

Effect of Concept Mapping Teaching Strategy on the Academic Achievement of Senior Secondary School Students in Physics

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Abstract

The study investigated the Effect of Concept Mapping Teaching Strategy on the Academic Achievement of Senior Secondary School Students in physics. The design for the study was pre-test and post-test control group design. All the 20 senior secondary schools in Obio/Akpor metropolis constituted the population for the study. Two senior secondary schools were randomly selected and made into experimental and control groups .physics Achievement Test (PAT) was prepared by the researchers and validated by two senior lecturers from education department, Ignatus Ajuru University of Education rivers state Nigeria and a reliability coefficient $r=0.70$ was arrived at after testing. Physics Achievement Test (PAT) was administered to the students by the researchers. Data collected was analysed using z- test statistics. The teaching and learning of physics in Secondary Schools in Nigeria has lot of problems. This is paper looked at some of them which include acute shortage of teachers, the use of inappropriate methods etc. these affect difficult subject, and unnecessary. Changing physics education from acquiring basis physical theories to experimental physics is one way suggested for the optimal acquisition of physics subject matter. The results indicated that students taught with physics using concept mapped instructional strategy achieved higher than those taught using expository method. It was recommended that, teachers need to diversify their method of teaching physics such as concept mapped teaching strategy as it will assist in higher academic achievement of learners.

Introduction

Education has been described as a vital and indispensable key to any form of development (Offiah & Achufusi, 2010) it is an instrument for economic, political and scientific development of all nations (Olarinoye, 2001 & Otuka, 2006). This could be the reason why the Federal Government of Nigeria emphasised the Teaching of Science (physics inclusive) in its National Policy on Education (FGN, 2008). It has been observed that the major challenges in teaching is to create experiences that involve the student and support of his own thinking, explanation, evaluation, communication and application of the scientific models needed to make sense of these experiences (Afolabi and Akinbobola 2009). In science education, there is an increasing awareness of the importance of learner-centeredness in the teaching- learning situation which has generated a lot of attention in relation to understanding how learners learn and how to help them learn about concepts in sciences (Jegede, Alaiymota & Okebukola 1990). These efforts according to Cliburn (1990) and Danjuma (2005) assisting learners to learn more effectively have led to the development of metacognitive strategies to enhance meaningful learning. According to Novak, (1983) meta-cognitive strategies are meta-knowledge and meta-learning which are strategies that empower a learner to take charge of his/her own learning in meaningful ways. Novak & Godwin (1984) explained further that meta-knowledge refers to knowledge that deals with the very nature of knowledge and knowing, and meta-learning refers to learning that deals with the nature of learning or learning about meaningful learning.

Secondary Schools attempt to achieve the educational goals through instruction within the school disciplines. Physics is one subject area through which educational objectives are to be achieved. Physics education is, therefore, about achieving educational goals through a context of physics.

Physics is taught in the second stage of secondary education i.e. senior secondary school stage. Secondary School Physics serves as a preparation for further training in physics and prepares students to be useful citizens within the society.

In order to achieve the objectives of physics education at this level of education, government has taken good, consistent and impressive policies and actions regarding science education in general and physics education in particular. Some of such measures includes the establishment of special science schools, intensified training of physics teachers by including them in the Technical Teachers Training Programme (TTTP). So far, government effort at improving physics education appears to be inadequate because of persistent poor performance of students in physics.

Since the provision of physics education consists of curriculum, personnel and equipment, this paper will focus on problem and perspectives of physics education delivery in secondary school schools. Specifically, this will include:

- Teacher supply and production
- Methods of physics education delivery
- Instructional/laboratory materials.

Teacher Supply and Production

The teacher is the pivot of any science education programme (Jegede 1989). It is the teacher who translates policies into practice and programmes into actions. Hence, Ivowi (1998) stated that the teacher is the key factor in determining the quality and success of any curriculum. According to him, it is upon their number (teachers), their quality, their devotion and commitment to duty that depend the success and progress of any educational system.

Method of Physics Education Delivery

Interactive engagement is now recognized as an important technique in teaching and learning of physics. Physics curriculum suggested the guided-discovery method as the best way to teach and learn physics but research reports have shown that lecture method of teaching is still prevalent. (Farmobi, 1997; Soyibo, 1976). However, educational research has shown that traditional lecturing, in which students listen passively, results in surprisingly little real learning. It portrays physics as a very abstract subject and makes students perceived the study of physics to be difficult and less interesting. Farombi (1997) opined that the student study of physics is so abstract that an average student hardly knows its difference from a mathematics class.

The presentation of physics as a mathematics course also poses a threat to study of physics According to Hobson (1999):

‘Students in physics learn only how to solve certain standard types of problems without actually learning the physics concepts that are the main point of the subject’

Therefore, the suggestion of concept mapping approach to the teaching and learning of physics rather than the mere memorization of formulas and carrying out routine calculations

was introduced.

The use of inappropriate teaching methods by teachers in teaching concepts in physics have been found to compound students' fright and make them have negative attitude towards studying physics in their next level of education (Adeyemi, 1999).

Laboratory Materials/Equipment

For better understanding of physics concepts, the science curriculum recommended the complete integration of theory and practical in the teaching and learning of physics. But it was discovered that science teachers in many schools are often reluctant to conduct science practical (Adeyemi, 1999; Okeke, 1985; Ajeyalemi, 1983). In fact, the practice is to defer the teaching and learning of physics practicals to a few weeks to any public examination conducted by WAC, NEC or NABTEB. This practice prepares the students for that particular examination and does not give room for any meaningful learning. This practical has persisted for the obvious reason that most of our school laboratories are empty or are filled with inadequate, obsolete and damaged laboratory facilities. This poses an enormous problem which adversely affects the teaching and learning of physics. It makes practical laboratory exercise very difficult for many students.

Malone and Dekker (1984) stated that meaningful learning means that learners can integrate new knowledge into their existing networks of concepts and propositions in their cognitive structures.

Therefore, concept mapping according to Kinchin, (2005) is a strategy that help learners organise their cognitive frameworks into more powerful integrated patterns. Many researchers such as Okebukola & Jegede, (1988); Novak,(1983); and Bello and Abimbola(1997) have observed that concept mapped can improve meaningful learning and help learners, learn independently, Concept mapping according to Novak and Godwin (1984). is a schematic device for representing a set of concept meaning embedded in a hierarchical diagram that illustrate the interconnections between and among concepts. It can be deduced that concept map provide a visual road map showing the pathways a learner can take to construct meaning of concepts and prepositions. This strategy as observed by Novak & Godwin (1984) and Novak,(1990) serves as both learning tool as well as evaluation tool, which encouraged the students to use meaningful mode-learning patterns. Similarly, Chiou (2008) conducted a research on the effect of concept mapping on students' learning achievements and interest. It was concluded that those exposed to accounting using concept map performed better than those exposed to accounting using expository method.

Despite the effort of science educators such as Bello (1996); Danjuma (2005) and Jibrin and Abba (2011) towards finding a suitable instructional strategy for effective teaching in secondary schools. There still exist some reports of poor academic performance in public examinations results such as NECO and WAEC in physics (Lakpini, 2007; gbenevwe, 2010; Adebayo, 2011 and WAEC, 2011). The poor performance were attributed to the use of inappropriate method of teaching; poor spelling of technical terms; shallow knowledge of the subject matter. Also Ornole (2011) was of the opinion that 75 per cent failure in mathematics and sciences is worrisome. There is the need to identify teaching methods that students can relate with share ideas and interact academically within themselves. The present study is designed to look at the effects of concept map instructional strategy on the academic achievement of senior secondary school students in physics.

Purpose of the Study

- The main purpose of this study was to determine the academic achievement of students taught physics using concept mapping teaching strategy and those taught using expository method.
- Examine the mean difference in the achievement of female student taught physics using concept mapping strategy and male student taught using expository teaching method?

Research Question

- What is the mean academic achievement of student taught physics using concept mapping teaching strategy and those taught using expository teaching method?
- What is the mean score academic achievement of female student taught physics using concept mapping strategy and male student taught using expository teaching method?

Research Hypothesis

The following null hypothesis was formulated for testing at $\leq P 0.05$

H0₁ There is no significance difference in the mean academic achievement of students taught physics using concept map teaching strategy and those taught using expository method.

H0₂ There is no significance difference in the mean score academic achievement of female student taught physics using concept mapping strategy and male student taught using expository teaching method

Research Design

The design for this research is Quasi- experimental that employed pre test post-test non equivalent control group design. Pre-test was administered before the treatment by the researcher. This was to determine the equivalents in their academic ability. Post-test was administered after the treatment to determine the effect of treatment (concept mapping teaching strategy) on the subjects. This was done using the same instrument (physics Achievement Test). Experimental group received treatment using concept mapping teaching strategy while Control group was taught using lecture method.

Population of the Study

The population of the study was all the twenty (20) Senior Secondary Schools II that were located in Obio/Akpor Metropolis with total of 15,500 Senior Secondary School Physics Students from public schools.

Sample and Sampling Procedure

Two (2) Senior Secondary Schools were randomly selected using 'balloting method' from the area of the study. In each school selected intact class of Senior Secondary II Students was used. And the two schools were divided into experimental and control groups using 'odd and even' number method where the odd number school becomes the control group while the even number school the experimental groups.

Instrument for Data Collection

A twenty (20) multiple choice items physics Achievement Test (PAT) developed by the

researchers was employed for data collection. The topics in physics covered by the students used in this study are:

- i. Definition of motion.
- ii. Characteristics of motion
- iii. Types of motion.
- iv. Application of SI units
- v. Solving problems on motion

Validity of the Instrument

The instrument (Physics Achievement Test) was validated by two (2) MSC holders and Senior lecturers from Department of Education, IGNATUS AJURU U.O.E Rivers state Nigeria and two (2) B.Ed holders teaching physics at Senior Secondary Schools. They made same recommendations on the areas of content and appropriateness of the language and the instrument was corrected before been used for this study.

Reliability of the Instrument

To determine the reliability of the instrument a test was conducted at Government Secondary School Rumuekini Rivers State which is outside the study area to ensure that the instrument was consistent. A test retest method was employed within two weeks interval in line with Tuckman (1975) recommendation. The results of the test were correlated using Pearson Product Movement Correlation Coefficient (PPMC), the reliability coefficient (r) was found to be 0.70 which shows that the instrument is reliable and was used for data collection in the study.

Method of Data Collection

Since there are two (2) groups for the study that is the experimental and control groups, respectively. Lesson plan was developed by the researchers for experimental group using concept mapped teaching strategy and control group using lecture method for the period of six (6) weeks. Pre-test was administered to the groups to determine the equivalent of the ability level of the sample subjects.

The researchers then administered the posttest physics Achievement Test (PAT) to the students using the same instrument and marking scheme. The instrument was reshuffled after the pretest to avoid test wiseness. The scripts were collected and marked. The scores were subjected to statistical analysis.

Table 1: z-test analysis between the mean academic achievement of the experimental and the control groups

Group	N	X	S.D	df	t_{cal}	T_{crit}	Remark
Experimental	30	54.8	14.5	79	2.08	0.98	Sig.
Control	50	48.3	11.9				

Table 1 show that, at 0.05 level of significance for z-tests the t_{cal} 2.08 is greater than the t_{crit} 0.98 with mean scores of 54.8 for experimental and 48.3 for control group at df 79. Therefore, the null hypothesis is rejected. Hence a significant different exist between the experimental and control groups is in favour of the experimental group.

Table 2: z-test analysis between the mean academic achievement of the experimental and the control groups of male and female

Experimental Groups	N	X	S.D	t-value	dt	Decision
Boys	15	58.88	7.58	0.10	30	ns
Girls	16	58.88	7.57			

ns=not significant

Table 2 showed that there was no significant difference between the mean scores of the experimental boys and that of the experimental girls after they had been taught using concept mapping instruction.

Table 3: z-test of mean scores of control group boys and girls in achievement Physics

Experimental Groups	N	X	S.D	t-value	dt	Decision
Boys	15	58.88	7.67	0.12	37	ns
Girls	24	57.77	7.51			

ns=not significant

Table 3 showed that there was no significant difference between the mean scores of the control group boys and that of the girls that were taught without using the concept mapping technique.

Analysis of variance (ANOVA) of the students scores for pretest and post test was a carried out.

Discussions

The results revealed that there was significant difference in the mean academic achievement of students who were taught physics using concept mapped instructional strategy and those taught to using expository method. The result is in agreement with that of Chiou, (2008) who reported that students' exposed to accounting using concept mapped performed better than those exposed to accounting using expository method. This might be possible because the students are directly involved in the learning process. It has been suggested earlier by Abdullahi (1982) & Danjuma (2005) that since students were actively involved in learning process and were able to found out some information for themselves through activity-based instructional strategy such as discovery method, problem-solving and concept mapping teaching method learning is better facilitated.

Conclusion

From the study it was concluded that concept mapping teaching method is one of the effective methods of teaching physics at the Senior Secondary School Level, since it shows potentiality of improving student's academic achievement.

Recommendation

Based on the findings of the study, the following recommendations were made:

1. Teachers need to use concept mapped teaching method so as to improve the academic achievement of students in physics.

2. There is the need for training of physics teachers on the effective use of concept mapped teaching method in teaching physics.
3. Facilities should be provided by the Federal and State governments as well as PTAs and NGOs for effective use of concept mapped teaching method for teaching in senior secondary schools
4. It may also be important to advice physics teachers to try concept mapping technique in teaching other difficult to learn topics, since the technique has been found to be significantly better than our conventional (lecture) mode of giving instruction to our students.
5. Physics education researchers may replicate and improve this study at a different location and at other education levels in the country.

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