth finding disclosed significant difference between the mean retention scores of male and female students taught using concept mapping teaching strategy. The finding is in line with the earlier findings of Lawal, Aminu and Gambo (2016) Ariaga and Nwanekezi (2018), who investigated the influence of concept mapping method on the academic performance and retention and found significant difference in the mean score of male and female in favor of male's students. The findings goes contrary to the findings of Wushishi, Danjuma and Usman (2013), Obiageli (2013) who revealed that male and female students achieved and retained the organic chemistry equally indicating that concept mapping is gender friendly.

Conclusion

Based on the findings of this research, it concluded that Concept mapping instructional strategy enhances geography student's academic achievement and retention in weather and climate concept and among science senior secondary school students under study.

Recommendations

Based on the findings the following recommendations were made.

1. Geography teachers in Science Secondary Schools should emphasized, encourage and expose in teaching their students using concept mapping strategy.

2. The Government through Ministry of Education and other professional bodies should ensure that teachers are familiar with other teaching methods including concept mapping strategy which could be possible through seminars and workshop.

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