Effect of Concept Mapping and Competitive Instructional Strategy on Basic Science Education Students Academic Performance in Thermal Energy in Ardo-Kola Local Government Area of Taraba State, Nigeria

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ABSTRACT

This study was conducted to determine the effect of Concept mapping and competitive instructional strategy on Basic Science students on academic performance in Ardo-Kola Local Government Area of Taraba Statte. Three research questions and hypotheses were formulated and tested at 0.05 level of significance. The quasi experimental research was adopted. The population of the study was 2,228 Upper Basic level students of public schools. The sample was 60 students, consists of (male 32 female 28) selected through a random sampling technique to form two intact classes. Thermal Energy Performance Test (TEPT) was used for the collection of data. Mean and standard deviation were used to answer the three research questions, while the three hypotheses were tested with t-test statistic tool. The research revealed that concept mapping has a substantial effect on students' academic performance in Thermal Energy while gender have no substantial effect on students' academic performance. Based on the findings of this study, it is recommended that the use of concept mapping teaching strategy should be encourage at upper basic, hence it enhanced better performance. Concept mapping teaching strategy is gender friendly, it should be encouraged among Males and Females students at upper basic level.

KEYWORDS: Concept mapping, Instructional strategy, Basic science, Academic performance, and Thermal energy

1. INTRODUCTION

Basic science is one of the core subjects listed in the National Policy on Education (2013) for Junior Secondary Schools in Nigeria. It is a basic subject that lays the foundation for the takeoff of the sciences (biology, chemistry and physics) in the Senior Secondary classes. Basic science as defined by Ukpai, Okafor, Abonyi and Ugoma (2016) is an approach to science in which concepts and principles are presented so as to express the fundamental unity of scientific thought and avoid premature or undue stress on the distinctions between the various scientific fields. Science in its general view, the authors stated 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. 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 teachers in schools and colleges 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. A number of factors have been identified as militating against students' attainment of the objectives of science instruction, and the most pronounced factor identified by researchers is the inappropriate and uninspiring teaching methods adopted by science teachers, (Cheema & Mirza, 2013).

One instructional strategy which probably has the potential to offer opportunities to address the problems of effective teaching and learning of basic science is the concept mapping advocated by Novak

and Godwin in 1984. 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. Concept maps 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. Concept maps simply put are diagrammatic propositions. And propositions are two or more concept labels linked by words which provide information on relationships or describe connections between concepts. Concepts do not exist in isolation; each concept depends on its relationship to many others for meaning.

Novak & Canas in Martins-Omole (2015) believes that one of the reasons concept mapping is so powerful for the facilitation of meaningful learning is that it serves as a kind of template or scaffold to help to organize knowledge and to structure it, even though the structure must be built up piece by piece with small units of interacting concept and propositional frameworks.

Performance in Basic Science over the years have been observed to be poor. The study conducted by Abonyi (2012) confirmed that students' achievement in basic science is very poor. BouJaoude and Barakat in Agaba (2013) posited a reason for these poor achievements. According to them the teaching methods adopted by teachers do not make the learning of Basic Science (thermal energy) easy for students'. Similarly, Oloyede (2010) identified that the method used by teachers of science contribute to students' poor Performance in science subjects such as Basic Science

Francisco, Nicol and Tantman in BouJaoude and Attieh (2008) posited that prevailing teaching practices do not actively involve the learners in the learning process and seem to deprive the learners of taking charge of their learning, thus, affecting their Performance in examinations. Therefore, it become imperative to empirically investigate into the effect of concept mapping in the teaching of energy flow in secondary school students.

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. Ahmed 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. Ukpai, at el (2016) stated that 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. Concept mapping is a procedure of arranging facts or data in way of maps as two-way diagram which comprises of concept connected by stipulated outline to illustrate relationship among words.

According to Henderson in Onyejekwe, Chika, Uchendu, Chinwe and Tochi (2018) concept map can be used in the following ways: teaching and revision of topic, which help learner, convey a clear general picture of topic, their relationship to their students and also help learner discover key concepts, reinforcing understanding –concept maps help to discover key concepts and summarize relationship, check learning and identify misconceptions- it serves as an evaluating tool in teaching and learning process and assessment- students' achievement can be tested or examined by concept maps. It also helps the instructor diagnose the misconceptions that make the instruction ineffective.

Review of Relevant Empirical Studies

Adeneye (2011) investigated the effect of concept mapping strategy on achievement in mathematics of 88 junior secondary year three Nigerian students. The study adopted a pre-test, posttest non-equivalent control group quasi-experimental design and data collected for the study were analysed using the t-test statistic. The experimental group, taught with concept mapping strategy obtained mean post-test score which was significantly higher than the mean post-test score of the control group. Results showed that concept mapping is an effective strategy for teaching and learning mathematics. The strategy is also capable of improving students' mastery of content at the higher-order levels of cognition. Based on the findings, the study recommended that concept mapping should be

added to the teaching strategies of mathematics teachers at the secondary school level.

Udeani and Okafor (2012) investigated the comparative effectiveness of the expository and concept mapping instructional strategy of presenting secondary school biology concepts to slow learners. One hundred and twenty four biology slow learners were identified and randomly assigned to the expository group (n=62) and concept mapping group (n=62) and respectively taught the concept of photosynthesis. The groups were post-tested after two weeks of teaching for any significant differences in their biology achievement. Analysis of post-test scores indicated that the group taught by the concept mapping instructional strategy performed significantly (p<0.05) better than their expository group counterparts. Specifically, female slow learners taught with the concept mapping instructional strategy performed significantly (p<0.05) better than their male counterparts taught by the same method. These results have implications for biology teacher preparation, especially in the areas of teaching females and identifying slow learners and adopting effective methods of tackling their problems.

Agaba (2013) carried out a study was to find out the effect of concept mapping instructional strategy on student's retention in Biology. The design of the study was quasi-experimental design. Specifically, non-randomized control group pre-test post-test design was used for the study. Two randomly selected intact classes from two schools were used and the students in the classes were assigned to experimental group or control group. The experimental groups were taught with concept mapping instructional strategy, while the control groups were taught with lecture method. Biology Retention Test (BRT) was the instrument used for data collection. Analysis of covariance (ANCOVA) was used to analyze data that were collected. The result of the study shows that concept mapping instructional strategy enhances retention in Biology.

Martin-Omole (2015) carried out the study aimed at determining the Effect of Using Concept Mapping and Experimental Techniques in Teaching Biology in Senior Secondary Schools in Federal Capital Territory. The design of the study was quasi experimental pretest posttest control group design. The population consisted of 6,208 SS2 Biology students of the Federal Capital Territory, from which 192 were selected from three schools within Karshi zone of Abuja Municipal Area Council. Intact classes of 64 students each of SS2A & SS2B students of Government Secondary School Nyanya were used for the experimental group which consisted of students

taught Biology using concept maps and experiments and 64 SS2A students of Government Day Secondary School Karu were used for the control group respectively. The choice of the schools were because they shared similar characteristics like student types (co-educational), number of students per class and presence of competent and experienced Biology teachers. To guide the study, five research questions were raised and five hypotheses stated and test at 0.05 level of significance. The major instruments used for data collection were Biology Achievement Test pretest and posttest (BAT), Biology Achievement Retention Test (BART) used after 2 weeks of instruction and Concept Mapping Attitude Scale Towards Biology Questionnaire (CMASTBQ) and Experiment Attitude Scale Towards Biology Questionnaire (EASTBQ).The treatment package included Concept Mapping Instructional Package (CMIP), Lesson Plan for Experiments and Lesson Plan for Control Group. The items used for the pretest, posttest and retention test were adopted from Educational Resource Centre (ERC) Abuja. The items were lifted based on the topics used for the study. The reliability of these instruments used was 0.65 for concept mapping and 0.78 for experimental techniques. The data collected was analyzed using comparative mean and standard deviation for research questions while the null hypotheses were analyzed using Two sample t-test, Covariance Analysis(ANCOVA) and Pairwise comparison tested at 0.05 alpha level of significance. The findings of the study showed a significantly better academic performance of students who were taught using experiments than those taught using concept mapping; students taught using experiments performed significantly higher in retention of Biology knowledge than those taught using concept mapping and lecture method, no significant difference was observed between students taught using concept mapping and lecture method on retention of these concepts; Students showed positive attitude towards the use of concept mapping over the use of experiments Based on the findings, experiments are indispensable if the teaching and learning of Biology is be effective and meaningful.

Ukpai, Okafor, Abonyi and Ugama (2016) investigated the effects of concept mapping on students' achievement in basic science. The study was carried out in Ebonyi State of Nigeria. The study employed a quasi experimental design. Specifically the pretest posttest non-equivalent control group research design was used. The sample was 122 students selected from two secondary schools drawn from the population through a simple random sampling. One school was used for treatment and the

other for control. The treatment group was taught basic science with concept mapping approach while the other was taught with conventional method. Three research questions and three null hypotheses guided the study. Mean, standard deviation and the Analysis of Co-Variance (ANCOVA) were used to analyze data. Results showed that concept mapping fosters students' achievement in basic science than conventional method. It boosts the achievement of both male female students in the subject. In addition there is no interaction between gender and teaching methods on students' achievement in basic science.

Meheux (2017) 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.

Ahmad and Munawar (2017) carried out the study to analyze effect of concept mapping, a constructivism based learning strategy, on academic performance of 7th grade students in the subject of general science. This quasi experimental research, based on 2x2 factorial research design, involved 167 students from two single sex schools. Major objectives of the study were to; (i) find out the effect of concept mapping as a learning strategy on the academic achievement of students (ii) study differential effect of concept mapping on academic achievement of male and female students (iii) to find out the interaction effect of concept mapping as a learning strategy and gender on students' academic achievement. Researcher's developed achievement test was used as pre test and post test. During the treatment of five months, experimental group was trained to develop concept maps for three weeks. Subsequently students developed concept maps of general science content individually, shared those in groups and were compared by teacher with scientifically accepted concept maps for possible correction and improvement. Data on gain achievement scores were analyzed through 2-way ANOVA. Results showed that the male and female students taught through concept mapping performed better than the students taught through traditional teaching method. However male students taught through concept mapping performed significantly better than the female students. It is therefore recommended that concept mapping should be used in elementary classes for teaching general science. Concepts maps may also be incorporated in the textbooks of science subjects at the school level.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. The research design used was quasi experimental design which consisted of a pre-test and posttest group. The population of the study consisted of 6168 SS2 students in Obio /Akpor metropolis, from which sample size of 90 SS2 students was arbitrarily chosen from two public co-educational schools. The experimental groups were taught genetics with concept mapping teaching method, while the control groups were taught using lecture method. Genetics performance test (GPT) was the instrument used for data collection. The instruments were validated and the reliability coefficient was established as 0.72 using Cronbach Alpha ϭ Reliability method. Four research questions and four hypotheses guided the study. Mean and standard deviations were used to answer research questions. Hypotheses one and three were tested using ANOVA while hypothesis two and hypothesis four was tested using ANCOVA at 0.05 level of significance. Results from the study showed better achievements of students' results in favour of concept mapping instructional method to the conventional method of teaching. Concept mapping teaching method enhanced students' performance in biology especially genetics. Base on the findings, it was recommended among others that there should be regular and adequate training of teachers on the use of

concept mapping for instruction of perceived difficult concepts in science topics and other subjects.

Eric (2018) examined the effect of concept mapping instructional strategy on students' academic achievement and interest in Economics in Imo State. The study adopted the quasiexperimental pre-test, post-test non-equivalent control group design. The population of the study comprised of all the 2,892 senior secondary two (SS II) students who offer Economics in 10 public secondary schools located within Owerri Municipal Council of Imo State. The Purposive sampling technique was used to select the two co-educational schools for the study. The sample for the study consisted of 48 Economics students from two intact classes. The instruments for data collection were "Economics Interest Scale (EIS)" and "Economics Achievement Test (EAT)". The instruments were pilot tested on 30 students from a nonparticipating school. The EIS yielded a Cronbach alpha reliability index of .84 which was a good reliability index while EAT has an index of .78 using Kuder Richardson formular 21. The research questions were answered using mean and standard deviation while the hypotheses were tested at .05 level of significance using One-Way Analysis of Covariance (ANCOVA). It was found among others that concept mapping teaching strategy is more effective than the lecture method in teaching of Economics. This implies that concept mapping was effective in the improvement of students' achievement and interest in Economics. Based on the findings in this study, it was recommended that: in order to enhance students' performance in Economics, concept-mapping should be adopted as a teaching strategy by Economics teachers, who are the central factor at the Economics curriculum implementation level, also the is need for seminars and workshops should be organised to improve Economics teachers pedagogical skills and to broaden their knowledge of instructional methods in order to constantly update their knowledge of innovations in teaching.

Jack and Suleiman (2020) investigated the effect of Concept Mapping and Guided-Inquiry instructional strategies on students' academic achievement in Chemistry. The study used a test-retest quasi experimental design. The population for the study is 659 Secondary School One (SS I) Chemistry students of 2017/2018 academic session in Jalingo metropolis, Taraba state. The Sample size consisted of 113 students drawn from two schools which use intact classes with equivalent mean scores of 10.22 and 9.76 in their pretest. Chemistry Achievement Test (CAT) was used for data collection. The reliability coefficient of the CAT was found to be r=0.84. Data collected was analyzed using means, standard deviation and analysis of covariance (ANCOVA). The result showed that the experimental group which was taught chemistry using Guided-Inquiry instructional strategy performed significantly better than the Concept Mapping group. The results also showed that there is no significant interaction effect of method of teaching and gender on students' achievement in chemistry. The conclusions drawn revealed that students taught chemistry using Guided-Inquiry strategy performed better than their counterparts that used

Concept Mapping strategy, and both methods were gender unbiased. The present study is related to the study under review in areas such as the study design, the study variables and instrument for data collection. However, the study differ in the population and sampling techniques. Therefore, this research work will seek to investigate the effect of concept mapping on students' academic achievement in energy flow in Basic Science in Taraba State, Nigeria. The study provides answers to the following questions. What is the effect of concept mapping and competitive instructional strategy on students' academic performance in thermal energy? What is the effect of concept mapping and competitive instructional strategy on the academic performance of male and female students in thermal energy? What is the interaction effect of gender and concept mapping and competitive instructional strategy on students' academic performance in thermal energy?

2. Materials and Methods
2.1. Area of the Study
The study area was Jalingo educational zone in Taraba State, Nigeria. Ardo-Kola Local Government Area in Jalingo Education Zone one of the education zone amongst the ten educational zones in the state. It has been observed that there is poor performance in Basic Science in the area which is contributed to many factors amongst which is the method of instructional strategy. The area is also selected for its concentration of the many public junior secondary schools (upper basic), availability of instructional media and qualifies teachers in the state since it is close to the state capital.

2.2. Research Design
The design for this research was Quasi- experimental which 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 performance. 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 (thermal energy performance Test).Experimental group received treatment using concept mapping teaching strategy while Control group was taught using competitive strategy.

2.3. Population of the Study
The population consists of two thousand two hundred and twenty eight (2,228) of upper basic school students within Ardo-Kola Local Government Area, Jalingo education zone. These public junior secondary schools (upper basic) were coeducational schools to enable the researchers obtained gander participation in the experimental and control groups during the study.

2.4. Sample and Sampling
A sample is group of people, objects or items that are taken from a large population for a measurement. The sample should be representative of the population to ensure that we can generalize the findings from the research sample to the population as a whole. (Majure, 2016). Sampling is the act, process, or technique of selecting a suitable sample, or a representative part of a population for the purpose of determining parameters or characteristics of the whole population. Two secondary schools were drawn from the secondary schools in Ardo-Kola Local Government Area of Taraba State through a simple random sampling. A total of sixty upper basic students drawn from two intact classes of JSSIII were involved in the study. In each school selected intact class of junior secondary school (JSSIII) students were used. Out of the two secondary schools that were used for the study, one was assigned to the treatment group while the other was assigned to the control group through a simple toss of coin. In all, 30 students were used for treatment group and 30 students for control group

2.5. Instrumentation
The thermal Energy Performance Test (TEPT) was used in the study. Two tests were used to measure achievement, one pretest was used to test students' pre-requisite knowledge in topic (thermal Energy) relating to the one to be covered during the study. The post-test measure students' achievement at the conclusion of the study. The objectives test was set to determine the academic achievement of the students before treatment and after the treatment. The pre-test assessed students' achievement on the topic listed out for the research. The post-test also assessed students' academic achievement on the topic. The thermal

Energy Performance Test consists of twenty five (25) items was used which will cover all the topic (thermal energy). The multiple choice questions with five options each (A-E) was used.

2.6. Validation of the Instrument
The instrument, thermal Energy Performance Test, (TEPT) and the lesson plans underwent validation from experts in Integrated Science education and measurement and evaluation in order to determine its effectiveness in measuring what it was expected to measure.

2.7. Reliability of the Instrument
The reliability co-efficient for instrument was determined using the Kuder-Richardson Formula 21 which determines the suitability of the instruments for the study.

2.8. Administration
To control for possible pre-existing differences in overall ability between the treatment and control groups a pretest was administered to both groups before the commencement of the experiment in the respective schools. The treatment group was taught with concept mapping strategy while the control group will be taught with competitive strategy using the same content outline for two weeks. Two tests were used to measure academic performance: one pretest was used to test students' pre-requisite knowledge in the topic (thermal energy) related to the ones that was covered during the study. The post-test measured students' academic performance at the conclusion of the study.

2.9. Method of Data Analysis
Data collected was analyzed using mean and standard deviation in answering research question 1, 2 and 3. T-test statistics was used to test hypothesis at 0.05 level of significance.

3. Results and Discussion\
The data collected for the purpose of this study were analyzed based on the questions raised using mean and standard deviation.

3.1. The first question: What is the effect of concept mapping and competitive instructional strategy on students' academic performance in thermal energy?

The descriptive statistics of mean and standard deviation were used to answer this research question and the summary of the results is presented in Table 1.

Table 1: Means and Standard Deviation of the Experimental (Concept mapping) and Control (Competitive Strategy) groups in Thermal Energy Performance Test (TEPT)

Groups	N Mean	SD	MD
Experimental group posttest	30 52.73	12.68	6.97
Control group posttest	30 45.76	14.43	

Results in Table 1, shows the mean score of the experimental group was 52.73 and a standard deviation of 12.68 while the mean scores for the control group was 45.76 and a standard deviation of 14.43. The mean difference of the experimental and control group was 6.97 in favor of the experimental group. This shows that the experimental group had mean score than the control group. This implied that the effect of the treatment had impact on the experimental group

3.1.1. The second question: What is the effect of concept mapping and competitive instructional strategy on the academic performance of male and female students in thermal energy?

A descriptive statistics of mean and standard deviation were used to answer this research question and the summary of the result is presented in Table 2

Table 2 Mean and Standard Deviation of the Experimental (Concept mapping) and Control group (Competitive Strategy) in Thermal Energy Performance Test (TEPT)

Groups	N	Mean	SD	MD
Experimental group posttest	30	54.09	14.14	10.33
Control group posttest	30	43.76	14.43	

Results in Table 2, show that the mean scores of the experimental group was 54.09 and a standard deviation of 14.14 while the means scores for the control group was 43.76 and a standard deviation of 14.43. The means difference of the experimental and control group was 10.33 in favour of the experimental group. This proved that the experimental group had mean scores more than the control group. It implied that the effect of the treatment had effect on the experimental group.

3.1.2. The third question: What is the interaction effect of gender and concept mapping and competitive instructional strategy on students' academic performance in thermal energy?

Descriptive statistics of mean and standard deviation were used to test this research question and the summary of the result is presented in Table 3

Table 3 Mean and Standard Deviation of the Experimental (Concept mapping) and Control groups (Competitive Strategy) 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 3 shows that the mean score of the experimental group was 24.72 and a standard deviation of 3.38 while the mean score for the control group was 22.84 and a standard deviation was 5.55. The mean difference of the experimental and control group was 1.88 in favor of the experimental group. This proved that the experimental group had mean score than the control group. This implied that the effect of the treatment had effect on the experimental group.

3.2. Test of hypothesis
In this section each hypothesis is re-stated, and the result of data analysis carried out to test it is presented. Each hypothesis of the study was tested at .05 level of significance.

3.2.1. Null Hypothesis 1: There is no significant difference in the effect of concept mapping and competitive instructional strategy on students' academic performance in thermal energy. The Ho_1 was analyzed using t-test statistic.

The inferential statistic t-test was used to test this hypothesis, and Table 4. present the summary of the analysis.

Table 4. Presents t-test of posttest means score of the control and Experimental groups in Thermal Energy Performance Test (TEPT)

Groups	N	Mean	SD	df	t-cal	t-crit	p-value	Decision
Experimental group	30	51.73	12.68	58	3.63	1.98	0.00	Significant
Control group	30	44.76	14.43					

The results in Table 4. 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 experimental and control groups. The significant difference is in favour of the experimental group exposed to Concept mapping teaching strategy as indicated by the mean scores. With this result the Null hypothesis 1 was therefore rejected.

3.2.2. Null Hypothesis 2: There is no significant difference in the effect of concept mapping and competitive instructional strategy on the academic performance of male and female students in thermal energy. The inferential statistic t-test was used to test this hypothesis, and Table 5 presents the summary of the analysis

Table 5 Present t-tests of posttest means scores of Experimental (concept mapping) and Control (competitive) groups in thermal energy.

Groups	N	Mean	SD	df	t-cal	t-crit	p-value	Decision
Experimental group	30	55.09	14.14	58	2.86	1.98	0.00	Significant
Control group	30	44.76	14.43					

The results in Table 5 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 experimental and the control groups in performance level of the students. The significant difference is in favour of the experimental group in performance level exposed to Concept mapping teaching strategy as indicated by the mean scores. With this result the Null hypothesis 2 was therefore rejected.

3.2.3 Null Hypothesis 3: There is no significant difference in the interaction effect of gender and concept mapping and competitive instructional strategy on students' academic performance in thermal energy. The t-test was used to test this hypothesis, and a summary of the result is presented in Table 6.

Table 6 Present t-test Analysis of posttest mean score of the Experimental (concept mapping) and Control (competitive strategy) groups in thermal energy

Groups	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	Not Sig
Females posttest	34	23.50	4.82					

Table 6 shows that the p is 0.127 which is greater than alpha α= 0.05 with degree of freedom (df) = 58. This means that there is no significant difference between the posttest scores of male and female exposed to Concept mapping teaching strategy. This implies that the performance level of male exposed to Concept mapping teaching strategy and their female counterparts were at par. Therefore, null hypothesis three was retained.

3.3. Discussion Findings
Based on the data analyzed in this study, it was found that there was significant difference between students exposed to Concept mapping and those who were taught using competitive strategy; there was significant difference between the mean scores of performance level between experimental and control groups in competitive strategy in favour of experimental group also there was no significant difference between the mean scores of male and female students exposed to Concept mapping teaching strategy. This implies that the performance level of male exposed to Concept mapping teaching strategy is almost the same with their female counter parts.

The objective of this study was to investigate the Effect of Concept mapping and Competitive Teaching Strategy on Basic Science Students Performance in Ardo-Kola Local Government Area of Taraba State, Nigeria. To achieve this, two groups of students were formed, the experimental and control groups. Students in experimental group were exposed to Concept mapping teaching strategy while those in control group were exposed to competitive strategy. The two groups of students were taught same concept (thermal energy). The dada of this study where based on performance of students in the Thermal Energy Performance Test (TEPT).The results of posttest was used to compare their performance according to the variable being measured which were analysed according to research hypotheses developed for the study. This unit presented explanation of results obtained from the hypotheses tested and acknowledged the published works of other authors to be stated herein after.

Table 4. revealed that the concept maps teaching strategy enhanced academic achievement of experimental group. This confirmed the findings of Eric (2018)) which stated that knowledge gains were found to be significant with experimental group using

concept maps teaching strategy is more effective than the lecture method in teaching of Economics. This implies that concept mapping was effective in the improvement of students' achievement and interest in Economics more than their counter part that were strictly taught in the class using competitive strategy method. Onyejekwe, Uchendu, Chinwe and Tochi (2018) carry out the study to determine 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. Concept mapping teaching method enhanced students' performance in Biology especially genetics. In the contrary Jack and Suleiman (2020) investigated the effect of Concept Mapping and Guided-Inquiry instructional strategies on students' academic achievement in Chemistry said that the experimental group which was taught chemistry using Guided-Inquiry instructional strategy performed significantly better than the Concept Mapping group. In the study of Ukpai, Okafor, Abonyi and Ugama (2016) investigated the effects of concept mapping on students' achievement in Basic science agreed that concept mapping fosters students' achievement in Basic science than conventional method. It boosts the achievement of both male female students in the subject. In addition there is no interaction between gender and teaching methods on students' achievement in Basic science. The study said that there was a statistically significant difference in the mean performance scores of student taught using concept maps and competitive strategy. The author recommended concept maps teaching strategy in science because of its influence on performance than their counter part that were strictly taught in the class using competitive strategy.

Table 6 showed that there was no significant different between male and female experimental and control groups taught using concept maps and competitive teaching strategy. This study is in conformity with the work of Achor, Ogbeba and Amadu (2014) who said there was no statically significant difference between the mean retention scores of boys and girls exposed to school concept maps. In the study of Jack and Suleiman (2020) which investigated the effect of Concept Mapping and Guided-Inquiry instructional strategies on students' academic achievement in Chemistry. The authors confirmed that there is no significant interaction effect of method of teaching and gender on students' achievement in chemistry. Therefore, the analysis in the table 6 indicated that

there is no significant effect of concept mapping strategy on gander.

4. Conclusion
Generally, it was confirmed that there was high significant difference between the mean scores of experimental (concept mapping) and control (competitive strategy) groups in thermal energy. In addition, there was high significant difference between experimental and control groups on performance. There is no significance difference between male and female in learning thermal energy using concept mapping teaching strategy. However, it was statistically shown that concept mapping teaching strategy favored experimental group in learning thermal energy.

5. Recommendations
Based on the finding of the study the following recommend that teaching and learning strategy involving presenting concepts in diagram forms such as concept maps to be encouraged at upper basic where this is often neglected. The use of concept mapping teaching strategy should be encourage at upper basic, hence it enhanced better performance. Concept mapping teaching strategy is gender friendly; it should be encouraged among Males and Females students at upper basic level. In addition all materials needed for carrying concept mapping should be provided by government and cooperate organizations because it motivates students to learn effectively.

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