

## **Effects of Concept Mapping teaching strategy on Students' Academic Performance and Retention in Senior Secondary School Physics in Ekiti State, Nigeria**

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### **Abstract**

*This study investigated the effects of Concept mapping teaching strategy on students' academic performance and retention in senior secondary school Physics in Ekiti state, Nigeria. The design for this study was Pretest-Posttest Quasi-Experimental. The population for the study was all the senior secondary class two (SS2) Physics students in Ikere Local Government Area of Ekiti State, Nigeria. The sample comprised thirty five (35) students from each of the two public secondary schools randomly selected in Ikere Local Government Area to make a total of seventy (70) SS2 students. One of the schools was selected for the experimental group while the other assigned for the control group. The experimental group was taught using Concept-mapping teaching strategy while the control group was taught using conventional method. Three null hypotheses were formulated and tested at 0.05 level of significance to guide the study. The instrument for data collection was thirty (30) standardized objective questions tagged: Physics Achievement Test (PAT). The data collected were analysed using t-test statistical analysis. The findings showed that: in the pre-test, the obtained mean scores are not significantly different from another which showed that the two groups selected are homogeneous. The obtained post-test mean scores of experimental group was significantly higher than the post-test mean scores of the control group. Also, the obtained retentive-test mean score of experimental group was significantly higher than the retentive-test mean scores of the control group. The findings revealed that, students in concept mapping teaching strategy group performed significantly better than their counterpart of conventional method. Conclusion and recommendations were also made in this paper.*

**Keywords:** concept mapping, teaching strategy, students' academic performance and retention

## Introduction

Science is regarded as a foundation upon which the bulk of the present technological breakthrough is built. Science education plays a vital role in the lives of individuals and development of a nation scientifically and technologically (Alebiosu and Ifamuyiwa, 2008) cited by Oludipe (2011). Similarly, Wasonga (2015) cited (Mutula,2012) that any breakthrough in science and technology is deeply rooted in the strength of science education. According to Wasonga (2015) that it is in recognition of this dominant position occupied by science that during the fifth ordinary session of the conference of Ministers of Education in Africa (COMEDAFV) held in April 2012 in Abuja, Nigeria, centre of Mathematics, Science and Technology Education in Africa (CEMASTE) was showcased as model centre of excellence in the promotion of quality of Mathematics and science education at the basic level of Africa. According to Oludipe (2011), it is widely and generally acknowledged that the gateway to the survival of a nation scientifically and technologically is scientific literacy which can only be achieved through science education.

Physics is among the three major pillars of science (i.e. Physics, Chemistry and Biology). Physics deals with the study of laws that determine the structure of the universe with reference to the matter and energy in the universe (Ike, 2002). Awodun (2015) cited Olarinmoye (2000) that “Physics is the most utilized basic science subject in most technology and technology- related profession”. This merely indicates that the enormous role that Physics plays in the technological growth of any nation must not be undermined. It is germane to say that the technological growth of a nation leads to its social and economic development.

The importance of Physics for the development of a nation is, therefore, glaring. Physics is the most basic of the sciences and its concepts and techniques underpin the understanding of other disciplines: A thorough understanding of mechanics is necessary to the chemists and the material scientists since the structure of every atom in the universe is determined by mechanics.

Physics is also a cross-cutting discipline that has applications in many sectors of economic development, including health, agriculture, water energy and information technology (Macmillan, 2012). There is no doubt that a good part of the scientific knowledge is derived from the principles of Physics. Indeed, the knowledge of Physics has led to so many inventions such as the production, application and utilization of integrated circuits, production and use of machines and other contrivances. It also accounts for the discovery and production of hydroelectric power, gas turbine and thermonuclear power plant, telephones, refrigerators, heaters and gas/electric cookers. Physics is an important science subject that makes immense academic demands on students in its learning (Sunday, 2010).

A number of factors have been identified 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 and Mirza, 2013) cited by Ali (2015). According to Ogunleye and Babajide (2011), Nigeria has witnessed persistent poor students’ performance in Physics at the senior school certificate level. This has been linked to the adoption of instructional strategies which did not give enough consideration to learners’ previous knowledge and how they reasoned in order for learners to construct their knowledge based on these. Similarly, Achufusi (2015) cited Nwagbo (2001) that ignorance of teachers and neglect of activity oriented methods by teachers grossly contributed to students’ low performance in Physics. One thing is to be grounded in conceptual understanding of a subject another is to be well acquitted with the best method to pass the concepts across to learners for proper comprehension.

Concept mapping based instruction is one of the instructional strategies advocated by CEMASTER as learner-centred approach (Makoba, 2016). Concept mapping is a teaching and learning strategy that established a bridge between how people learn knowledge and sensible learning (Yunus, 2010). According to Jaya (2015) originally, the concept mapping method was developed by Novak at Cornell University in the 1960s. Yunus (2010) cited Canas and Novak, (2005) that concept map tools provides a variety of features that make it possible for teachers to use concept maps for a variety of the tasks that students perform. Similarly, Ali (2015) opined that concept maps are tools that help to organize knowledge for meaningful learning. The linking words that are used to connect concepts provide meaning for the preposition and the domain of the knowledge when concept maps are used to represent scientific concept, they help to resolve ambiguities, inconsistencies and rigours of representing scientific knowledge (Khartmal and Nagarjuna,2006) cited by Ali (2015). According to Yunus (2010) students need to have sufficient foundation and critical thinking about concept mapping and the relations between different concepts. Concepts mapping promotes to be useful in enhancing meaningful learning and students' conceptual understanding in science and Physics.

Jaya (2015) asserted that to be successful in learning, students have to take passion of knowledge actively by seeking expert conceptual linkages between new concepts and those, they already possess. Similarly, Fatokun and Eniayeju (2014) in the study on the effect of concept mapping guided discovery integrated teaching approach on chemistry students' achievement and retention found that teaching through concept mapping has significant positive effect on the achievement of students. Conversely, Abdulkarim and Hassan (2013) in the study of effect of using concept mapping of the first year students in Oman found no significant difference in the academic achievement between concept mapping and traditional method. Moreover, according to Afuwape (2004), concept mapping promotes the development of critical thinking skills which are embedded in creativity that can be used to ensure meaningful learning for enhancing academic achievement.

Agwagah and Ezeugo (2000) stated that concept-mapping method helps to make clear to both learners and teachers the small number of key ideas they must focus on for any specific learning task. Concept learning breaks down the task to be learnt into smaller units. These smaller units serve as the key to each segment of the problem, as the learning maps each unit to the key ideas. Concept mapping is a method to visualize the structure of knowledge as a means of representing frameworks for the interrelationship between concepts as an instructional and assessment tool to facilitate meaningful learning.

Research evidence has indicated that pieces of information are better remembered by students when they are communicated and learn verbally and visually. Concept mapping combines visual learning with spatial representation of information to promote meaningful conceptual learning. Adeneye (2011) got a significantly better result when concept mapping was used to teach some concept in Physics. Similarly, in Awofila (2011) post-test mean score of the students in the concept mapping strategy was found to be significantly different from that of their counterparts in the control group.

Esiobu and Soyibo (2009) research report claim that the low correlation between concept mapping scores and convectional tests measure different attributes of students' abilities. Specifically they claim that concept mappings assess higher-order abilities while convectional assessment assesses lower-order abilities. In cases where lack of understanding of concepts occurs, there could be production of poor maps by students.

Therefore, the strategies for learning should be overhaul to enable students improve their performance. The present study through the use of hierarchy maps which have direct relationship with the concepts learned, focused on encouraging students to organize information in a way that is compatible with their understanding of the lessons in order to help them learn Physics better.

### **Purpose of the study**

This study investigated the effects of Concept mapping teaching strategy on students' academic performance in senior secondary school Physics in Ekiti state, Nigeria. Also, effects of Concept mapping teaching strategy on students' retention in Physics of senior secondary school two students in Ekiti state, Nigeria.

### **Research hypotheses**

The following null hypotheses were formulated to guide the study:

1. There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.
2. There is no significant difference in mean academic achievement of the students taught Physics with concept mapping teaching strategy and conventional method after treatment.
3. There is no significant difference in the mean scores of academic retention of students in experimental and control groups.

### **Methodology**

The design for this study was Pretest-Posttest Quasi-Experimental. The design afforded the researcher the opportunity to collect relevant data which helped to facilitate better understanding and evaluation of the problem under study. The pre-test was used to establish the knowledge baseline of the students as well as the academic homogeneity of the two groups before the commencement of the experiment. The post-test was used to determine the levels of academic performance of students within the two groups after the application of treatment.

The population of the study was made up of all senior secondary student class two SS 2 in Ikere Local Government Area of Ekiti State. The sample comprised thirty five (35) students each selected from each of the two public senior secondary schools in Ikere Local Government Area to make a total of seventy (70) SS2 Physics students. The instrument used for the study was thirty (30) standardized objective questions tagged: 'Physics Achievement Test (PAT)' drawn from the topic (causes of motion, concepts associated with motion in straight line, parameters and equation of motion) with four options (A-D) considered for the study.

The teaching covered three weeks with the control group taught using conventional method while the experimental group was taught using concept mapping teaching strategy. The tests (Pretest and Posttest) questions were administered to students; each of the tests was marked and scored accordingly.

The three formulated null hypotheses were tested at 0.05 level of significance. The data collected were analysed using inferential statistics of t-test analysis.

## Results and Discussion

### Hypothesis 1

There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.

**Table 1: t-test analysis of achievement mean scores of students in experimental and control groups before treatment**

| GROUP        | N  | $\bar{X}$ | SD   | df | $t_{cal}$ | $t_{tab}$ | Result |
|--------------|----|-----------|------|----|-----------|-----------|--------|
| Experimental | 35 | 12.23     | 8.24 | 68 | 0.418     | 1.671     | NS     |
| Control      | 35 | 11.45     | 7.34 |    |           |           |        |

**$P > 0.05$  (Result Not significant at 0.05 level), NS = Not Significant.**

As shown in table 1, when the mean score of students in the experimental and control groups before the treatments (pre-test) were statistically compared, a *t-value* ( $t_{cal} = 0.418$ ) with  $p > 0.05$  alpha level was obtained, which was not significant at 0.05 level. This implies that there is no significant difference between experimental and control groups in pretest achievement mean score. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in experimental and control groups before treatment was accepted.

### Hypothesis 2

There is no significant difference in mean academic achievement of the students taught mathematics with concept mapping teaching strategy and conventional method after treatment.

**Table 2: t-test comparison of the post- test mean scores of students taught mathematics with concept mapping teaching strategy and those taught through conventional method**

| GROUP        | N  | $\bar{X}$ | SD    | df | $t_{cal}$ | $t_{tab}$ | Result |
|--------------|----|-----------|-------|----|-----------|-----------|--------|
| Experimental | 35 | 28.67     | 14.44 | 68 | 2.251     | 1.671     | *      |
| Control      | 35 | 21.22     | 13.26 |    |           |           |        |

**$P < 0.05$  (Result significant at 0.05 level), \* = Significant.**

As shown in table 2, when the mean score of students in the control and experimental groups after the treatments (posttest) were statistically compared, a *t-value* ( $t_{cal} = 2.251$ ) with  $P < 0.05$  alpha level was obtained, which was significant at 0.05 level. This implies that there exists significant difference between the control and experimental groups' achievement mean scores after the treatment in favour of experimental group. Consequently, the null hypothesis which states that there is no significant difference in mean academic achievement of the students taught mathematics with concept mapping teaching strategy and conventional method after treatment

was rejected. As such, the conventional method of instruction used for control group can be said to be less effective compared with concept mapping teaching strategy used in the experimental group.

### Hypothesis 3

There is no significant difference in the mean scores of academic retention of students in experimental and control groups.

**Table 3: t-test comparison of difference in the mean scores of academic retention of students in experimental and control groups.**

| GROUP        | N  | $\bar{X}$ | SD   | df | $t_{cal}$ | $t_{tab}$ | Result |
|--------------|----|-----------|------|----|-----------|-----------|--------|
| Experimental | 35 | 26.84     | 9.45 | 68 | 1.747     | 1.671     | *      |
| Control      | 35 | 23.12     | 8.33 |    |           |           |        |

**P < 0.05 (Result significant at 0.05 level), \* = Significant.**

As shown in table 3, when the mean score of students in the control and experimental groups after the treatments (posttest) were statistically compared, a *t-value* ( $t_{cal} = 1.747$ ) with  $P < 0.05$  alpha level was obtained, which was significant at 0.05 level. This implies that there exists significant difference in the mean scores of academic retention of students in experimental and control groups in favour of experimental group. Consequently, the null hypothesis which states that there is no significant difference in the mean scores of academic retention of students in experimental and control groups was rejected. As such, the conventional method of instruction used for control group can be said to be less effective compared with concept mapping teaching strategy used in the experimental group.

### Discussion

The result of this study revealed that the pre-test mean scores of the students in the Concept mapping strategy was not significantly different from that of those exposed to conventional method. The implication of this is that the two groups involved in the study exhibited comparable characteristics. Thus, they both entered the instructional experiment on equal strength and ability which showed that the two groups were suitable for the study when comparing concept mapping with tradition conventional method on achievement and retention in Physics. The result of the study revealed a relative increase in the post-test mean score of the students in the concept mapping group over those taught with the traditional conventional method. Thus confirmed that concept mapping strategies are learner-centered and capable of making remarkable impart on instructional practices. This result agrees with the findings of Agwagah and Ezeugo (2000), Afuwape (2004), Adeneye (2011) and Awofila (2011) who found that there is significant achievement in academic performance of students thought using concept

mapping strategy. But, the result is at variance with the findings of Abdulkarim and Hassan (2013) in the study of effect of using concept mapping of the first year students in Oman who found no significant difference in the academic achievement between concept mapping and traditional method.

Likewise, the result of the finding of treatment on the students' retention scores of achievement in Physics shown a significant difference gave credence to the use of concept mapping for a better understanding and remembering. Since understanding comes from meaningfulness, things that are understood are better retained and recalled than things that are not meaningful. The finding though not in agreement with the outcome of similar studies conducted by Esiobu and Soyibo (2009), is however corroborating the studies of Adeneye (2011), Awofila (2011), which showed that concept mapping strategy was more effective in increasing students' achievement than the tradition conventional method. These outcomes showed that the students exposed to the concept mapping strategy achieved better than those exposed to the conventional method at all level of cognition. Even though Esiobu and Soyibo (2009) are of the opinion that concept mapping not significant at lower level of cognition, the present finding revealed a contrary considerable significant difference.

### **Conclusion**

Based on the findings of this study, it can be concluded that concept mapping teaching strategy is more potent in improving students' academic performance in Physics in secondary schools than conventional method in vogue in the nation in term of performance and retention.

The study however found no significant difference between academic performance of male and female students in Physics when concept mapping was used as strategy of instruction. This simply implies that performance of students taught using different teaching strategies is not in any manner affected by either their gender.

### **Recommendations**

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

1. Concept mapping assessment should be practically applied to classroom situations. Teachers should use concept mapping strategy to arouse the interest of their students in Physics teaching. They should be trained and encourage to use concept mapping teaching strategy.
2. Principals of secondary schools should encourage their Physics teachers through sponsorship to attend refresher courses and other forms of in-service training to enable them acquire the needed skill that can help them use or apply different strategies in the classroom teaching and learning. Thus help eradicate mediocrity among Physics teachers and expose them to a wide range of methods which can enhance their teaching in classroom situation.
3. Authors of Physics textbooks should present the content and concepts alongside the worked examples using concept mapping approach.

## References

- Abdulkarim, R and Hassan, K.A. (2013). The effect of using concept mapping in teaching Physics on academic achievement of the first year students in Oman. *Scottish Journal of Arts, social sciences and scientific studies*, 10(1), 3-15. Retrieved from <http://scottishjournal.co.uk>.
- Achufusi, N.N. (2015). Influence of Physics Teachers Qualification on the performance of students in external Examination in Awka Education Zone, Anambra State, Nigeria. *International Journal of Innovative Science, Engineering & Technology*. 2(6), 288-396.
- Adeneye, O.A.A. (2011): Effect of Concept Mapping Strategy on students' Achievement in Junior Secondary School Mathematics. *International Journal of Mathematics Trend and Technology*. 2(3), 11-17.
- Afuwape, M.O. (2004). Enhancing creativity in integrated science. *Nigerian Journal of Emotional creativity*. 6, 45-51.
- Agwagah, U.N.V. & Ezeugo, N.C. (2000): Effect of concept mapping on students' Achievement in Algebra. *ABACUS: The Journal of Mathematics Association of Nigeria*. 25(1), 1-11.
- Ali, A. (2015). Effects of concept mapping and inquiry strategies on achievement and creativity among colleges of Education Physics students in North-West Nigeria. Masters Degree Dissertation, Ahmadu Bello University, Zaria.
- Awodun, A.O. (2015). *Effects of out-door activities on students' learning outcomes in Senior Secondary school Physics in Ekiti State*. Unpublished Ph.D Thesis, Ekiti State University, Ado-Ekiti.
- Awofila, M. N. (2011): *Effective Teaching: A book of reading*; Onitsha, Kimensu Educational Publisher.
- Esiobu, G.O. & Soyibo, K. (2009): Effect of concept mapping under three learning Modes on students' cognitive achievement in Genetics. *Journal of National Association for research in Science Teaching*. 23(1), 971-989.
- Fatokun, K.V.F. and Eniayeju, P.A. (2014). The effect of concept mapping guided discovery integrated teaching approach on Chemistry students achievement and retention. *Education Research and Review*, 9(22), 1218-1223. Retrieved from <http://www.academicjournals.org/journal/ERR/article.abstract/BD662D148681>.
- Ike, E.E. (2002). *Physics for WASSCE, NECO, UME and PCE*. Aba: Eric er Consultant and Publishers.
- Jaya, C. (2015). Effect of concept mapping strategy on achievement in chemistry of IX graders in relation to gender. *International Journal of Science and Research (IJSR)*, 4(12), 531-536.
- Macmillan, M. J. (2012). School location versus academic Achievement in Physics: Does Computer-Assisted Instruction (CAI) Has Any Effect? *Journal of Educational and Social Research*, 2(8).
- Makoba, K. (Ed). CEMASTEAs- Instructional strategies. Retrieved 11/12/ 2016 from <http://cemastea.wikispaces.com/instructiona+strategies>.



- Ogunleye, B.O. and Babajide, V.F.T. (2011). Generative Instructional Strategy Enhances Senior Secondary Schools Students' Achievement in Physics. *European Journal of Humanities and Social Science*, 2(1), 112-126.
- Oludipe, D.I. (2011). Developing Nigerian Integrated Science Curriculum. *Journal of Soil Science and Environmental Management*. 2(8).
- Sunday, A.A. (2010). Background and Classroom correlates of students' achievement in Physics. *International Journal of Educational Research and Technology*. 1(1).
- Wasonga, V.O. (2015). Effects of concept mapping instruction on students' achievement in Physics in public secondary schools, Nairobi county, Kenya. A Masters Degree dissertation, School of Education of Kenyatta University, Kenya.
- Yunus, K. (2010). The concept mapping on attitude achievement in a Physics course. *International Journal of Physical Sciences*. 5(6), 724-737.