

Comparative Analysis of Hierarchy and Spider Modes ofconcept Mapping on Secondary School Students' Achievement in Mathematics in Niger State, Nigeria

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ABSTRACT: *The purpose of this study is to determine the effects of concept mapping modes on secondary school students' achievement in mathematics in Niger State. Two research questions were raised and two null hypotheses were formulated and tested at 0.05 significant level. A pretest-posttest randomized group design was used in this study. Two hundred and four (125 male and 79 female) senior secondary school class one (SSS I) students in six randomly selected co-educational secondary schools in Niger State were used as sample. The instrument for data collection was Algebra Achievement test on spider and hierarchy modes of concept mapping (AATSAHON) which has reliability co-efficient of 0.78. The data analysis involved the use of analysis of variance (ANOVA). The two hypotheses were not rejected. The findings revealed that the achievement of experimental group has no significant difference with that of control group and that both hierarchy and spider modes of concept mapping does not show any gender difference in achievement. It was recommended that government, publishers and authors should take necessary steps to popularize concept mapping as a technique of teaching among teachers in order to enhance learning among students.*

KEYWORDS: Concept Mapping, Hierarchy mode, Students' Achievement, Secondary School, Spider mode

I. INTRODUCTION

Mathematics play crucial role in the advancement of technology and researchers reports have indicated poor academic achievement of secondary school students in mathematics education in Nigeria. Ezenwa, (2005) reveled that in the entire science subjects and mathematics less than forty (40%) percent of the students passed West Africa Examination Council (WAEC) Examination at the credit level. The quarterly journal of the consumer protection council (2011) revealed that the level of students' performance in mathematics from 2005 to 2009 in National Examination Council(NECO) conducted examination in Nigeria indicated a general poor performance of students in mathematics at secondary school level. According to Ezema (2000), traditional mathematics teaching is still the norm in Nigeria's schools. It has continued to dominate the mathematics classroom. Traditional teaching method is not able to sustain the development of children in mathematics, especially in secondary school education (Agwagah, 2004). Ezenwa (2005) asserted that one of the main aims of research in science education is to provide data in order to answer the question "what curriculum and instructional method are most appropriate for learners". Hence, recent research in science education is towards developing better instructional strategies to assist students learn science and perform well in science and mathematics particularly during examinations. In a similar development, low achievement in mathematics by learners has been attributed to ineffective instructional skills and methodologies by the teachers (Awofolaju, 2006). One of the possible factors militating against the positive relationship between instructional strategy and cognitive achievement of students is gender (Akinsola and Popoola, 2004). They further explained that the achievement of students in many learning situations depend on the school location, socio-economic background and the gender of learner.

Alio and Harbor (2002) find significant gender effect in their study in favor of male. Ohalebo (2002) in Akinsola and Popoola (2004), in his study find no significant gender effect. Duniya (2009) is of the view that gender issues in science education still remain unresolved as it affects performance. Therefore, gender effect on mathematics learning will continue to be a topical issue. The study therefore evaluated the comparative effects of spider and hierarchy modes of concept mapping instructional strategies on the achievement of senior secondary school students (SSSI) in mathematics in Niger state. It also determined the effect of gender on the achievement of students.

1.1 Statement of the Problem

Several studies have reported poor students' achievement in Mathematics despite the crucial role mathematics play in technology. The performance of students in mathematics at the secondary school level is still below average (Ezenwa, 2005). This has become a source of concern to all stakeholders in Nigeria education system. Those who teach subjects requiring the application of mathematics complained of the challenges they face. One of such challenges was attributed to the neglect of students centered learning which has been identified as a major reason for the problems in secondary school science education (Ezenwa, 2005). Furthermore, it has been observed that traditional teaching method is not able to sustain the development of children in mathematics, especially in secondary school level (Agwagah, 2004). Also the federal government declared, that decline in teacher's quality, as well as quality of instruction and instructional methods are responsible for students' failure (Daily Trust, 2011). It is against this background that this study evaluated the comparative effects of hierarchy and spider modes of concept mapping instructional strategies on the achievement of senior secondary school students (SSS I) in mathematics in three Educational Zones of Niger State, Nigeria. The study also determined the interaction effects of gender on the achievement of students.

1.2 Objectives of the Study

The following were the research objectives of the study:

1. To determine whether students taught using spider mode of concept mapping would perform better than students taught with hierarchy mode of concept mapping instructional strategy.
2. To determine if gender influences student's performance when both hierarchy and spider modes of concept mapping are used as instructional strategies

1.3 Research Questions

1. Is there any difference in the means score of students taught Mathematics using hierarchy concept mapping and those taught with spider concept mapping?
2. Is there any difference between male and female students taught Mathematics with hierarchy concept mapping and those taught with spider concept mapping?

1.4 Null Hypotheses

- H_01 : There is no significant difference in the mean scores of SSS I students taught mathematics using hierarchy mode of concept mapping and those taught with spider mode of concept mapping instructional strategies.
- H_02 : There is no significant difference in the mean scores of male and female SSS I students taught mathematics using hierarchy mode of concept mapping and those taught with spider mode of concept mapping instructional strategies.

II. METHODOLOGY

The study adopts a pretest-posttest randomized group as recommended by (Jack and Norman 2000). Two groups of subjects were used comprising of both male and female students. The control group were taught using spider mode of concept mapping instructional strategy while the experimental group were taught using hierarchy mode of concept mapping instructional strategy. The targeted population for the study is Senior Secondary School Students (SSS1) of the three educational zones of Niger State, with a total population of 36,537 students. It is from this population that Two hundred and four SSS I students comprising of 125 male and 79 female were randomly sampled.

Algebraic Achievement Test on Spider and Hierarchy Mode of Concept Mapping (AATSAHCON) developed by the researcher was the instrument used for data collection. The (AATSAHCON) was validated by a team of experts two each from Department of Science Education, and Mathematics and Computer Science of Federal University of Technology, Minna. The reliability coefficient of 0.78 was obtained for the instrument by administering a single test to a class and using Kuder-Richardson formula (KR12) method of estimating the reliability of an instrument. Analysis of data collected was done using one way Analysis of Variance(ANOVA)

III. RESULTS

The pretest and posttest analysis are presented in tabular form below.

Table 1: ANOVA comparison of the pretest mean scores of experimental and control groups.

Source of variation	Sum of Squares	df	Mean Square	Fcal	Sig. Level
Between Groups	1,394.114	30	46.470	1.177	.284 ^{ns}
Within Groups	2,763.589	70	39.480		
Total	4,157.703	100			

Ns-not significant at 0.05 levels

In table 1: The observed significant level $P = 0.284$ which is greater than $\alpha = 0.05$. This indicates that there is no statistically significant difference between the pretest mean scores of experimental and control group at $\alpha = 0.05$ level. This means that the students in the two groups were comparable with respect to their knowledge of the mathematics concept concerned before the experiment started.

H₀₁ There is no significant difference in the mean scores of SSS I students taught mathematics using spider mode of concept mapping and those taught with hierarchy mode of concept mapping instructional strategies.

Table 2: ANOVA comparison of posttest mean scores of SSS I students taught using hierarchy mode of concept mapping and those taught using spider mode of concept mapping instructional strategy.

Source of variation	Sum of Squares	df	Mean Square	Fcal	Sig. level
Between Groups	5,288.478	34	155.543	0.736	.834 ^{ns}
Within Groups	13,939.285	66	211.201		
Total	19,227.762	100			

ns- Not Significant at 0.05level

In table 2: the observed significant level $P = 0.834$, is greater than $\alpha = 0.05$. This means that hypothesis one is not rejected. This indicates that there is no statistical significant difference between the posttest mean scores of the hierarchy and spider groups at $\alpha = 0.05$ level.

H₀₂: There is no significant different in the mean scores of male and female SSS I student taught mathematics using hierarchy mode of concept mapping and those taught with spider mode of concept mapping instructional strategies.

Table 3: Anova comparison of the posttest mean scores of male and female experimental group and male and female control groups.

Source of Variation	Sum Of Squares	df	Means Square	Fcal	Sig. Level
Between Groups	658.108	3	219.369	1.313	.217 ^{ns}
Within Groups	33,424.637	200	167.123		
Total	34,082.745	203			

ns- Not significant at 0.05 level

In table 3: the observed significant level $P = 0.271$ is greater than $\alpha = 0.05$. This shows that hypothesis two is not rejected. There is no significant difference between the posttest mean scores of male and female students. This means the use of the two types of concept mapping instructional strategies are not gender dependent.

3.1 Summary of Findings

The findings of this study are as follows:

1. There is no significant difference between mean scores of students taught mathematics using hierarchy mode of concept mapping and those taught with spider mode of concept mapping instructional strategy.
2. There is no significance difference between mean scores of male and female students taught mathematics using hierarchy mode of concept and those taught using spider mode of concept mapping instructional strategy.

3.2 Discussion of Results

The ANOVA result in table showed that there is no significant differences between the pretest mean scores of the experimental and the control groups. This means; the students in the two groups were comparable with respect to their knowledge of the mathematics concepts concerned before the experiment started.

The ANOVA result in table 2 showed that there is no significant difference ($F = 0.736$, $P > 0.05$) between the mean scores of the students taught using spider mode of concept mapping and those taught using hierarchy mode of concept mapping instructional strategies. This indicates that the two modes of concept mapping instructional strategies enhance students understanding of mathematics concepts equally. Thus, the results of the study revealed that students' achievement in mathematics would be improve if appropriate methods such as concept mapping instructional strategies are applied, this is in live with the result of Awofolaju (2006); Aiyede (2008) and Eze (2008). The found concept mapping instructional strategy very effective in

teaching students mathematics concepts. In a similar development this is also in agreement with the result of Wushishi (2001), Ezenwa (2005); Osagbemi (2004) whose studies indicated that concept mapping is an effective instructional strategy in teaching science (Chemistry) concepts.

The Anova result in Table 3 reveals that there is no statistically significant difference ($F = 1.313, P > 0.05$) between the performance of male and female students taught using both spider and hierarchy modes of concept mapping instructional strategies. That is, both spider and hierarchy modes of concept mapping have no significant gender bias in terms of achievement, this agrees with the findings of Exenwa (1999), Danwole and Adeoye (2004), Olialebo (2002), Awofolaju (2006), that no significant gender effects in the use of concept mapping instructional strategies. It is however in disagreement with the findings of Alio and Harbor (2002) that indicated a significant gender effect in instructional strategy in favour of the male.

IV. CONCLUSION

From the findings of this study, it was concluded that the use of concept mapping instructional strategies:

1. Enhanced the quality of instruction and understanding of mathematical concepts thereby increasing the student's achievement in mathematics more significantly.
2. Enhance gender equality in achievement of the mathematical concept by students.
3. Both the spider and hierarchy modes of concept mapping instructional strategies enhanced the student's achievement.

V. RECOMMENDATIONS

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

1. Mathematicsteachers should incorporate these techniques in teaching mathematics in classrooms in the secondary schools.
2. Concept mapping instructional strategy should be included in the mathematics pedagogy of teacher training institutions to endure that the teachers are adequately train on how to use the method.

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