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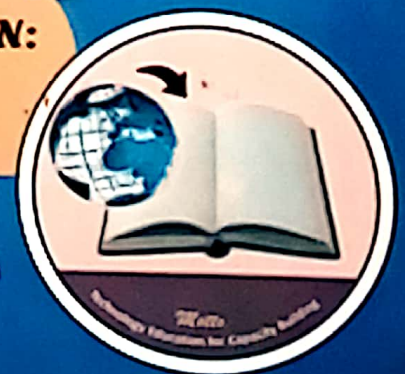
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Effects of Computer Assisted Concept Mapping and Analogical Instructional Packages on Niger State Male and Female Secondary School Students' Achievement in Biology

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Abstract

The study examined the Effects of Computer Assisted Concept Mapping and Analogical Instructional Packages on Niger State Male and Female Secondary School Students' Achievement on the concept of metabolism in Biology. Quasi-Experimental design (Pretest-Posttest-Control group design) was adopted for the study. The target population for the study was all the year II Senior Secondary (SSII) biology students from the three senatorial Zones (A, B and C) of Niger State. Three (3) co-educational Senior Secondary Schools were purposively selected from each of the three zones making a total of nine (9) schools used for the study. One (1) school from each zone was used as experimental group 1, another one (1) school as experimental group 2, and the third school was used as control group. A total of two hundred and seventy (270) students (135 male and 135 female) were selected (by simple balloting) from the nine (9) schools used for the study. Thirty (30) SSII students (15 male and 15 female) were selected from each school for the study. 50-Multiple Choice Test Items on Metabolism (MCTIM) and the CAI packages. Experts validated the instruments. A pilot test was conducted and the reliability coefficient (r) of 0.96 was obtained. Analysis of Covariance (ANCOVA) was used to test the hypothesis formulated at 0.05 significant levels. The result revealed that there was no gender difference among the students exposed to the CAI packages. It was recommended that the use of Computer Assisted Concept Mapping Instructional Package (CACMIP) and Computer Assisted Analogical Instructional Package (CAAIP) as teaching strategies should be adopted by science teachers in secondary schools.

Keyword: Achievement, biology, concept, effects, metabolism, students, and Niger State.

Introduction

Womens' role in social and economic development seem to be culturally determined in traditional societies, hence, their potentials seriously constrained and taken for granted (Morenikeji, 2000). This resulted in women being subjected to considerable industrial and occupational segregation. They are particularly concentrated in semi skilled and unskilled employment in retailing, catering, cleaning and clothing industry. Women are mostly employed to the lower grade clerical and secretarial posts, while the relatively small portion of professional women employees are concentrated in the caring profession like education, social welfare and health (Morenikeji, 2000). Federal office of statistics (1996) in Morenikeji (2000) reported that one of the causes of low status accorded women in several societies is the discrimination against them in education. World Bank (1993a) reported that there is a great disparity in male-female school enrolment ratio in favour of male. This finding is supported by a five year (2007 - 2011) enrolment analysis of Government Day Secondary School, Minna, students for Senior School Certificate Examination (SSCE) as shown in table 2.

Table 1: Enrolment Analysis of G.D.S.S. Minna Students for SSCE (2007-2011)

Sex	2007	2008	2009	2010	2011
Male	340 (57.14%)	412 (64.67%)	447 (57.60%)	475 (56.48%)	511 (58.00%)
Female	255 (42.86%)	230 (35.33%)	329 (42.40%)	366 (43.52%)	370 (42.00%)
Total	595	651	776	841	881

Source: Secondary School Education Board, Minna

It can be seen from table 1 that, the percentage enrolment of male is higher than that of the female students. Government Day Secondary School is one of the secondary schools in Minna and the percentage enrolment shown above is not quite different from that of other secondary schools. This disparity in school enrolment in favour of male was attributed to the desire of some parents to educate male child rather than the female child partly because, they believe that the male child has better employment opportunities than the female child (World Bank, 1993a). This therefore drew attention of the whole world to the gender issues in developmental efforts most especially in the developing countries like Nigeria. Many researchers have shown much interest in the study of the relationship between gender and differential effectiveness of schooling by gender globally (Olatoye, 2008; Iwendi, 2009; and Enu, Anuah & Danso, 2013). Their findings are in line with the report by World Bank (1993a) as they all reported that more male are found in school than female students. They further asserted that female participation both in science and education in general have been observed to decline drastically. Bogar, Kalender & Sankaya (2012) opined that factors responsible for this decline include early maturation and early marriage of the female wards, which leads to their removal from schools particularly in northern Nigeria. Iwendi (2007) and Chado (2009) reported that both the attendance rate and the quality of female education differ from region to region. More girls attend schools in the southern and western part of the country than in the northern part. Studies by Enu, Anuah and Danso (2013) also showed that there are differences in performance of boys and girls in science class. They further reported that there was a significant higher achievement of boys over girls in integrated science in Junior Secondary Schools. Olatoye (2008) reported that male students responds to teacher's questions by raising their hands and also manipulates equipment to a greater extent than female students in classroom and laboratory activities. The studies above examined the gender difference in different areas of research. The present study is aimed at determining gender differences with the hope that further confirmation of the existence of gender differences in performance would be made through the use of concept mapping and analogies inform of Computer Assisted Instruction (CAI).

Many research works conducted on the use of Computer Assisted Instructional (CAI) strategy reported that, CAI has been effective in enhancing students' performance than the conventional classroom instruction otherwise called traditional method (Ifeakor, 2005; Karper, Robinson & Casado-Kehoe, 2005; Basturk, 2005; Davis, 2005; Akour, 2006; Collazos, Guerrero, Llana & Oetzel, 2008 and Mudasiru & Adedeji, 2010). However, literature on Computer Assisted Concept Mapping and Computer Assisted Analogical Instructional Packages are not commonly available in Nigeria. This is one of the major reasons that motivated the researchers to apply Concept Mapping and Analogy in form of Computer Assisted Instruction (CAI) which is the current global trend in Information and Communication Technology (ICT) for classroom instruction to determine whether secondary school students' achievement will be improved

Objective of the study

The purpose of this study was to determine the gender differences in achievement on the concept of metabolism among secondary school biology students.

Research Question

During the research study, the answer to the following research question was persuad. Is there any significant difference in the achievement of male and female students taught the concept of metabolism in biology with computer assisted concept mapping and analogical instructional packages and those taught with conventional lecture method?

Null hypothesis
The following null hypothesis was formulated and tested at 0.5 level of significant.

H_0: There is no significant difference in the achievement mean scores of male and female students taught the concept of metabolism in biology with Computer Assisted Concept Mapping and Analogical Instructional Packages and Conventional method

Research methodology
Design: The research design adopted for this study is a Quasi-Experimental design. It is a Pretest-Posttest-Control group design consisting of multiple treatments. This design enabled the researcher to concurrently manipulate the two independent variables (Computer Assisted Concept Mapping and Computer Assisted Analogical Packages) to assess the effects of their interactions on the dependent variables (Male and Female Students' Achievement).

Sample and sampling techniques:
Purposive sampling was used for selecting schools for the study as 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 experimental and control groups. The target population for this study is all the year II Senior Secondary (SSII) biology students in Niger State.

Sample for the research study consist of two hundred and seventy (270) students (135 males and 135 females) from nine (9) co-educational Senior Secondary Schools selected by simple balloting technique from all the three (3) Senatorial zones of the state. Three schools represented each of the three zones (A, B and C) making a total of nine (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 thirty (30) SSII students (15 males and 15 females) 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 Package (CACMIP) while experimental group 2 was taught the same concept using Computer Assisted Analogical Instructional Package (CAAIP). Control group on the other hand was taught same concept using Conventional Method

Instrumentation:
Two research instruments used for this study were Test instrument and Treatment instruments

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

Treatment Instruments
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 Package (CACMIP) and (ii) Computer Assisted Analogical Instructional Package (CACIP). 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 (√) and (x) 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.

Method of Data Collection

The selected students formed an intact class 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 Package (CAIP) 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 packages and administration of pretest and posttest. The contact period for the study was fourteen (14) weeks.

Method of Data Analysis

The Pretest and Posttest scores of the students were analyzed using Statistical Package for Social Science (SPSS) version 16. Significance of the various statistical analyses were determined at 0.05 significance level. The statistics used for analyses were Means, Standard deviation, Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA) and Scheffes' *post hoc test*

Results and Discussion

Table 2: Analysis of Variance (ANOVA) of Pretest Result of Experimental and Control Groups

Group	Sum of Squares	Df	Mean Square	F	Sig.
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 2 shows the pretest ANOVA results of both Experimental and Control group students. The ANOVA result (F = 5.568), is significant at 0.004. The F value is also significant at 0.05 (F = 5.568, p<0.05). The result revealed that there was a significant difference on the pretest scores of the students. This implies that, the three groups were not equivalent in terms of their prior knowledge on the concept of metabolism before the treatment.

Null Hypothesis (HO)

There is no significant difference in the achievement mean scores of male and female students taught the concept of metabolism in biology with Computer Assisted Concept Mapping Instructional Model, Computer Assisted Analogical Instructional Model and Conventional method

Table 3: Analysis of Covariance (ANCOVA) Result of Achievement Scores of Experimental And Control Group Students on Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	9252.638	6	1542.106	447.244	.000
Intercept	5981.206	1	5981.206	1.735E3	.000
Pretest	8406.593	1	8406.593	2.438E3	.122
Gender	1919.814	5	383.963	111.358	.000
Error	906.829	263	3.448		
Total	668464.000	270			
Corrected Total	10159.467	269			

Table 3 reveals that, the ANCOVA result (F = 111.358) is significant at 0.000. This F value is also significant at 0.05 (p = 0.000; p < 0.05). The treatment instrument is believed to have produced a significant difference on male and female students' achievement. Scheffe Analysis was then carried out to find out where the significant difference existed among the three groups as shown in table 4.

Table 4: Scheffe Analysis of Achievement Scores of Experimental and Control Group Students on Gender

		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
4	5	.844	1.221	.993	-3.25	4.94
	6	-.356	1.221	1.000	-4.45	3.74
	7	.489	1.221	.999	-3.60	4.58
	8	3.422	1.221	.168	-.67	7.51
	9	4.222*	1.221	.038	.13	8.31
5	4	-.844	1.221	.993	-4.94	3.25
	6	-1.200	1.221	.965	-5.29	2.89
	7	-.356	1.221	1.000	-4.45	3.74
	8	2.578	1.221	.487	-1.51	6.67
	9	3.378	1.221	.180	-.71	7.47
6	4	.356	1.221	1.000	-3.74	4.45
	5	1.200	1.221	.965	-2.89	5.29
	7	.844	1.221	.993	-3.25	4.94
	8	3.778	1.221	.092	-.31	7.87
	9	4.578*	1.221	.017	.49	8.67
7	4	-.489	1.221	.999	-4.58	3.60
	5	.356	1.221	1.000	-3.74	4.45
	6	-.844	1.221	.993	-4.94	3.25
	8	2.933	1.221	.332	-1.16	7.03
	9	3.733	1.221	.100	-.36	7.83
8	4	-3.422	1.221	.168	-7.51	.67
	5	-2.578	1.221	.487	-6.67	1.51
	6	-3.778	1.221	.092	-7.87	.31
	7	-2.933	1.221	.332	-7.03	1.16
	9	.800	1.221	.994	-3.29	4.89
9	4	-4.222*	1.221	.038	-8.31	-.13
	5	-3.378	1.221	.180	-7.47	.71
	6	-4.578*	1.221	.017	-8.67	-.49
	7	-3.733	1.221	.100	-7.83	.36
	8	-.800	1.221	.994	-4.89	3.29

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

KEY:

EXPERIMENTAL GROUP ONE   EXPERIMENTAL GROUP TWO   CONTROL GROUP

4 = Male and 5 = Female   6 = Male and 7 = Female   8 = Male and 9 = Female

From table 4, Scheffe result indicated a mean score of 4.22 and a high upper bound of 8.31 (p = 0.038; p < 0.05) between experimental group1 male (4) and control group female (9). This is an indication that significant difference existed between experimental group 1 male and control group female. Scheffe result also indicated a mean score of 4.58 and a high upper bound of 8.67 (p = 0.017; p < 0.05) between experimental group 2 male (6) and control group female (9). This is an indication that significant difference existed between experimental group 2 male and control group female. Scheffe result in addition, indicated a mean score of -4.22 and a high upper bound of -.13 (p = 0.038; p < 0.05) between experimental group 1 male (4) and control group male (8). This is an indication that significant difference existed between experimental group 1 male and control group female. Finally, Scheffe result indicated a mean score of -4.58 and a high upper bound of -.49 (p = 0.017; p < 0.05) between experimental group 2 male (6) and control group female (9). This is an indication that significant difference existed between experimental group 2 male and control group female. In the other word, the differences observed were between, first, male of experimental group 1 and control group female and secondly, male of experimental group 2 and control group female.

From the above Scheffe results therefore, research hypothesis that there is no significant difference in the achievement mean scores of male and female students taught the concept of metabolism in biology with Computer Assisted Concept Mapping Instructional Model, Computer Assisted Analogical Instructional Model and Conventional method was rejected. The result was not in consonance with the findings of Arbaba (2003); Joiner, Messer, Littleton & Light (2006); Iwendi (2007); Orabi (2007); Chado (2009) and Ramatu (2014) who reported no significant difference in students' achievement when taught with CAI packages.

Major Findings of the Study

The following findings were recorded based on the statistical analysis of data collected during the study

1. There was a significant difference on the pretest scores of the students when ANOVA was used to analyze their scores. This therefore indicates that, the three groups were not equivalent in terms of their prior knowledge on the concept of metabolism in biology before the treatment.

2. The experimental groups 1 and 2 upon which the research instruments were used achieved higher than the control group upon which Conventional method was used. The difference in achievement was found to be significant favouring experimental group 2 students.

3. Experimental Group 1 and 2 male and female students achieved higher than the control group. The difference in achievement was found to be significant favouring experimental group 2 with achievement mean gain of 1.60

Conclusion

In the light of the above major findings, if the exposure of the students used for the study to Computer Assisted Concept Mapping Instructional Model (CACMIM) and Computer Assisted Analogical Instructional Model (CAAIM) in such a limited period of time could result in such a striking achievement and retention, it stands to reason that under normal classroom setting, the use of these instruments as instructional strategies would prove to be very efficient and effective in improving students' achievement and retention.

Recommendations

From the above findings, the following recommendations were made for the effective utilization of the instruments:

(i) The use of Computer Assisted Concept Mapping Instructional Model (CACMIM) and Computer Assisted Analogical Instructional Model (CAAIM) as teaching strategies be adopted by science teachers in secondary schools.

(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) Government should motivate teachers by raising their status and increasing their monthly emolument. This will encourage them to stay in the teaching profession and discharge their duties effectively.

(iv) Authors should use relevant and familiar concept maps and analogies for presenting specific concepts and principles in science textbooks. This will make students' learning more meaningful as the familiar concept maps and analogies in the book will encourage them to read on their own.

(v) Teachers should be conversant with previous knowledge of students and make efforts to build on them particularly while using analogy instructional strategy.

References

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.* Retrieved 10th July, 2008 from httpL//ejtc.isu.edu A volume5/Akour.pdf.

Basturk, R. (2005). The effectiveness of computer assisted instruction in teaching introductory statistics. *Journal of Educational Technology and Society, 8 (2), 170-178.* Retrieved 10^{a} July, 2008 from http://www.ifets.info/journals 8 2/16.pdf.

Bogar, Y, Kalender, S. & Sarikaya, M. (2012):*The effects of constructive learning method on students' academic achievement, retention of knowledge, gender and attitudes towards science course in "matter of structure and characteristics" unit.* Procedia - Social and Behavioral Sciences, 46, 1766 – 1770.

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.uchie.cl/-luguerre/papers/ICNEE-02.pdf

Davies G. (2005) *Computer assisted language learning: Where are we now and where are we going?.* Retrieved from: http://www.cu.uk/docs/UC^{1}ALL.Kenote.htm.

Egunjobi, A. O. (2002). The efficacy of two computer assisted instructional modes on learners' practical geography achievement at the secondary school level in Ibadan metropolis, Nigeria. Paper delivered at NAEMT conference, 20 - 23 November.

Enu, J., Anuah, E., & Danso,P. (2013): A comparative study of achievement test scores of boys and girls taught through cooperative learning strategy; Journal of Education and Practice,4(28).

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.

Iwendi, B. C. (2009). The Influence of Gender and Age on the Mathematics Achievement of Secondary School Students in Minna Metropolis of Niger State. *Unpublished M. Tech. Thesis, department of science education, PUT, Minna-Nigeria.*

Karper, C.; Robinson, E. H. & Casado-Kehoe. M. (2005). Computer assisted instruction and academic achievement in counsellor education. *Journal of Technology in Counseling, 4 (1).* 2007, from http://jtc.colstate.edu/Vol4_1/Kcirper/Karper.htm

Koroka, M. U. S. & Ezenwa, V. I. (2009).Effects of analogy on the understanding of the concept of osmosis among secondary school students in Minna, Niger State, Nigeria. *Nigerian Jounal of Technological Research.* 4(2), 80 - 83.

Lagoke, B. A. (2000). An appraisal of the findings of some recent researches on the role of analogy in the teaching-learning process of science. *Journal of Science, Technology, Mathematics and Education* 3 (1), 57-62

Mills, R. (2001) A comparison study of the learning effectiveness of computer aided instruction vs classroom lecture. Retrieved December 22, 2007, from: http://www.concentric.net/~Walwpr/thesis/4result.html.

Morenikeji, W. (2000). The influence of female education in explaining the north-south dichotomy in Nigeria. *Journal of Science, Technology and Mathematics Education* 3(1), 2000.

Okoro, C. A. and Etukudo, U. E. (2001). *CAI versus Extrinsic motivation based traditional method: Its effect on female genders performance in chemistry.* A paper presented at 42nd STAN Conference in Ilorin.

Okoye, A. C. (2012). Effects of computer assisted instruction on students' acquisition of science process skills and interest in biology. *Unpublished PhD thesis of the University of Nigeria, Nsukka.*

Olatoye, R.A. (2008): "Self-Concept and Science Achievement in Co-Educational and Single-Sex Junior Secondary School in Ogun State Nigeria": *Review of Higher Education and Self-Learning.* Vol.1 No1. Available at: www.Intellectbase.org.

Spencer, D. J. (2004). Engagement with mathematics courseware in traditional and onlinelearning environments: Relationship to motivation, achievement, gender, and gender orientation. Unpublished dissertation submitted to the Faculty of Graduate School of Emory University, in partial fulfilment of the requirement for the degree of Doctor of Philosophy. From http://www/des.emory.edu/mfp/Speiice.Dissertation2004.pdf.

WAEC, (2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013 & 2014). Chief Examiners' Report.