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An Investigation of Concept Attainment Model on Learning Achievement in Biology in Public Secondary Schools in Kibwezi sub-County, Kenya

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Abstract:

For quite some time, Biology performance in public secondary schools has been poor. This has been attributed to the nature of teaching methods, abstract nature of biology and the teaching-learning resources. This study sought to investigate the effect of concept attainment model on learning achievement in biology in public secondary schools of Kibwezi sub-county, Kenya. There is however inadequate research done on the effect of concept attainment model in the teaching-learning process in the classroom situation. The objective of the study was to establish how concept attainment model influences student's performance in biology concepts. The research was based on Bruner's learning theory and Component display theory by Dr. D. Merrill. The research methodology was quantitative methods with a Quasi Experimental design as the research design. Simple random sample of four schools were obtained from 52 mixed sex sub-county schools. The sample size comprised of 224 students from the four schools of 52, 58, 58 and 56 respectively. Piloting was in one public mixed sub-county secondary school of Makindu sub-county. Concept attainment test (CAT Constructed by the researcher was the instrument used to collect data. This CAT was administered into two groups, one experimental and one control group before intervention and then to all four groups after intervention. It was validated by use of experts' judgment in the department of educational psychology and technology and its reliability was estimated at 0.7 by having the split-up test administered. Analysis of data was by use of statistical package of social science (SPSS) Version 21.0. The analysis involved the use of descriptive statistics that tested on frequencies, means and percentages and the inferential statistics that tested on t-test, ANOVA at a co-efficient of alpha α level 0.05. The findings of this study are likely to benefit secondary school students and educational stakeholders like Kenya institute of curriculum development (KICD). The study showed that students taught using CAM scored better and had increased biology content than those taught using the traditional methods.

Keywords: Concept attainment model, biology achievement

1. Introduction

Biology is a natural science concerned with the study of life and living organisms. It has certain general and unifying concepts that govern all study and research. Its practical skills equip students with concepts and skills that are useful in solving the day-to-day problems of life. The study of biology aims at providing the learner with the necessary knowledge that can control or change the environment for the benefit of the individual, family and the community. According to Bransford, Brown and Corking, (1999), students develop usable biology knowledge if teachers give repeated feedback on the students' understanding.

Crow, (2004) looks at combination of both laboratory practical and lectures to stimulate students' understanding. Several studies have focused on the poor performance by students in national and school based examinations indicating that most of the students are not prepared for a world shaped by science and technology (pepsin, 1998). The poor performance in science subjects especially biology is global (Valverde and Landry (1998) in Canada, Fonseca and Conboy (2006) in Portugal. In relation to Caribbean examination Council (CEO) examiners (1987-2002), students demonstrated lack of understanding of many biological concepts hence poor performance in biology. Dina (2013), argues out that students' achievement in biology was unsatisfactory for many years in Nigerian National Examination for Senior Secondary Certificate Examination (SSCE), due to lack of innovative teaching strategy like the use of the concept attainment model (CAM). In Kenya, though biology has key important aspects of life it addresses, there has been a nation-wide out cry about the students' performance and subsequent drop in the number of students taking biology (Aduda, 2009) as in the table 1 below.

Year	Maximum Score	Mean Score	% Mean
2009	200	54.29	27.15
2010	200	58.29	29.15
2011	200	64.87	32.49
2012	200	52.41	26.21
2013	200	63.26	31.63
2014	200	63.65	31.83

Table 1: A Summary of Biology K.C.S.E Candidates' Overall Performance in Kenya from 2009- 2014.

Source: K.C.S.E annual report 2014

KNEC report (2008), indicated poor attainment and misconception of biological concepts in gaseous exchange. Owino et al., (2004), attaches the poor performance in biology with the teaching-learning resources, the teaching methods used and the parental inability to support education. Similar poor performance due to poor attainment of biological concepts was experienced in Kibwezi sub-County public secondary school as in table 2.

Year	Mean score	% Mean Score
2012	4.035	23.625
2013	4.642	28.683
2014	4.321	26.008

Table 2: Summary of Biology Students' Performance in K.C.S.E in Kibwezi Sub-county from 2012-2014.

Source K.C.S.E report 2014

The same reasons were quoted about the poor attainment of Concepts as given nationally. The study on CAM reflects how students should know how to learn but not what to learn.

1.1. Concept of Concept Attainment Model

Concept attainment is the search for and listing of attributes that can be used to distinguish exemplars from non-exemplars or the "Yes" and "No" of various categories (Bruner, Goodnow and Austin, 1956). It uses positive and negative examples or clues to guide the categorization into significant groups. It involves both decision making and personalized historical experiences of each student. Joyce and Weil (1967), further looks at concept attainment to focus on decision-making and categorization process that leads to creation and understanding of concepts. Bruner et al; (1956) talks of concept attainment be able to ensure that: -

- The concept is attained after minimum number of encounters has been made with relevant examples.
- A concept is attained with certainty regardless of the number of instances one tests.
- Minimum amount of strain on guessing and memorization guarantees attainment of a concept.
- There is minimum number of wrong categorization prior to attainment of concepts.

Teachers use the concept attainment model when they want their students to learn a set of attributes or characteristics about biological concept, group or category. During the teaching, the teacher has to have stack cards, each card with a picture or word about the new concept to be taught. From the cards, the teacher is expected to tell the students to guess and discuss the common positive characteristics of the sub-topics to teach that alongside with negative characteristics of the same. The negative characteristics are expected to form a basis for the next lesson. The teacher is expected to hold up the cards of any of the concept of the topic and allow the students to say "Yes" if there is or are pictures of the concept and "No" if a different picture or pictures about another type of the concept appears.

Concept attainment model lesson is usually based on three principles: - principle of conceptual clarity, principle of multiple examples, and the principle of conceptual competence (Marzano, Pickering, and Pollock, 2001). This study used these principles to prove how CAM improves learning activities that provide good achievements and increase biology content. The study found out that students taught by CAM achieved significantly higher scores in the concept attainment test (CAT) than those taught by the conventional teaching methods. This agreed with a research done by Kumar and Mathur (2013), in which there was a significant difference between the mean scores of post-test scores of the experimental and control groups in physics achievement test that was done due to the intervention by the CAM the researcher used. In this study, the experimental groups scored higher mean scores than the control groups because they were exposed to CAM Interventions but the control groups were taught using the conventional methods.

1.2. Problem of the Study

There has been an outcry nation-wide that the achievement in science biology included is poor as observed in table1. This may be due to the level of attainment and understanding of biological concepts resulting from the nature of teaching methods. Much of the biological concepts are taught through the use of packaged information and the teacher centered approach. Other factors associated with the poor achievement are inadequate teaching materials, class size, and parental inability to support education. Little has been done on how students would attain biological concepts through learning how to learn but not what to learn and therefore the need to research on the effect of concept attainment model to the achievement in biology in public secondary schools and the long-life objectives.

1.3. Purpose of the Study

The study carried out an investigation of concept attainment model on learning achievement in biology in public secondary schools in Kibwezi sub-county Kenya.

1.4. Research Objectives

- i. To establish how concept attainment model influences students’ performance in biological concepts in public secondary schools of Kibwezi sub-county, Makueni County.

1.5. Research Questions

- i. What is the effect of concept attainment model towards students’ performance in biological concepts in public secondary schools of Kibwezi Sub-county, Makueni County?

1.6. Conceptual Framework on Concept Attainment Model on Learning Achievement in Biology

The conceptual framework of this study is based on Bruner’s learning theory, (Bruner, 1957) and the component display theory (CDT) by Dr. D. Meril, (1964). Bruner’s theory emphasis on the learner who should be able to learn how to learn with the teacher’s role been to create a situation in which learners learn on their own instead of the packaged information. Component display theory focuses on allowing the learners to select and control their own instructional methods that would enable them to attain the three performance levels: memory and recall, application or utilization and generalization. The framework in figure 1 shows the dependent variables as learning achievement in biology particularly the learner’s performance, and learner’s biology content. The independent variables are on the use of the concept attainment model in teaching instead of the conventional methods. The research had intervening variables such as teaching resources, learning environment, parental support to education and the students’ physical and mental status.

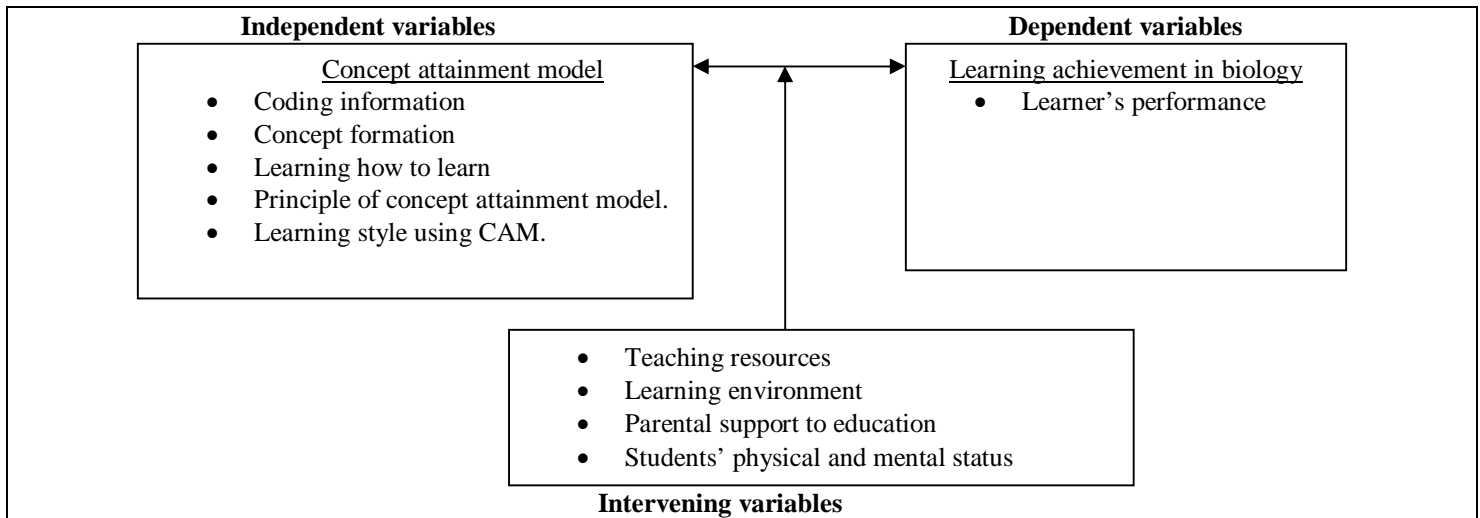


Figure 1

2. Research Methodology

This study used quantitative research method that employs experimental methods and qualitative measures that tests hypothetical generalizations (Hoepiti, 1997). It used quasi experimental design that involves non-Equivalent Control Group Design (Gitua and Nyabwa, 2008). The design was preferred because secondary school authorities do not normally allow their classes to be dismantled and get reconstituted for purpose of study (Shadish, Cork and Campbell, 2002). It helped to assess the effect of the treatment group relative to the control group; the interaction and treatment condition; the effect of the pre-test relative to the post-test and lastly the homogeneity of the groups the treatment was administered (Borg and Gall, 1989). The pre-test and post-test approaches were used to partially eliminate the initial differences between the experimental and control groups.

Group	Pre-test	Intervention	Post-test
T ₁	B ₁	R _x	A ₁
C ₁	B ₂	O	A ₂
T ₂	_____	R _x	A ₃
C ₂	_____	O	A ₄

Table 3: Quasi – Experimental; Non- Equivalent Control Group Design

In the figure; C₁ and C₂ represented the sample control schools that used the conventional methods. Groups T₁ and T₂ represented the sample experimental schools that received the treatment. B₁ and B₂ denote the pre-test that was given to T₁ and C₁ before the intervention. A₁, A₂, A₃ and A₄ indicate the post-test for all groups involved in the study. R_x denotes the intervention by use of the

concept attainment model, O represented the no treatment given, (-) represented no pre-test given to the groups while the broken line separating the parallel rows indicated that the assignment of the students to experimental and control groups was not by random assignment.

2.1. Population of the Study

The target population was secondary school students of Kibwezi sub-county that has 65 public secondary schools out of which 2-single sex extra county, 5 single sex counties, 1 mixed sex county, 4 single sex sub-county and 52 mixed sex sub-county secondary schools. The study targeted 4564 forms two students from mixed sex sub-county schools that had almost equal sex-ratio. The study targeted to use mixed sex sub-county secondary schools that were the majority and diploma and degree biology with a minimum of two years teaching experiences.

2.2. Sampling Procedure and Sample Size

Stratified sampling was used to assign each of the four administrative divisions of Kibwezi sub-county the four groups so that the interaction between the experimental and control groups would be minimized. Then a purposive random sampling was used to select the school per each division. Kerlinger (1986), explains purposive sampling as a non-probability sampling in which deliberate representatives are obtained. Each school formed a group as either experimental or control. The randomizing used gave out two experimental and two control groups. Each class had more than the least 30 cases required giving a total sample size of 224 form two students.

2.3. Research Instrument

In this study, a concept attainment test (CAT) was used to collect the required data. The CAT had items that tested the students' knowledge, comprehension, and application of the skills learnt. It had a maximum score of 100 for those who scored all items correct and a minimum of 0 where all items were scored wrong. Piloting was done in Makindu sub-county which is next to Kibwezi and has similar characteristics. Validation was by use of two biology trained teachers who had five years teaching experience while reliability of 0.7 from K-R-20 was tested by use of the split half technique.

3. Results

C ₁	T ₁	C ₂	T ₂	Total
Total 52	58	56	58	224

Table 4: Shows the total number of students who participated in the study by experimental and Control schools

Groups C₁ and T₁ sat for the pre-test CAT, which enabled the study to assess the homogeneity of the groups before treatment was recommended (Gall, Borg and Call, 1996). The t-test for the pre-test was done as in table 5 and their mean and standard deviation computed out.

Variable	Group	N	Mean	S.D	DF	t-critical	P-value
CAT	C1	52	15.71	7.247	108	-0.02	0.9802
	T1	58	15.67	9.068			

Table 5: Independent sample t-test of the pre-test scores of CAT based on C₁ and T₁ groups

Not significant at 0.9802 since $P > 0.05$ ($\alpha = 0.05$ level).

From table 5 there is no significant difference between the means of pre-test scores of the students in the experimental and control groups. Therefore, the two groups had similar characteristics hence suitable for the study.

3.1. Effects of the Concept Attainment Model on Students' Achievement in Biology

Analysis on students' achievement in biology resulting from the use of concept attainment model was performed in the topic of gaseous exchange using the post-test scores of the CAT. It was made to prove that there is a significant difference in performance between students taught by the concept attainment mode compared to those taught using the conventional method. No significant difference was noted between the groups of schools taught using neither conventional methods nor those taught by the concept attainment model only as observed in tables.

Group	(J) Group	Mean difference (I-J)	Standard error	Significant
C1	T1	-4.737	1.605	0.036
	C2	0.551	1.618	0.990
	T2	-5.875	1.605	0.005
T1	C1	4.737	1.605	0.036
	C2	5.288	1.574	0.012
	T2	-1.138	1.561	0.912
C2	C1	-0.551	1.618	0.990
	T1	-5.288	1.574	0.012
	T2	-6.425	1.740	0.001
T2	C1	5.875	1.605	0.005
	T1	1.138	1.561	0.912
	C2	6.425	1.574	0.001

Table 6: Scheffe's Post hoc comparison of the post-test CAT mean scores for the study groups

The mean difference is significant at 0.05 α level.

The mean difference between the experimental groups and the control groups were all below α (alpha) 0.05 α that is the p -value was $p < 0.05\alpha$ level meaning that the concept attainment model used in the study influenced greatly the students' biology performance. There was no significant difference between the treatment groups because the CAM had equal influence to the two groups and also no significant difference noted between the two control groups because both were not exposed to the intervention of the CAM.

4. Implications of the Study

Concept attainment model was found to be superior to the conventional teaching methods towards students' achievement of biological concepts and content. Therefore, concept attainment model should be adopted in teaching of biology to improve the performance and the students' biology content.

5. Recommendations

It is recommended that teacher educational programs, workshops and in-service courses have concept attainment model in co-operated in them to increase the ability of the biology teacher to teach. Further research should be done on areas that research has not covered.

- The perception of biology teachers towards the use of the concept attainment model.
- The attitude of educational experts towards models of teaching.
- The effectiveness of concept attainment model in teaching in all other educational teaching levels other than secondary schools.
- The topics that can be effectively taught using concept attainment model.

6. References

- Aduda (2009). Marks for Alliance, Daily Nation. Nairobi: National Media Group Limited.
- Borg, and Gall, (1989). Educational Research: An introduction. New York: Longman.
- Bransford, J., A., Brown; and Cooking (2000). How people learn: brain, mind, experiences, and school. Committee on developments in the science of learning. Washington D.C. National academic press.
- Bruner, J., Goodnow, J., and Austin G., (1956). A study of thinking. New York: Wiley and sons, Inc.
- Bruner, J., Goodnow, J., and Austin G., (1956). A study of thinking. Chapman and Hall, Limited. London.
- Caribbean Examinations Council (1987-2002). Reports on candidates' work in the secondary education certificate general proficiency examinations. Biology. St. Michael, Barbados CXC.
- Fonseca, and Conboy, (2006). Secondary Student Perceptions of Factors affecting failure in Science in Portugal. Euratia Journal of Mathematics, 2(1): 83-93. Retrieved 20th July, 2006 from <http://www.ejmste.com/022006/ab5.htm>.
- Githua, B. N. & Nyabwa, R. A. (2008). Effect of Advance Organizer Strategy During Instruction on Secondary School Students' Mathematics Achievement in Kenya's Nakuru District. International Journal of Science and Mathematics Education 6, 439-457.
- Hoepfl, M.C. (1997) Choosing qualitative research: A primer for technology education Research. Journal of technology Education, 9(1), 47-63. Retrieved February 25, 1998. From <http://scholar.l.b.vt.educa/ejournals/JTE/v9n/pdf/fthoepfl.pdf>.
- Joyce, Weil, Calhoun, (2008). Models of Teaching. Publisher, Allyn Bacon.
- Kenya National Examination Council (2006-2010). KCSE Examination reports: KNEC, Nairobi.
- Kerlinger, (1986). Foundations of behavioral research (3rd.ed.). Fort Worth, TX: Rinehart, and Winton.
- Kumar, A. and Mathur, M (2013) Effect of Concept Attainment Model on Acquisition of Physics Concepts. Universal Journal of Educational Research 1(3): 165-169, 2013.
- Marzano, Robert, Debra Pickering, and Jane Pollock. (2001). Classroom Instruction that works: Research-Based Strategies for increasing student achievement. Alexandria via Association for Supervision and Curriculum Development.
- Merril M., (2002). Instructional Strategies and learning Styles: which takes precedence?
- Mugenda and Mugenda (2002). Research methods. Quantitative and qualitative approaches. Nairobi: Acts Press.
- Pepin, (1998), 'Practical knowledge and school knowledge. -A Constructivist representation of education'. In Larochelle, Bednorz and Garrison (Eds.), constructivism and Education, Cambridge University Press, pp. 173-1992.
- Valverde, and Schmidt, (1997). Refocusing VS Maths and Science Education issues in Science and Technology. Retrieved 14th July, 2 <http://www.issues.org/14.2/Schmidt.htm>.