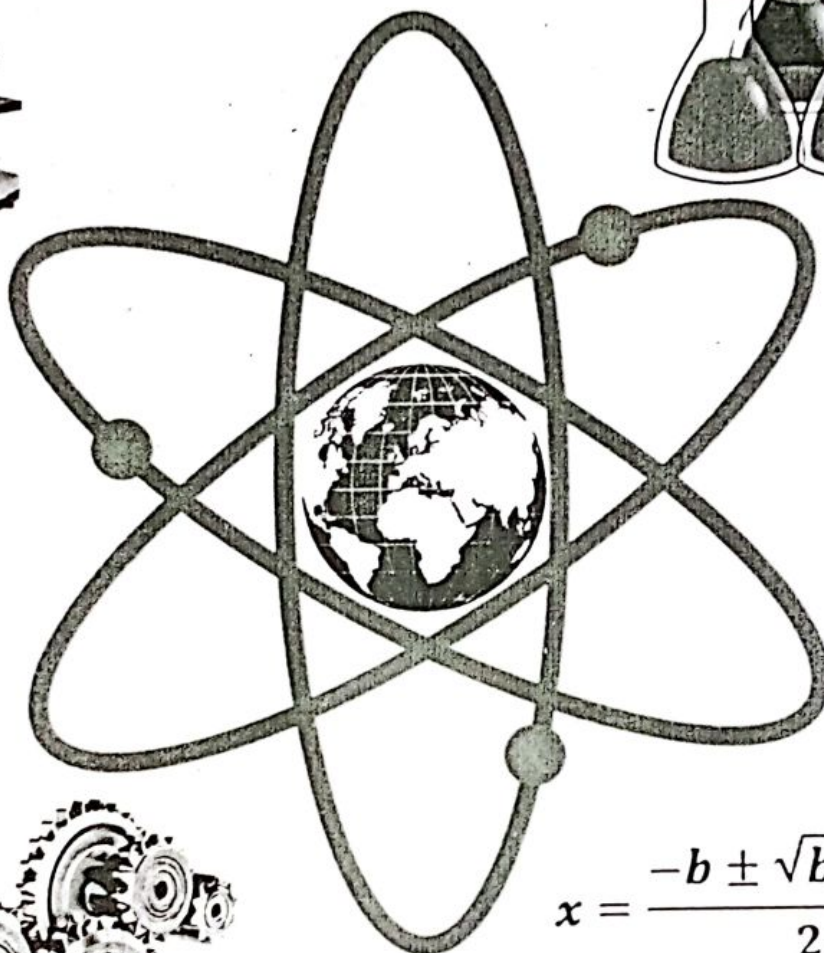


**BAYERO JOURNAL OF SCIENCE, TECHNOLOGY
AND MATHEMATICS EDUCATION (BAJOSTME)**



$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$a^2 + b^2 = c^2$$

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Editorial Notes

I am delighted to introduce *Bayero Journal of Science, Technology and Mathematics Education (BAJOSTME)*. BAJOSTME is a biannual journal that will be publishing up-to-date, high-quality and original research papers in the area of Agric, Biology, Chemistry, Geography, Physics and Mathematics education as well as Technical and Vocational Education. The papers published in BAJOSTME, Volume 1, Number 1 were born out of the first National Conference organized by the Department of Science and Technology Education, Bayero University, Kano in March, 2018. The journal contains articles not only in the area of science, technology and mathematics education but also in art and special education as well as pure science. However, in subsequent publications, only articles that are within the scope of the journal will be accepted for publication. Intending contributors should abide by the guidelines given under notes to contributors. We are looking forward to receiving more articles for publication from you in the near future. Best wishes and thank you in advance for your contribution to the Bayero Journal of Science, Technology and Mathematics Education.

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Bayero Journal of Science, Technology and Mathematics Education (BAJOSTME)

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AbdulkadirAbubakar Salman, Yahaya Quadri,
Dr. Abdulrasaq O. Akanbi & Adebisi Nurudeen Adebayo

Abstract

The study investigated the effects of concept mapping instructional strategy (CMIS) on senior secondary school students' performance in physics in Ilorin west, Nigeria. Two research questions raised were answered and two hypotheses tested at the 0.05 level of significance guided the study. The design of the study was a 2 x 2 pretest, posttest quasi experimental, nonequivalent, non-randomized control group design with 178 senior secondary students selected purposively from four senior secondary schools in Ilorin west, Kwara State, Nigeria. Instrument used for data collection was Physics Performance Test (PPT) adapted from West African Senior School Certificate Examinations (WASSCE) questions. The instrument was validated by two experts and two other teachers teaching physics at senior secondary school. A test-retest method was used to ascertain the reliability and Pearson product-moment correlation was used to obtain a reliability coefficient index of 0.72. The treatment for the study lasted for one week and data collected were analyzed using t-test and Analysis of Covariance. The result revealed that, concept mapping instructional strategy significantly improved students' performance in physics. Furthermore, there was no significant difference between male and female students in the experimental group. It was recommended that, teachers should make the teaching of physics more interactive by using concept mapping instructional strategy in order to improve performance of students consequently empower with educational economic independence.

Key words: Concept mapping, Strategy, Gender, Achievement, Secondary School, Physics

Introduction

Education is one of the fundamental factors of development. No country can achieve economic development without substantial investment in human capital (Barnamala, 2015). Education in Nigeria has no doubt faced economic challenges in the effort to augment peoples acceptance of their realm, improves the quality of their lives and leads to broad social benefits to individuals and society. This have established the need to raises Nigeria's education productivity and its ingenuity and thus, promotes entrepreneurship and technological advances. It is believed this could played a very crucial role in safeguarding economic and social advancement and improving income delivery (Odia & Omofonmwa, 2007). The economic growth of Nigeria needs to largely depend on technological improvement and on its scientific and technical manpower. That is to say, the need to make a sizeable shift from crude oil exportation, a significant achievement that has been recorded in the present administration (Abgowuro, Saidu & Jimwan, 2017).

Science learning has a crucial role in speeding up a country's economic development. Science education provides one of the most effective means for development of skilled manpower as required by various sectors in a country's economy. Abimbola (2006) defined science education as the consistency of knowledge which involves a way of investigating, a mode of thinking and the pursuit of an apprehension of nature. The knowledge apprehension, Abimbola believed is derived from its subject components; Biology, Chemistry and Physics.

Physics is seen as the basis of national power, productivity and upon which the mass of the present technological breakthrough is made (Ajiboye, 2014, Okeke, 2007&Omosewo, 2009). Physics have proved significantly useful in man's daily struggle to hold in his environment and make a virile economic contribution. Most developing countries like Nigeria, as a result of visible role of physics education now make a coherent effort to improve on the work of physics and other allied subjects in their schools towards self-sustenance. For example, in Nigeria, the National Policy on Education stipulated that:

1. A sizable proportion of spending on university teaching should be given to science and engineering
2. Not less than 60% of places shall be allocated to science and science oriented courses in the conventional university and not less than 80% at the University of Technology and Agriculture. (Federal Republic of Nigeria, 2013, p. 29)

No doubt the proposition spendings and preference in allocation has contributed to the knowledge and application of physics to Nigerians socio-economic development and has brought it to a global village. Specifically, physics has contributed to the successful launch of five satellites into space, they are: NIGCOMSAT1, SAT2, SAT3, SAT X, and NIGCOMSAT1R. these satellites have contributed to economic growth (Udoh, &Akpan, 2014).

In spite of the importance of physics, students' performance in physics has been very low (Ballah & Ugwumba, 2015; Erinosh, 2013). This performance is not good enough for physics oriented courses at tertiary schools for nations that focused towards high technology and industrialization. Therefore, this reflects the handicap this nation is confronted with in having adequate number of qualified students pursuing various sciences oriented courses in universities, polytechnics and other tertiary institutions that could help to acquire careers that are in demand in this era of information technology.

A number of reasons have been identified by researchers (Adepitan, 2004; Danmole & Adeoye, 2004; Gunasingham, 2009; Smithers, 2006) contributing to poor performance in physics. Smithers (2006) observed that the subject area of physics in schools and universities is spiraling into decline as teenagers think it is also difficult, i.e. there is a perception among students that the subject is hard to grasp conceptually. One area identified is simple alternating current. Likewise, the West African Senior School Certificate Examinations (WASSCE) Chief Examiners' Reports (2008, 2009, 2011, 2013, 2014, 2016 & 2017) observed that there is weakness of the students in providing enough information and resolving questions relating to Simple A.C. Circuit in Physics. The reports further attributed the poor performance to the negative interest of the students in the subject, and inappropriate teaching method employed by teachers among others. However, Mkpanang (2010) reported that one of the reasons adduced for students' poor performance in certain areas of physics like simple Alternative Current (A.C) circuits is its methods of teaching which most of the students find uninteresting. Simple Alternating Current is the one in which the current changes periodically. It is produced by time dependent alternating voltage given by the relation $V = V_0 \sin \omega t$. The source of an A. C. shows the potential difference and the frequency. Alternating Current varies sinusoidally in such a way as to reverse its direction periodically. Simple A. C. Circuit is the circuit in which an alternating current flows.

The teaching method employed by teacher has been shown to reflect on students' understanding of the subject. It is also important for teachers to understand and interpret the

objectives of physics. Lack of attention to these aspects of the physics curriculum by respective physics teachers, could lead to students' perception of physics as a difficult, irrelevant and boring subject, hence performing poorly. It is thus necessary to apply methods which utilize instructional activities that pupils are involved and guessing around the applications of what they are taking away (Adesoji & Ibraheem, 2009).

Literature has shown that one of the most effective ways is taking advantage of better instructional design such as the concept mapping. Otor (2013) reported that students taught using concept mapping strategy as an instructional tool achieved higher and significantly better than those taught using conventional methods and therefore recommended adequate training of chemistry teachers on the use of concept mapping strategy in teaching chemistry at the secondary school level. Karakuyu (2010) remarked that teaching using concept map instruction is more effective than traditional instruction in improving the physics performance of the participating students.

Concept mapping is a strategy that was first developed as a research tool to represent learner's prior relevant knowledge and as a tool to enhance meaningful learning (Novak & Canas, 2006). The technique of concept mapping was developed by Novak and his inquiry team at Cornell University in the 1970s, as a way of interpreting the emerging science knowledge of students. Concept mapping process and its usage according to Novak (1990), Trowbridge and Wandersee (1993) lead to concept map construction. It involves the organization of concepts, linking existing concepts with other relevant concepts; arranging these concepts hierarchically and labeling the linkages in such a way that the most general concepts are at the top while the most specific concepts are at the bottom of the map. Concept map has its origin in the learning movement called constructivism which holds that learners actively construct knowledge. Novak's work was based on the cognitive theory of the David Ausubel's assimilation theory of learning that stresses the importance of prior knowledge in being able to discover new concepts (Ausubel, 1968; Novak & Canas, 2006; Novak and Gowin, 1984)

Summarily, Novak (1984) identified the following six (6) procedures in constructing a concept map.

1. Identify the key concepts in a paragraph, research report, and chapter; or simply think of the concepts of a subject area and list them.
2. Rank the concepts by placing the broadest and most inclusive idea at the top of the map.
3. Work down the paper and add more specific concepts.
4. Relate the concepts by lines. Label the lines with action or linking words. The linking words should define the relationship between the two concepts so that it registers as a truthful assertion, or proposition. The connection creates meaning.
5. Specific examples of concepts can be added below the concept labels.
6. Perhaps you can already see ways that the concept map could be made differently.

The use of gender in the present research work is inevitable since issue of sex role is predominant in our culture and gender difference as submitted by research experts has shown a difference in students' performance. Gender, according to Okeke (2008) is the social or cultural characteristics, roles or behaviour which males and females are known for by a society. Onyegegbu (2008) referred to gender as the sum total of cultural values, attitudes, roles practices and characteristics based on sex, i.e., innate biological differences between women and men. Okeke (2008) identified the men as bold, tactful, intelligent, belligerent, etc. and the women as dull, passive, submissive, and talkative. Nnaka (2008) reported that girls

do not receive encouragement in science classes from the instructors; rather they draw negative comments to girls about the kind of work girls should undertake. Researchers such as Ugwuanyi (2012) reported that girls perform better than boys in students' conceptual understanding of force and motion. Okeke (2007) reported that gender has insignificant effect on science performance.

The inconsistent results in several studies on students' performance and gender differences generated the need for the present study. Also, evidence from literature available to the researcher does not show any conclusion has been reached on the influence of gender on students' performance. Likewise, trends on research findings on poor performance of physics students still revealed undesired results.

Statement of the Problem

The WASSCE Chief Examiners' Report (2008, 2009, 2011, 2013 & 2014) showed the poor performance of students in physics examination and weakness of the students in providing adequate information to answer questions relating to Simple A.C. Circuit in Physics. The reports further attributed the poor performance to the negative interest of the students in the subject, and inappropriate teaching method employed by teachers among others. Jegede, Okota and Eniayeju (1992) reported factors responsible for students' general poor performance in scientific discipline, technology and mathematics education to include poor laboratory facilities, accessibility of the physics teacher to put across ideas clearly to the students and inadequate numbers of learning facilities in schools as against a consistent growth in the number of pupils. Another reason adduced for students' poor performance in certain concepts of physics like simple A.C circuits is its methods of teaching which most of the students find uninteresting (Mkpanang, 2010). A research finding on attitudes and performance in a physics course by Karakuyu (2010), revealed the effect of concept mapping instruction to be more effective than traditional instruction in improving physics performance. Also, Alebiosu and Michael (2011) research on the concept mapping teaching strategy on secondary students' attitude to physics in Ibadan, Nigeria, revealed positive attitudinal change from students, ie, concept mapping method had a significant main effect on students' attitudes.

The success of many nations in tackling major developmental problems such as poor achievement in education, poverty, unemployment, technology among others can be traced to their educational organization and standard attained. Today, Nigeria educational system is facing challenges in instructional issues. The need for ingenuity in instructions has never been greater. The present study therefore investigate the effects of the use of the concept mapping instructional strategy on senior secondary school students' performance in simple A. C. circuit in Ilorin west of Nigeria in a depressed economy. Having in mind the need to recognize the economic benefit irrespective sex status through better learning process, the research examines secondary school students' performance as a catalyst for socio-economic development of the nation.

Purpose of the Study

This study investigated the effects of concept mapping instructional strategy on senior school students' performance in physics in Ilorin west, Nigeria. Specifically, the study investigated:

1. the effect of concept mapping instructional strategy on students' performance when taught simple A.C. circuit; and
2. influence of gender on students' performance when taught simple A. C. circuit using concept mapping instructional strategy

Research Questions

The following questions were raised and answered.

1. What is the effect of concept mapping instructional strategy on senior secondary school students' performance taught simple A.C. circuit?
2. What is the difference in the performance of students taught simple A.C circuit using concept mapping instructional strategy based on their gender?

Research Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

- H₀₁: There is no significant difference in the performance of students in simple A.C. circuit when taught using concept mapping instructional strategy and those taught using conventional methods
- H₀₂: There is no significant difference in the performance of students when taught simple A.C. circuit using concept mapping instructional strategy based on gender

Methodology

The study adopted the quasi experimental of the pretest, posttest, non-randomized, nonequivalent control group design. The study was conducted in Ilorin west, Nigeria. The population comprised of all senior secondary school III students in senior secondary schools in Ilorin offering physics. Reason for using SS III students was because the concept considered (Simple A. C. Circuit) is scheduled for the third year in the current physics curriculum. The sample consisted of 116 male and 62 female SS III physics students from four (4) intact classes of public single sex and coeducational schools. Purposive sampling was used in selecting the schools for the study. The experimental group was exposed to CMIS and the control group was exposed to the conventional method of teaching.

The instrument for data collection was a Physics Performance Test (PPT). The PPT is a 20 item multiple choice questions with four options. The instrument was adapted from WASSCE past questions on simple A. C. circuit. The validation of the instrument was carried out by two experts from Science Education Department, University of Ilorin west, Ilorin and two other physics teachers from senior secondary schools. The reliability of the instrument was ascertained using a test retest method on 40 students from non-participating schools. The PPT yielded a reliability index of 0.72 using the Pearson product-moment correlation. Pretest was administered to both experimental and control groups before the treatment. The experimental group was subjected to CMIS while the control group was taught using the conventional method. At the end of the instruction, the items in the pretest were rearranged and re-administered to both groups as posttest. This procedure lasted for a week. Mean gain scores were used to answer the research questions raised in the study. t-test analysis was used to test hypotheses formulated for the study.

Results and Analyses

Research Question One

What is the effect of concept mapping instructional strategy on senior secondary school students' performance taught simple A.C. circuit?

Table 1: Analysis on Meaning Performance of Senior Secondary School Students when Taught A.C Circuit using Concept Mapping Instructional Strategy

Group	Group Statistic	Pretest	Posttest	Mean Score	Gain	Diff
Control Group	N	77	77			
	Mean	35.50	50.35	14.85		
	Std Dev.	9.75	5.85			8.58
Experimental Group	N	10	101			
	Mean	35.24	58.68	23.43		
	Std Dev.	10.04	5.59			

Research Hypothesis One

There is no significant difference in the performance of students in simple A.C. circuit when taught using concept mapping instructional strategy and those taught using conventional methods

Table 2: The t-test Analysis of Students' Posttest Performance when Taught Simple A. C. Circuit using Concept Mapping Instructional Strategy and those in the Control Group

Group	N	Posttest mean	SD	Df	t-val	Mean diff.	Sig. (2-tailed)
Control	77	8.77	2.44	176	7.99	3.64	0.00
Experimental	101	12.38	3.19				

P<0.05

Table 1 presents the mean performance of students that participated in the simple alternating current circuit achievement test. The mean performance of students taught simple A. C. circuit using concept mapping instructional strategy was 24.43, while the mean performance of students in the control group was 14.85. The mean gain performance of the experimental group was 8.58 greater than the control group, indicating that students taught using concept mapping instructional strategy performed better than the students in the control group.

Table 2 revealed that t-value of 7.99 with the degree of freedom of 176 and p-value of 0.00. Since the p-value is less than 0.05 level of significance, the hypothesis is rejected. Thus, there was a significant difference in the performance of students taught simple A. C. circuit using concept mapping instructional strategy and those taught using conventional methods in favour of the experimental group. $t_{(176)}=7.99, p<0.05$.

Research Question Two

What is the difference in the performance of students taught simple A.C circuit using concept mapping instructional strategy based on gender?

Table 3: Analysis of difference in the Performance of Students Taught A C circuit using Concept Mapping Instructional Strategy

Group	Group Statistic	Pretest	Posttest	Mean Gain Score	Diff
Male	N	63	63		
	Mean	9.30	12.35	26.71	
	Std Dev.		3.31		0.07
Female	N	38	38		
	Mean	8.90	12.42	19.13	
	Std Dev.		3.15		

Research Hypothesis Two

There is no significant difference in the performance of students in when taught simple A.C. circuit using concept mapping instructional strategy based on gender.

Table 4: The t-test Analysis of Results of Male and Female Students When Taught Simple A. C. Circuit using Concept Mapping Instructional Strategy

Gender	N	Pretest Mean	Posttest Mean	SD	df	t-val	Mean difference	Sig.(2-tailed)
Female	38	8.90	12.42	3.31	99	0.11	0.07	0.91
Male	63	9.30	12.35	3.15				

P>0.05

Table 3 presents the mean performance of male and female students taught simple A.C. circuit that participated in the study. The posttest mean performance of female students taught simple A. C. circuit using concept mapping instructional strategy was 12.42 while the posttest mean performance of male students taught using the same strategy was 12.35. The mean gain performance difference is 0.07 which is in favour of the female students.

The result in Table 4 revealed that the t-value of 0.11 with the degree of freedom of 99 and p-value of 0.91. Since the p-value is greater than the 0.05 level of significance, hypothesis two is not rejected. Hence, there is no significant difference in the performance of male and female students when taught using the concept mapping instructional strategy in favour of the female students. $t_{(101)}=0.11, p>0.05$.

Discussions

This study investigated the effects of concept mapping instructional strategy on senior secondary school students' performance in physics in Ilorin west of Nigeria in depressed economy towards socio-economic and educational attainment. There was a difference between the mean gain performances of students taught simple A. C. circuit using concept mapping instructional strategy and those taught using the conventional method. This implies that an interactive and student centered concept mapping instructional strategy is effective in teaching of simple A. C. circuit in physics. Consequently, concept mapping instructional strategy improves students' performance in simple A. C. circuit. This outcome agrees with the findings of Karren (2015), Obunwo (2014), Ezeudu (2013), Uchenna and Philomena (2012), Jibrin and Zayum (2012), which reported that the concept mapping instructional strategy is more efficient than the traditional teaching method. The finding is against

Karakuyu (2010) who sited poor pedagogy knowledge among teachers and insufficient organized workshops to update practices in education circuit.

The study also revealed that there was no difference in the performance of male and female students but a small difference in the mean gain performances of female when compared to male students when taught simple A. C. circuit using concept mapping instructional strategy in favour of the female student. This could be as a result of the female students not feeling inferior in the class and are ready to compete with the male students. This result is against the findings of Aina and Akintunde (2013), Apata (2011) which eluded better performance to male students but in agreement with the findings of Nworgu, Ugwanyi and Nworgu (2013) which reported that female students performed better than male students.

Conclusion and Recommendations

The study concluded that there was a difference between the mean gain performances of students taught simple A. C. circuit using concept mapping instructional strategy and those taught using the conventional method. The study also concluded that there was no difference in the performance of male and female students when taught simple A. C. circuit using concept mapping instructional strategy in favour of the female student.

In line with the findings of this study, the following recommendations were made:

1. Concept Mapping Instructional Strategy was found helpful in students' ability to grasp difficult concepts because it was more interactive. It is recommended that the teachers should make the teaching of physics more interactive by using concept mapping instructional strategy in order to bridge educational and socio-economic independence.
2. Male and female students should be encouraged to actively participate in physics class lesson for all students are equal in class. Economic empowerment should outweigh gender difference.

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