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EFFECTIVENESS OF CONCEPT MAPPING AND COMPETITIVE INSTRUCTIONAL STRATEGIES ON BASIC EDUCATION STUDENTS' PERFORMANCE IN THERMAL ENERGY IN TARABA STATE, NIGERIA

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ABSTRACT

The study determined the effects of Concept mapping and competitive instructional strategies on upper basic education students' performance in thermal energy. Quasi experimental design was adopted for the study. Out of 2,228 Upper Basic education students 60 students, (male 32 female 28) from two intact classes served as sample of the study. Three purposes, three research questions and three hypotheses guided the study. Mean and standard deviation were used to answer the three research questions, while the three hypotheses were tested at 0.05 significant level using t-test statistics tool. The reliability of instrument of the study was 0.74. The research revealed that concept mapping has a substantial effect on students' academic performance in Thermal Energy (t- cal = 3.63, P-value = 0.00 at degree of freedom (df) = 58). It also showed that gender have no substantial influence on upper basic education students' performance (t-cal is 1.546 and P-value is 0.000 which is less than alpha α= 0.05 with degree of freedom (df) = 58). It was concluded that concept mapping strategy improve students' performance in basic science. Based on the findings of this study, it was recommended that the use of concept mapping instructional strategy in the teaching of basic science should be encouraged during upper basic education program since it enhanced students' performance and it is also gender friendly

Keywords: Concept mapping instructional strategy, competitive instructional strategy, Students' performance and thermal energy

INTRODUCTION

Basic science is one of the core subjects listed in the National Policy on Education (2013) for primary level of education in Nigeria. It is a basic subject that lays the foundation for the takeoff of the sciences (biology, chemistry and physics) at the Secondary school level of education. Ukpai, Okafor, Abonyi and Ugoma (2016) submitted that the subject is an approach to science in which concepts and principles are presented so as to express the fundamental unity of scientific thoughts and avoid premature or undue stress on the distinctions between the various scientific fields. The authors opined that Basic Science is the tool with which man learns about his environment, its resources and problems and how to control and utilize them both productively and sustainably. It is therefore important for the learner have a good background in the subject for meaningful learning in science education to occur.

Ausubel in Auta (2015) maintained that meaningful learning occurs only when the learner consciously and explicitly ties new knowledge to relevant concepts and expressions. Therefore, the responsibility of basic science teachers is not only to teach students the particular content of knowledge needed for their professional discipline but also to help them develop successful lifelong skills of acquiring knowledge which is the main objective of teaching the subject.

One of the major goals of Basic science at primary school to produce students who will takeoff science subjects related to Basic Science without difficulties. It has been observed that the achievement in the subject is poor. Researchers have identified the teacher variable, that is the teachers teaching strategy as being responsible for students' poor academic achievement in science (BouJaoude and Attie, 2008). Science Educators had also found out that Basic Education students' inability to learn the concept thermal energy could be one of the reasons their poor performance in Basic Science which might affect students' performance in physics at the secondary

school level (Danjuma & Obioha, 2021). This under achievement in the subject could be attributed to many factors among which are the instructional method employed by the teacher (Oloyede, 2010). This implies that there is the need for the use of appropriate instructional strategy if the objectives of teaching basic science are to be attained.

There are different types of instructional strategies some of which are concept mapping and competitive instructional strategies. One instructional strategy which probably has the potential to offer opportunities to address the problems of effective teaching and learning is the concept mapping advocated by Novak and Godwin in 1984. Concept mapping is one of the newest instructional approaches developed by Novak. It is a process of organizing information or knowledge in form of maps as show relationships between and among those concepts. According to Novak (1990) concept mapping makes learning easier and easily understandable. Ahmad and Mirza (2013) posited that Concept mapping is a technique of visually representing the structure of information, concepts and their relationship. The authors further stated that research studies in the field of science education reflect that concept mapping can be used as a successful teaching – learning strategy from primary school to university level.

The use of concept maps as a teaching strategy was first developed by J.D. Novak of Cornell University in the early 1980's. It was derived from Ausubel's learning theory which places central emphasis on the influence of students' prior knowledge on subsequent meaningful learning. The concept map is a diagrammatic devise used to represent the conceptual structure of a subject discipline in a two dimensional form which is analogous to a road map. Novak (1990) further explained that concept maps are also visual diagrams constructed to represent the organization of concepts/ideas and outline the relationship among or between those concepts. They are representations of organized knowledge in diagrams which can be done in hierarchical and/or linear order with the most inclusive concept on top of the map and the most specific concept at the bottom (Novak 1991). Concept mapping deals with linking concepts. It can be likened to a spider chart, an organized chart or a flow diagram. Concepts do not exist in isolation; each concept depends on its relationship to many others for meaning.

Another instructional strategy that the researchers explored in an attempt to find out the appropriate strategy for the teaching of thermal energy in basic science is the competitive instructional strategy . This strategy is motivated by participation in a competition. In this instructional strategy, once a student achieves the goal, all other students fail to reach that goal (Johnson & Johnson 1991) in Danjuma and Nwagbo (2016). There is always a winner and a looser in competitive instruction. The competition can be interpersonal (between individuals), or intergroup (between groups) where a group setting is appropriate. However, in this study, the competition was between individual learners. The use of competitive instructional strategy ensures that each of the learners struggles to outperform the other by all means; at all cost as they compete among themselves. The teacher in this case encourages individual efforts and make sure that learners sit apart from each other so as not to enable them share ideas. Tabesh (2007) was of the view that competitive alongside cooperative instructional strategy makes learning outcomes more effective. Johnson, Geoffrey, Johnson, Nelson and Skon (1981) found out that the use of competitive instructional strategy is not as effective as the use of cooperative instructional strategy. Danjuma (2015) also submitted that students learn better when they collaborate than when in competition with each other. Generally, instructional strategy has a considerable effect when considering students' performance because when teachers acquire new information, try to figure out the relationship between new ideas in the information and previous knowledge, they are engaged in strategy use. The use of strategies in delivering instruction to the learner could go to a long way in affecting students' performance however gender could influence students' performance in learning education basic science.

Gender is a socio-cultural construct differentiating the roles of girls and boys in a given society; the physical, biological, mental and behavioural characteristics about and differentiating between the feminine and masculine (male or female) population.

Researchers like Useini (2022) submitted that there is no significant difference in the performance of female and male students in the learning of human skeleton. However (Danjuma 2015) opined that gender disparity in education basic science classroom reduces when appropriate learning strategy is in place. Studies on gender as it affects students' performance in education basic science is inconclusive, hence, needs further investigations.
Therefore, the quest for the appropriate teaching strategy that will enhance students' understanding of thermal energy in basic science is what necessitated this study.

Purpose of the Study

i. To determine the students' performance in thermal energy using concept mapping and competitive instructional strategies
ii. To determine the influence of gender on students' performance in thermal energy using concept mapping and competitive instructional strategies

Research Questions

1. What is the mean performance score of students taught thermal energy using concept mapping instructional strategy and those taught thermal energy using competitive instructional strategy?
2. What is the mean performance score of male and female students taught thermal energy using concept mapping instructional strategy and those taught thermal energy using competitive instructional strategy?

Hypotheses

$H0_1$ There is no significant difference in the mean performance scores of students taught thermal energy using concept mapping instructional strategy and those taught thermal energy using competitive instructional strategy.

$H0_2$ There is no significant difference in the mean performance scores of male and female students taught thermal energy using concept mapping strategy and those taught thermal energy using competitive instructional strategy.

Research Methodology

The design for this research was Quasi- experimental which employed pre-test post-test non-equivalent control group design. The design seeks to establish the cause-effect relationship of a given treatment. The design is considered appropriate because it can be used to identify confidently the cause of any given effect. Pre-test was administered before the treatment by the researcher to determine the equivalents in the academic performances of the respondents. Post-test was administered after the treatment to determine the effects of treatments on the respondents.

The study was carried out in Jalingo educational zone. The area was chosen because it was observed that basic education students' performance in basic science is low as revealed from the state education resource centre. The population of the study consists of 2,228 of upper basic science students from 364 public coeducational schools to enable the researchers obtained gander participation in the study. 60 upper basic III students were sampled out for the study using multi stage sampling.

Using random sampling Ardo Kola local government area was selected out of Jalingo education zone after which two government owned schools with at least two streams each were selected using purposive sampling. 60 students drawn from two intact classes from each of the selected schools designated concept mapping and competitive groups make up the sample of the study.

Thermal Energy Performance Test (TEPT) developed by the researchers was used for data collection. The instrument was administered (pretest) to the subjects of the study by research assistants who doubled up as the respondents' basic science teachers to determine their pre-

requisite knowledge in thermal Energy. After the administration of the pretest, the respondents were taught thermal energy using concept mapping instructional strategy and competitive instructional strategies. TEPT was set to determine the performance of the students before administering treatment and after the treatment. TEPT consists of 25 multiple choice items covering concepts in thermal energy. TEPT and the lesson plans for the instructional strategies underwent validation by experts in Science education and measurement and evaluation from Taraba State University, Jalingo in order to determine its effectiveness in measuring what it was expected to measured. The reliability co-efficient for instrument determined using the Kuder-Richardson Formula 21 which determines the suitability of the instruments for the study was found to be 0.74

To control for possible pre-existing differences in overall ability between the experimental groups a pretest was administered to both groups before the commencement of the experiment in the sampled schools. After the administration of Pretest, the concept mapping group was taught using concept mapping instructional strategy while the competitive group was taught using competitive instructional strategy for two weeks.

Data collected was analyzed using mean and standard deviation in answering research question 1 and 2, while t-test statistics was used to test hypothesis at 0.05 level of significance. The choice of t-test statistical analysis for this study was based on the fact that the researcher wants to determine whether there is a significant difference between the mean performance sc of respondents under concept mapping group and those under competitive group.

Result

Research Question 1: What is the effect of concept mapping and competitive instructional strategy on students' academic performance in thermal energy?

Table 1: Means and Standard Deviation of Concept mapping and Competitive Strategies in Thermal Energy Performance Test (TEPT)

Groups		N	Mean	SD	MD
Concept mapping	posttest	30	52.73	12.68	
					6.97
Competitive	posttest	30	45.76	14.43	

Results in Table 1, shows the mean score of the concept mapping group was 52.73 and a standard deviation of 12.68 while the mean scores for the competitive group was 45.76 and a standard deviation of 14.43. The mean difference of concept mapping and competitive group was 6.97 in favour of the concept mapping group.

Research Question 2: What is the effect of concept mapping and competitive instructional strategy on the academic performance of male and female students in thermal energy?

Table 2 Mean and Standard Deviation of male and female students' performance under Concept mapping and Competitive Strategies in thermal energy

Groups	N	Mean	SD	MD
Males posttest	26	24.72	3.38	1.88
Females posttest	34	22.84	5.55	

Result in Table 2 above shows that the mean score of the male gender was 24.72 and a standard deviation of 3.38 while the mean score for the female gender was 22.84 and a standard

deviation was 5.55. The mean difference of male and female gender was 1.88 in favor of the male gender.

$H0_1$ There is no significant difference in the mean performance scores of students taught thermal energy using concept mapping instructional strategy and those taught thermal energy using competitive instructional strategy.

Table 3: Presents t-test of posttest means score of the concept mapping and competitive instructional strategies in Thermal Energy Performance Test (TEPT)

Groups	N	Mean	SD	df	t-cal	t-crit	p-value	Decision
Concept mapping	30	51.73	12.68					
				58	3.63	1.98	0.00	Significant
Competitive	30	44.76	1 4.43					

The results in Table 3 Shows that the t- cal is 3.63 and the P-value = 0.00 at degree of freedom (df) = 58. Since the P-value = 0.00 < α= 0.05. It means that there is a significant difference in the mean scores of the concept mapping and competitive groups. The significant difference is in favour of the Concept mapping group as indicated by the mean scores. With this result the $H0_1$ was rejected.

$H0_2$ There is no significant difference in the mean performance scores of male and female students taught thermal energy using concept mapping strategy and those taught thermal energy using competitive instructional strategy.

Table 4: t-test analysis of posttest male and female students' performance mean scores under concept mapping and competitive instructional strategies in thermal energy

Group	N	Mean	SD	df	t.cal	t.crit	P-value	Decision
Males posttest	26	25.14	3.21					
				58	1.546	0.127	0.000	significant
Females posttest	34	23.50	4.82					

Table 4.7 shows that the t-cal is 1.546 and P-value is 0.000 which is less than alpha α= 0.05 with degree of freedom (df) = 58. This means that there is significant difference between the posttest scores of male and female exposed to Concept mapping teaching strategy. Therefore, $H0_2$ was not rejected.

The results in Table 4.6 Shows that t- cal is 2.86 and the P-value = 0.00 at degree of freedom (df) = 58. Since the P = 0.00 < α = 0.05. It means that there is a significant difference in the mean scores of the concept mapping and the competitive groups in performance level of the students. The significant difference is in favour of the concept mapping group. With this result $H0_2$ was rejected.

Discussion Findings

Table 4 revealed that the concept maps teaching strategy enhanced academic perfomance of students in learning thermal energy. Onyejekwe, Uchendu, Chinwe and Tochi (2018) carry out the study was to discover the effect of concept mapping on students' Performance in Genetics in selected senior secondary school in Obio/Akpor metropolis..Results from the study showed better achievements of students' results in favour of concept mapping instructional method to the conventional method of teaching. In the study of Ukpai, Okafor, Abonyi and Ugama (2016)

investigated the effects of concept mapping on students' performance in basic science agreed that concept mapping fosters students' performance in basic science than conventional method. It boosts the achievement of both male female students in the subject. The study revealed that there was a statistically significant difference in the mean performance scores of students taught using concept maps and competitive strategy. The author recommended concept mapping teaching strategy in basic science because of its influence on performance than their counter part that were strictly taught in the class using competitive strategy.

Table 4 showed that there was significant difference between male and female taught using concept mapping and competitive teaching strategy. This study is in conformity with the work of Ahmad and Munawar (2017) where the authours submitted that male students taught through concept mapping performed significantly better than the female students. The finding of this study is contrary to the finding of Danjuma (2015) which states that gender gap in basic science is closing up. With this kind of disparity in gender studies, there is the need for continuous investigation in gender issues in basic science.

CONCLUSION

It was concluded that concept mapping strategy improve students' performance in basic science and there was a significant difference between male and female students' performance under concept mapping instructional strategy

RECOMMENDATION

i. Basic science teachers should endevour to use concept mapping stratey during lesson since it enhanced better performance.
ii. Since Concept mapping teaching strategy is gender friendly its' application should be encouraged among Males and Females learners at upper basic classes.

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