

Effect of Concept Mapping Strategy on Students' Achievement in Difficult Chemistry Concepts in Rural and Urban Areas in Benue State, Nigeria.

Author Detail:

Otor, Eriba Emmanuel (Phd)-Department Of Curriculum and Teaching
Benue State University Makurdi, Nigeria.

Abstract

This study examined the effect of concept mapping teaching strategy on student's achievement in difficult chemistry concepts in secondary schools in Nigeria. It also examined the differential effect in achievement among chemistry students in rural and urban schools. Two research questions and two hypotheses guided the study. The study used a quasi-experimental pretest-posttest control group design. Data were collected from 1,357 senior secondary 2 students using a stratified random sampling procedure from two local government areas of Benue State of Nigeria. Chemistry Achievement Test (CAT) on structure of matter and energy changes developed by the researcher and validated by experts was used for data collection. The research questions were answered using mean and standard deviation scores while the hypotheses were tested at 0.05 significance level using Analysis of Covariance (ANCOVA). Students taught using concept mapping strategy achieved higher scores and significantly better than those taught using conventional (lecture) method. There was also a better achievement in favour of the rural chemistry students compared to their urban counter parts. The study recommended among other things, that since concept mapping is found to be an effective strategy and enhanced achievement among chemistry students, teachers of this subject should accept it as one of the strategies they can use in chemistry classroom.

Introduction

The teaching of science at whatever level should aim at satisfying the immediate and long term wholistic needs of the beneficiary hence serves as the bases for scientific and industrial advancement. The emphasis of modern science teaching and learning is on learners' active participation in the learning process. This concern calls for the use of teaching strategies which emphasize the teaching of process skills of science and child-centered inquiry-based instruction. It is expected that the teaching strategies that emphasize the teaching of process skills of science as noted by Rejane, Zelia and Milke (2004) and Wasagu (2006) would enhance a shift from the "passive status of learners by the lecture method to an active status". In support of this view, Feher, Dicking and Falk (2003) and Savery and Deffy (2003) maintained that science teachers should be knowledge builders but not supply of knowledge. This is in tune with the constructivist view of learning that learning is a process in which the learner constructs knowledge from pre-existing idea (O' Neil and Brooks, 1998).

Chemistry is one of the core science subjects among science students in secondary school curriculum in Nigeria and linked to almost everything on earth. It plays vital role in the industrial, technological and economic development of any nation. It also features prominently in the areas of oil and gas, health, agriculture to mention but a few. It is therefore a catalyst of sustainable national growth and development.

Chemistry teachers have applied several instructional approaches in teaching chemistry yet the desire result in students achievement has not been achieved (Otor, 2011). Usman and Memeh (2007) further reported that the poor achievement of students in chemistry among others include teachers' inadequate preparations and methods adopted in teaching this subject. The pursuance of how to improve the achievement of students in chemistry is the concern for this investigation. The questions for this research are; what is the effect of concept mapping strategy on chemistry students' achievement? Is there any different in achievement among the urban and rural chemistry students?

Theoretical Bases for the Study

Concept mapping measures the cognitive activities of the learner (Otor, 2011). It teaches mental skills as opposed to psychomotor activities. The pedagogical use of concept map is to help students learn subject matter more meaningfully in science. The study of psychological theories of learning is very important and valuable as they are the fundamental theoretical foundations for innovative instructional strategies which are used in the teaching-learning process of science. This study is anchored on Ausubel's (1968) psychological theory of learning which is concerned with processing of information and make it more meaningful to the learner so that it can be better understood and used.

Statement of the problem

The researcher observed that the instructional strategies chemistry teachers adopt could be responsible for the low achievement among the students in this subject. Buzan (2007) reported that using an appropriate teaching strategy at a given learning objective enhanced students achievement. Certain difficult chemistry concepts have also been contributing to poor achievement among chemistry students (Okebukola, 2005). This study is therefore set to find out if concept mapping teaching strategy could enhance students' achievement in chemistry and its differential effects on rural and urban areas.

Purpose of the study

This study determined the effect of using concept mapping strategy in teaching difficult concepts in chemistry on students' achievement. The following specific objectives are the main issues of the study;

- i) To find out the effectiveness of using concept mapping strategy in teaching difficult concepts in chemistry on students' achievement
- ii) To determine if the use of concept mapping strategy in teaching difficult concepts has the same effect on rural and urban chemistry students.

Research Questions

The following research questions were addressed in the study;

- i. What is the effect of concept mapping teaching strategy on students' achievement in chemistry?
- ii. What is the difference between the mean achievement scores of rural and urban students taught using concept mapping strategy?

Null Hypotheses

To find out the extent to which this strategy was effective in realizing the goal of this study, the following hypotheses were tested at 0.05 significance level.

- H0₁: There is no significant difference in the mean achievement scores of senior secondary school chemistry students taught using concept mapping and those taught using the conventional method.
- H0₂: There is no significant difference between the mean achievement scores of chemistry students in urban and rural schools taught using concept mapping.

Methodology

Quasi-experimental design was used for this study. A non randomized control and experimental groups involving a pretest posttest was applied. The experiment lasted for six weeks. The target population of this study was all SS2 chemistry students in Benue State of Nigeria. A sample of 1357 male and female chemistry students representing 12.27% of the total population of 11062 was used for the study.

A research instrument which was validated by experts in chemistry education, measurement and evaluation was used for this study namely Chemistry Achievement Test (CAT). The instrument was pilotested and its reliability was found to be 0.83. The CAT was made of twenty six items drawn from the difficult chemistry concepts of matter and energy changes. Two research assistants were trained and used for this study.

The researcher and the trained assistants were involved in the administration of the researcher instruments and collection of data. The research hypotheses were tested using Analysis of

Covariance (ANCOVA) while the research questions were treated using means and standard deviations.

Research Question 1

1. Is there a significant difference between the mean achievement scores of chemistry students taught using conventional method and those taught using concept mappings strategy?

Result and Discussion of Findings

The results of this investigation are presented according to research questions and hypotheses.

Table 1: Mean achievement scores and standard deviations of subjects in the experimental and control groups

Group	No of subjects	pre-test		Post-test		mean		difference
		Mean	SD	Mean	SD	Mean	SD	
Experimental	687	5.11	1.34	15.18	2.02	10.07		
Control	670	5.06	1.34	10.84	1.65	5.78		
Difference in mean				4.29				

Presentation of Results

Table 1 shows that the mean achievement score of the experimental group in the post-test was 15.18 with a standard deviation of 2.02. This mean is higher than that of the control group which was 10.84 with a standard deviation of 1.65. This difference in mean achievement score of 4.29 is in favour of the experimental group. The pretest-posttest gain of 10.07 (from 5.11 to 15.18) for the experimental group was also higher than that of the control group which was 5.78 (from 5.06 to 10.84). The experimental group therefore achieved better than control group in the post-test. The mean and standard deviation of pre-test were 5.11 and 1.34 respectively for the experimental group while the control group had a mean of 5.06 and standard deviation of 1.34. The implication for this difference in the mean and standard deviations of the group is that the subjects of the study were almost at the same level of knowledge for structure of matter and energy change before the commencement of the experiment.

To ascertain whether the observed difference was significant, hypothesis 1 was tested.

Null hypothesis One (H_{01})

There is no significant difference in the mean achievement scores of senior secondary school chemistry students taught using concept mapping and those taught using the conventional method.

Table 2: Tests of Between-Subjects Effects
(The results of the analysis of covariance for CAT)

Source	Type III Sum of Squares	df	Mean square	F	Sig
Corrected Model	7519.605 ^a	8	939.951	361.259	.000
Intercept	8230.140	1	8230.140	3163.160	.000
PRETEST	930.572	1	930.572	357.655	.000
GROUP	6246.181	1	6246.181	2400.648	.000
LOCATION	53.696	1	53.696	20.638	.000
SEX	38.239	1	38.239	14.697	.000
GROUP*LOCATION	31.316	1	31.316	12.036	.001
GROUP* SEX	59.707	1	59.707	22.948	.000
LOCATION*SEX	107.304	1	107.304	41.241	.000
GROUP* LOCATION* *SEX	7.205	1	7.205	2.769	.096

Error	3507.325	1348	2.602
Total	241740.000	1357	
Corrected Total	11026.930	1356	

R Squared = .682 (Adjusted R Squared = .680)

The results in Table 2 indicate that method is a significant factor in students' mean achievement in structure of matter and energy changes. Hypothesis one which stated that method is not a significant factor in students' achievement in chemistry is therefore rejected. This means that there is a significant difference in the mean achievement scores of students taught using concept mapping and those taught using the conventional method. The experimental group achieved significantly higher than the control group in the structure of matter and energy changes test. Hence, the use of concept mapping strategy influenced achievement in structure of matter and energy changes.

Research Question 2

What is the difference between the mean achievement scores of rural and urban students taught using concept mapping strategy?

Table 3: The mean achievement scores and standard deviations of students in urban and rural schools in experimental group.

Type of Tests	urban (n=689)		rural (n=668)	
	mean	SD	Mean	SD
Pre-test	5.06	1.41	5.15	1.26
Post-test	15.11	2.00	16.26	2.05
Mean difference	10.05		11.11	

Table 3 shows that in the chemistry achievement test (CAT), the rural subjects in the experimental group obtained a higher mean achievement score of 16.26 with a standard deviation of 2.05 compared with their counterparts in urban schools who had a mean achievement of 15.11 and a standard deviation of 2.00.

However, considering their pretest- posttest gains, the urban subjects in the experimental group obtained pretest-posttest gain of 10.05 while the rural subjects in the experimental group obtained a pretest-posttest gain of 11.11. This implies that the rural subjects performed better than their urban counterparts, due to the use of the concept mapping strategy.

Null Hypothesis Two (H₀₂)

There is no significant difference between the mean achievement scores of chemistry students in urban and rural schools taught using concept mapping.

From the results presented in Table 2, it is observed that school location has a significant effect on students' performance in the structure of matter and energy changes. Thus, hypothesis 2 is rejected. This implies that a significant difference exists in the mean achievement scores of urban and rural subjects in favour of the rural subjects.

Discussion of Finding

The results in Table 3 reveal that students in the rural schools had higher mean score than the urban schools. The mean achievement gain of 11.11 of the rural students was higher than that of the urban schools with a gain of 10.05. Table 2 indicates that location is a significant factor on students' achievement on structure of matter and energy changes. The Table reveals that students in rural schools had greater achievement score. Hence the use of concept mapping strategy enhanced the achievement of students in chemistry in rural schools.

Conclusion

The students who were taught using concept mapping teaching strategy disposed favourably to

chemistry learning than those who were taught using the lecture method. There was also a significant difference in achievement scores of urban and rural chemistry students in favour of rural students.

Recommendations

The following recommendations were made based on the findings of this study:

- a). Since concept mapping is found to be an effective teaching strategy that enhances achievement among chemistry students, chemistry teachers should accept it as one of the strategies they can use in chemistry classrooms
- b). Chemistry teachers should put more efforts when using this strategy in teaching the urban chemistry students.
- c). Teacher training institutions should include the concept mapping strategy in their chemistry method course content. This will ensure that pre-service chemistry teachers know the value of and how to use the concept mapping teaching strategy.

References

- Ausubel, D. (1968). *Educational psychology: A cognitive view*. New York: Holt Rinehart.
- Buzan, T. (2007). Learning skills programme concept mapping. Retrieved from <http://www.cun.uvic.ca/learn/program/handouts/mapho.html>. On 13th April, 2007.
- Feher, J. Dieking, T. & Falk, S. (2003). *Toward an agenda for advancing research on science learning in out-school settings* Wiley Periodicals, Inc.
- Okebukola, P.A. (2005). The race against obsolescence: Science Teachers' Association of Nigeria (STAN) memorial lecture series, 17. Enhancing the Relevance

of STAN to National Development Jos, Plateau State, Nigeria.

O'Neil, J & Brooks, B. in C.K. William (1998). *The official journal of the National Association for Research in Science Teaching*. 35 (10), 61-63. John Willey and Sons, Inc.

Otor, E.E. (2011). *Effects of Concept Mapping Strategy on Students' Attitude and Achievement in Difficult Chemistry Concepts*. A PhD Thesis Submitted to the Postgraduate School, Benue State University Makurdi.

Rejane, B; Zelia, F; & Mike, W. (2004). Cooperating in Constructing knowledge: *Case studies from chemistry and citizenship*. *International Journal of Science Education*, 24(8), 935-949.

Savery, J.R. & Duffy, T.M. (2003). Problem based learning: An instructional and its constructivist framework. In B.E Wilson. *Constructivist learning environments: case studies in instructional design*. Educational Technology publications. Eagle wood Cliffs N.J.

Usman, I. A. & Memeh (2007). *The relationship between student's performance in practical activities and their academic achievement in integrated science using NISTEP mode of teaching*. Unpublished PhD Thesis, A.B.U Zaria.

Wasagu, M.A (2006). *Communiqué for the 47th annual conference of science teacher's Association of Nigeria on researches for Science, Technology and Mathematics (STM) education*. Helda Cross-River State University of Technology, Calabar.