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**Effects of Computer Assisted Concept Mapping and  
Analogical Instructional Packages on Students' Retention  
in Biology in Niger State**

Karuka, M. U. S.<sup>1</sup>  
Prof. (Mrs.) Ezenwa, V. L.<sup>2</sup>  
Wurshishi, D. I.<sup>1</sup>  
Omalu, I. C. I.<sup>1</sup>

<sup>1,2,3</sup> Department of Science Education, Federal University of  
Technology, Minna, Nigeria

<sup>1</sup> Department of Biological Sciences, Federal University of  
Technology, Minna, Nigeria

**Abstract**

The study examined the effects of computer assisted concept mapping and analogical models on students' retention in Biology in Niger State. Quasi-experimental design (pre-test-posttest-control group design) consisting of multiple treatments was adopted for the study. The target population for the study was all the Senior Secondary 2 Biology students from the three senatorial zones of Niger State. Three co-educational senior secondary schools were purposively selected from each of the three zones making a total of nine schools used for the study. One school from each zone was used as experimental group 1, another school as experimental group 2, while the third school was used as control group. A total of 270 (135 male and 135 female) students were randomly selected by simple balloting from the nine schools for the study. Thirty SSII students (15 male and 15 female) were selected from each school. The instruments used were Multiple Choice Test Items on Metabolism (MCTIM) and the CAI packages. A pilot test was conducted and the reliability coefficient ( $r$ ) of 0.98 was obtained. Analysis of Covariance (ANCOVA) was used to test the hypotheses formulated at 0.05 level of significance. The result revealed that students exposed to CAI packages retained the concepts more than those exposed to conventional method. It was recommended that the use of Computer Assisted Concept Mapping Instructional Model (CACMIM) and Computer Assisted Analogical Instructional Model (CAAIM) as teaching strategies should be adopted by science teachers in secondary schools.

**Keyword** Achievement, biology, concept effects, metabolism, students, and Niger state

### Introduction

Biology is a branch of science that deals with living organisms. It seeks to explain the nature, structure and roles of living organisms in their environments. Abu (2000) in discussing the usefulness of Biology to man stated that, the study of Biology enables one to be aware of his changing environment and the need to contribute positively to national development. Biology is also a core and compulsory subject for all students in secondary schools. This is because the knowledge of biology is needed in the study of medicine, dentistry, veterinary science, agriculture and biotechnology and genetic engineering. The objectives of the

current Biology curriculum used in secondary schools in Nigeria is directed towards the realization of the usefulness of biology as a field of study to national development. In spite of the richly designed biology curriculum and efforts of biology teachers to help students perform well in biology examinations, evidence continue to abound that little achievement has been made in terms of students' performance in biology especially at the Secondary School Certificate Examination (SSCE) level. The West African Examination Council Chief Examiners' report (2000, 2002, 2003, 2004, 2006, 2009, 2010 & 2011) all revealed that Biology students performed below average. A five year WAEC results (2006 - 2010) of Niger State Biology students indicates students' poor performance at SSCE as presented in Table 1 below:

Table 1: A 5-Year WAEC Result of Niger State Biology Students (2006 - 2010)

Subject	Year	Total	Credit pass (A1 - C6) & %	Pass (P7 - P8) & %	Total that failed (F9) & %
Biology	2006	6640	1190 (17.92)	1563 (23.54)	3887 (58.54)
	2007	3395	289 (8.51)	453 (13.34)	2653 (78.14)
	2008	6385	698 (10.93)	1092 (17.10)	4595 (71.97)
	2009	6526	1134 (17.38)	1301 (19.94)	4091 (62.68)
	2010	6845	1308 (19.11)	1580 (23.08)	3957 (57.81)

Source: Niger State Ministry of Education (2011)

Table 1 reveals poor performance of Niger State biology students as their percentage pass at credit level were 17.92% (in 2006), 8.51% (in 2007), 10.93% (in 2008), 17.38% (2009) and 19.11% (2010) while the percentage failure (combining D7, E8 and F9) were 82.08% (in

2006), 91.48% (in 2007), 89.07% (in 2008), 82.62% (in 2009) and 80.89% (in 2010). Problem of students' poor performance is not peculiar to Niger State alone but a national problem as revealed on Table 2.

Table 2: Senior Secondary School Biology Student's WAEC Result (2006 - 2012)

Subject	Year	Total	A1 - C6 (%)	D7 - E8 (%)	F9 (%)
Biology	2006	380,104	170670(44.90)	86423(22.73)	114475(30.11)
	2007	422,681	194284(45.96)	104680(24.76)	111322(26.33)
	2008	418,423	188949(45.18)	114697(27.41)	110417(26.38)
	2009	468,546	204725(43.69)	114020(24.33)	119260(25.45)
	2010	465,643	236059(50.70)	109944(23.61)	98165(21.08)
	2011	882,119	278122(31.53)	270301(30.64)	333696(37.83)
	2012	1,005,553	424636(42.23)	271058(26.96)	266222(26.48)

Source: WAEC Office Minna, Niger State

A critical look at table 2 reveals that biology students' poor performance at SSCE level is a national problem. Also, analysis of National Examinations Council (NECO) result of biology students at SSCE level over a period of seven years (2006 - 2012) as shown in table 3 reveals general poor performance of secondary school students.

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Subject	Year	Total	Credit (A1 - C6) & %	Pass (D7 - E8) & %	Total that failed (F9) & %
Biology	2006	890,866	440,190(49.41)	212,303(23.83)	178,245(20.00)
	2007	980,337	503,388(51.24)	239,909(24.47)	195,189(19.91)
	2008	1,082,262	815,331(75.33)	114,489(10.57)	94,518(8.73)
	2009	1,157,883	501,968(43.35)	267,119(23.06)	125,758(10.86)
	2010	1,110,735	502,677(45.26)	316,249(28.41)	225,055(20.26)
	2011	1,005,894	298,555(29.68)	326,092(32.42)	348,890(34.69)
	2012	1,005,032	316,049(31.45)	455,955(45.37)	264,486(26.32)

Source: Head of research (NECO)

Results of the two different examination bodies as shown above followed the same trend indicating that there must be a general problem responsible for students' poor performance particularly at secondary level of the educational system. All these are associated with the problems of students' poor retention of concepts taught in the class (Ifeakor, 2005).

### Statement of the Problem

Many studies revealed that teacher's

instructional strategy is one of the factors responsible for students' poor performance in Biology. These studies revealed that teacher's instructional strategies are ineffective as a result of which students find many topics difficult to understand and retain (Akour, 2006; Ahmed, 2008). In search of a better way to improve Biology learning, Abu (2000), Onwukwe and Onwukwe (2010) and Ijoma & Onwukwe (2011) among others listed various methods which seemed to bring about meaningful

learning to include Vee-mapping, Concept mapping, Metaphor, Analogy, Computer Assisted Instructional (CAI) strategy, Co-operative learning and Problem solving. Many research conducted on the use of Computer Assisted Instructional (CAI) strategy reported that, CAI could be used to enhance students' retention (Akour, 2006, Collazos, Guerrero, Llana & Oetzel, 2008 and Mudasiri & Adedeji, 2010). However, literature on Computer Assisted Concept Mapping and Computer Assisted Analogical Instructional Models are limited in Nigeria. These are the major reasons that motivated the researchers to apply Concept Mapping and Analogy in form of Computer Assisted Instruction (CAI) as one of the current global trend in Information and Communication Technology (ICT) for classroom instruction to determine whether secondary school students' retention of biology concepts will be improved.

#### **Objective of the Study**

The objective of this study was to determine the effect of Computer Assisted Concept Mapping and Analogical Instructional packages on Niger State Secondary School Students' retention of Biology concepts.

#### **Research Question**

The answer to the following research question was pursued:

Is there any significant difference in the retention of students taught the concept metabolism in Biology with Computer Assisted Concept Mapping and Analogical Instructional packages and those taught with Conventional lecture method?

#### **Hypothesis**

The following null hypothesis was formulated and tested at 0.05 level of significance.

$H_{01}$  There is no significant difference in the retention mean scores of students taught the concept of metabolism in biology with Computer Assisted Concept Mapping and

Analogical Instructional packages and those taught with Conventional lecture method

#### **Methodology**

The research design adopted for this study was a quasi-experimental design. It is a pretest-posttest-control group design consisting of multiple treatments. This design enabled the researchers to concurrently manipulate the two independent variables (Computer Assisted Concept Mapping and Computer Assisted Analogical Models) to assess the effects of their interactions on the dependent variables (students' retention).

Purposive sampling technique was used for selecting schools for the study. Only few of the secondary schools in Niger State have e-learning facilities. Simple random sampling technique by balloting was used to assign the sampled schools to different experimental and control groups. The target population for this study is all the year II Senior Secondary (SSII) Biology students in Niger State across the three (3) senatorial zones (Zones A, B and C).

Sample for the research study consisted of 270 students (135 male and 135 female) from 9 co-educational Senior Secondary Schools selected by simple balloting technique from all the 3 senatorial zones of the state. Three schools represented each of the three zones (A, B and C) making a total of 9 schools used for the study. This implies that, one school each from each zone was used as experimental group 1, experimental group 2 and control group. A total of 30 SSII students (15 male and 15 female) were selected by simple balloting technique from each school for the study. The experimental group 1 was taught the concept of Metabolism in biology using Computer Assisted Concept Mapping Instructional Model (CACMIM) while experimental group 2 was taught the same concept using Computer Assisted Analogical Instructional Model (CAAIM). Control group on the other hand was

teach same concept using Conventional Lecture Method.

The retention test instrument used was a 50- Multiple Choice Test Items on Metabolism (MCTIM) drawn from past question papers of Senior Secondary Certificate Examination (SSCE) 'O' levels conducted by the West Africa Examinations Council (WAEC) and National Examinations Council (NECO). The questions were based on SSII syllabus and specifically on the concept of Metabolism and were subjected to further validation by three experts in biology. Each test item had four (4) options (A - D) and only one of them is correct. The pilot test was conducted and students' scores were analyzed using Pearson Product Moment Correlation ( $r$ ) and reliability coefficient of 0.96 was obtained.

The test instrument was administered on both experimental and control groups as pretest and posttest. The students' scripts were marked and their scores analyzed.

The treatment instruments were the Computer Assisted Instruction (CAI) packages developed by the researchers with the help of a computer programmer. The two CAI instruments were: (i) Computer Assisted Concept Mapping Instructional Model (CACMIM) and (ii) Computer Assisted Analogical Instructional Model (CACIM). Lessons in the CAI packages were planned in an organized manner and the learning materials presented sequentially in the following manner: Introduction, presentation of content with pictorial illustrations (animation) and evaluation. There is also a section of text that will enable the students copy notes on the topics being studied. Additionally, there is a self-assessment section at the end of every lesson. This section consists of 10-Multiple Choice Test

Items as formative questions. The first five (5) questions are to be answered by the students in the class and the remaining five (5) are assignment questions. Each question has four options (A - D) and only one of them is correct. The students will be informed when his/her answer is correct or wrong using ticks ( $\checkmark$ ) and ( $\times$ ) respectively. A correct answer is also followed by a voice sound "CORRECT" and a wrong answer is followed by a voice sound "WRONG". Students are scored as they supply answers to the questions and the total score is displayed at the end of each self-assessment section.

Intact classes and were used for the purpose of this study. The school biology teachers were trained as research assistants in each school. The researchers used the developed Computer Assisted Instructional Models (CAIM) on the experimental groups but taught the control group personally using Conventional method, although, they solicited for the assistance of the school biology teachers particularly during the use of instructional models and administration of pretest and posttest. The contact period for data collection was 14 weeks.

The pretest and posttest scores of the students were analyzed using Statistical Package for Social Sciences (SPSS) version 16. Significance of the various statistical analyses were determined at 0.05 significant level. The statistics used for analyses were Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA) and Scheffes' *post hoc test*. The ANCOVA was used for analysis because the pretest result was found to have a significant difference. This explains the presence of extraneous variables

## Result and discussion

Table 4: Analysis of Variance (ANOVA) of Pretest Result of Experimental and Control Groups

Group	Sum of Squares	DF	Mean Square	F <sub>cal</sub>	P <sub>value</sub>
Between Groups	434.467	2	217.233	5.568*	.004
Within Groups	10416.900	267	39.015		
Total	10851.367	269			

\*Significant at  $p < 0.05$

Table 4 shows the pretest results of Experimental Group 1, Group 2 and Control Group students taught the concept of metabolism in biology with Computer Assisted Concept Mapping Instructional Model, Computer Assisted Analogical Instructional Model and Conventional method respectively. The ANOVA result is significant at 0.004 ( $F = 5.568, p < 0.05$ ). This result therefore, indicates that the three groups were not equivalent in

terms of their prior knowledge on the concept of metabolism before the treatment.

$H_0$ : There is no significant difference in the retention mean scores of students taught the concept of metabolism in biology with Computer Assisted Concept Mapping and Analogical Instructional packages and those taught with Conventional lecture method

Table 5: Analysis of Covariance (ANCOVA) Result of Retention Scores of Experimental and Control Group Students

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8513.529	3	2837.843	652.942	.000
Intercept	7495.359	1	7495.359	1724.561	.000
Pretest	7739.811	1	7739.811	1780.805	.671
Group	1824.361	2	912.181	209.878	.000
Error	1156.100	266	4.346		
Total	7.109E5	270			
Corrected Total	9669.630	269			

Table 5 reveals the main effect of treatment on retention scores of students taught the concept of metabolism in biology with Computer Assisted Concept Mapping Instructional Model, Computer Assisted Analogical Instructional Model and Conventional lecture method. The ANCOVA result is significant at 0.000 ( $p < 0.05$ ). Therefore, the hypothesis was rejected. This means that there was significant difference

in the retention of students taught the concept of metabolism in biology with Computer Assisted Concept Mapping Instructional Model, Computer Assisted Analogical Instructional Model and Conventional lecture method. Scheffe Analysis was then carried out to find where the significant difference actually existed among the three groups as shown in table 6.

Table 6: Scheffe Analysis of Retention Scores of Experimental and Control Groups Students

(I)	J	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	3.400*	.860	.918	-2.47	1.76
	3	3.400*	.860	.001	1.28	5.52
2	1	-.356	.860	.918	-1.76	2.47
	3	3.756*	.860	.000	1.64	5.87
3	1	-3.400*	.860	.001	-5.52	-1.28
	2	-3.756*	.860	.000	-5.87	-1.64

\* The mean difference is significant at the 0.05 level.

KEY: 1 = EXPERIMENTAL GROUP ONE, 2 = EXPERIMENTAL GROUP TWO AND 3 = CONTROL GROUP

From Table 6, Scheffe result indicated a significant mean difference of 3.40 and a high upper boundary of 5.52 between experimental group 1 and control group. This is an indication that there was a significant difference between experimental group 1 and control group but there was no significant difference between experimental groups 1 and 2. The result also indicated a significant mean difference of 3.76 and a high upper boundary of 5.87 between experimental group 2 and control group.

**Summary of Finding**

The finding of the study was that there was a significant improvement in the students' retention on the concept of metabolism in biology as the mean score of both experimental groups on retention were higher than that of the control group.

**Discussion of Result**

It was revealed that there was a significant difference on the pretest scores of the students. This result therefore indicates that, the three groups were not equivalent in terms of their prior knowledge on the concept of metabolism before the treatment. Table 5 revealed that retention test scores of the experimental groups 1 and 2 upon which Computer Assisted Concept Mapping Instructional Model (CACMIM) and Computer Assisted Analogical Instructional

Model (CAAIM) were used respectively had better retention than the control group upon which Conventional method was used Table 6 also indicated that there was a significant difference between experimental group 1 and control group but there was no significant difference between experimental groups 2 and 1. The two experimental groups had high significant mean difference than the control group. Hence the research hypothesis that, there is no significant difference in the retention mean scores of students taught the concept of metabolism in biology with Computer Assisted Concept Mapping Instructional Model, Computer Assisted Analogical Instructional Model and Conventional lecture method was therefore rejected. This result is in consonance with the findings of Altin (2002); Kara (2008); and Ramatu (2014) who all reported that students taught with CAI package retained better than those taught with conventional method. In addition, the result is in line with the findings of Karper, Robinson & Casado-Kehoe, (2005) who reported that, Computer Assisted Instruction (CAI) has been found to enhance students' performance and retention than the conventional instructional method in counsellor Education. Ifeakor (2005) also investigated the effects of CAI on science students' academic achievement and retention and reported a significant improvement in their retention.



## Conclusion

Result of this study revealed that retention test scores of the experimental groups 1 and 2 upon which Computer Assisted Concept Mapping Instructional Model (CACMIM) and Computer Assisted Analogical Instructional Model (CAAIM) were used respectively had better retention than the control group upon which Conventional method was used.

## Recommendations

Since the exposure of secondary school students to teaching with the research instruments has resulted in such a significant improvement in their retention, the following recommendations were made for the effective utilization of the instruments

- (i) Computer Assisted Concept Mapping Instructional Model (CACMIM) and Computer Assisted Analogical Instructional Model (CAAIM) as teaching strategies should be adopted by science teachers in secondary schools to improve students' retention.
- (ii) Government should organize and sponsor teachers to attend training courses on the use of Computer Assisted Concept Mapping Instructional Model (CACMIM) and Computer Assisted Analogical Instructional Model (CAAIM) as instructional strategies.
- (iii) Science teachers should study and harness appropriate and familiar analogy and concept mapping strategies in their teaching to enhance better understanding and retention of science concepts. This would reduce misconceptions by students.
- (iv) Teachers should be conversant with previous knowledge of students and make efforts to build on them particularly while using analogy instructional strategy.
- (v) Authors should use relevant and familiar concept maps and analogies for presenting specific concepts and principles in science textbooks. This

would make students' learning more meaningful as the familiar concept maps and analogies in the book will encourage them to read on their own and improve their retention.

## References

- Abu, A. O. (2000). Resource utilization in classroom: The effect of learning activity package to teach Biology at the senior secondary school level of education. *Science Teachers Association of Nigerian, 41st Annual Conference Proceedings, 103-106.*
- Ahmed, M. A. (2008). Influence of personality factors on biology lecturers' assessment of difficulty levels of genetics concepts in Nigerian colleges of education. *Unpublished PhD thesis, University of Ilorin, Ilorin.*
- Akour, M. A. A. (2006). The effects of computer assisted instruction on Jordanian college students' achievements in an introductory computer science course. *Electronic Journal for the Integration of Technology in Education, 17-24.*
- Altin, K. (2002). *The effectiveness of computer assisted environmental method and concept mapping with regard to some cognitive process and level of retention. Unpublished Ph.D Thesis, Marmara University, Turkey.*
- Collazos, C., Guerrero, L. A., Liana, M., & Oetzel, J. (2008). Gender: An influence factor in the collaborative work process in computer-mediated communication. Retrieved December 17, 2008, from <http://www.dcc.uchile.cl/~luguerre/papers/ICNEE-02.pdf>
- Haluk, O. (2008). The influence of computer-assisted instruction on students' conceptual understanding of chemical bonding and attitude towards Chemistry: A case study of Turkey. *Elsevier Science Limited*
- Ifeakor, A. C. (2005). Effects of commercially

- produced computer assisted instruction package on students' achievement and interest in secondary school Chemistry. *Unpublished Ph.D Dissertation*, Nsukka University of Nigeria.
- Ojoana, B. C., & Onwukwe, I. O. (2011). Using culturally-based analogical concepts in teaching secondary school science: Model of a lesson plan. *International Journal of Science and Technology Education Research*, 2(1), 1-5.
- Kara, I. (2008). The effect on retention of computer assisted instruction in science education. Retrieved from <http://www.thefreelibrary.com/the-effect-on-retention-of-computer>.
- Karper, C., Robinson, E. H., & Casado-Kehoe, M. (2005). Computer assisted instruction and academic achievement in counsellor education. Retrieved from [http://jtc.colstate.edu/Vol4\\_1/Karper/Karper.htm](http://jtc.colstate.edu/Vol4_1/Karper/Karper.htm)
- Mudasiru, O. Y., & Adedeji, O. A. (2010). Effects of Computer Assisted Instruction (CAI) on secondary school students' performance in Biology. *The Turkish Online Journal of Educational Technology (TOJET)*. Retrieved January 15<sup>th</sup>, 2010 from <http://je.education.pitt.edu/library/SelESteem>.
- Onwukwe, E. O., & Onwukwe, C. M. (2010). Linking electrolysis and related topics with analogical thinking processes of students using play simulations. In Osisoma, I. (2006). Active learning strategies for the science classrooms. *STAN 47<sup>th</sup> Annual Conference*. 13<sup>th</sup> - 19<sup>th</sup> August, 2006.
- Ramatu, G. W. (2014). Effects of computer assisted instructional package on achievement, retention and interest in set theory among senior secondary school students in Niger State. *Unpublished Ph.D thesis*, University of Nigeria, Nsukka.
- WAEC, (2000, 2002, 2003, 2004, 2006, 2009, 2010 & 2011). *Chief Examiners' Report*.

