PDF - EFFECTS OF TEACHER MADE MODELS AND STUDENTS MADE MODELS ON STUDENTS' ACHIEVEMENT AND INTEREST IN ORGANIC CHEMISTRY - researchcub.info**ABSTRACT**

This study was carried out to investigate the effects of teachermade models and students made models on the achievement and interest of seniorsecondary school II (SSII) students in organic chemistry. The study alsoinvestigated the effect of gender on academic achievement and interest of SS(II) students in Organic Chemistry. Four research questions and four hypotheseswere formulated for the study. The researcher reviewed related literature. Aquasi-experimental design, specifically, the non-equivalent control groupdesign involving four intact classes were used. The population of the studycomprised 2960 Senior Secondary II (SSII) students in the forty-eight secondaryschools offering chemistry in Nsukka Zone. The sample for the study consistedof 140 senior secondary II chemistry students from two co-educational schoolsin Nsukka Local Government Area. A purposive random sampling technique was usedto select two co-educational schools that have two chemistry intact classes.The classes were assigned to the two experimental groups, Teacher Made Model(TMM) and Students Made Model (SMM) by balloting. The regular chemistryteachers of the selected schools were trained and used for the study. Theinstruments for data collection included the Organic Chemistry Achievement Test(OCAT) and the Organic Chemistry Interest Inventory (OCII). The "OCAT" with areliability Coefficient of 0.97 and the "OCII" of 0.77 were developed by theresearcher and validated by two experts in Measurement and Evaluation and onein Education Chemistry. The data collected were analysed using mean andstandard deviation and Analysis of Covariance (ANCOVA). The major findings ofthe study include the following: The use of models had a significanteffect on academic achievement and interest of students in organicchemistry; the students taught organic chemistry using students mademodels performed significantly better than their counterparts taught with theteacher-made models; students taught using students-made models showed greaterinterest in organic chemistry than those taught using the teacher made models;Gender has no significant effect on the achievement and interest of students inOrganic Chemistry; there was no significant interaction effect of model typeand gender on the students' achievement and interest in Organic Chemistry. Theimplications of these findings with respect to students, teachers, Ministry ofEducation as well as tertiary institutions were presented. Based on these, itwas recommended that the application of students-made models for teachingconcepts in organic chemistry should be included in the school curriculum.

CHAPTER ONE

INTRODUCTION

Background of the Study

The roleof science and technology in the development of a nation is never in dispute.According to Jegede (1983) the current development in science and technologyhas

greatly affected human beings and to be ignorant of these developments isto live in an empty, meaningless and probably unreal life.

The technological development of any nation lies on its emphasison sciences especially chemistry. This is evidenced in the admission ratio of60:40 of the science and science-related courses to the Arts and Humanitiesinto Nigerian Federal and State universities. In an effort to achieve nationaldevelopmental needs, the Federal Government of Nigeria made special provisionsand incentives through the provision of instructional materials, laboratoryequipments, training and retraining of teachers, provision of research grantsand adoption of information and communication technology (ICT). (FederalMinistry of Education, 2008).

Inaddition to these provisions, the Federal Government of Nigeria through theEducational Tax Fund (ETF) intervention project supplied lableless scienceequipments and instructional materials to about six hundred and thirty-threesecondary schools all over the country in 2008 (Federal Ministry of Education,2008). The aim was to reduce or eradicate the problems encountered by theteachers as a result of the absence or dearth of laboratory equipments andinstructional materials in schools. However, inspite of these efforts by theFederal Government, students performance is still very poor in the sciencesparticularly chemistry.

Chemistryis the branch of science which deals with how substances are made up, how theatoms of elements combine or break up and how atoms and compounds react underdifferent conditions. Pure chemistry is more concerned with academicdevelopment of chemistry, extending the frontiers of chemical knowledge throughlaboratory research, developing improved methods of imparting chemicalknowledge and experimenting on alternative methods of producing desiredresults. A pure chemist is not interested in commercializing the results of hisexperiments. Industrial or applied chemistry as the name implies translates thelaboratory findings of the pure chemist into commercial products. For example,in the laboratory the pure chemist will boil a small quantity of oil and sodato produce a small amount of soap. He is interested not in selling thisquantity but in studying its properties – the colour, the odour, the amount oflather it can produce etc. The industrial chemist will make use of thesefindings of the pure chemist but has to design ways and means of producing thesoap on a very large scale, and cheaply too.

Relationship between Chemistry and other Sciences

In otherprofessions other than chemistry, problems concerning chemistry occurrepeatedly. The physician, for example, needs to be familiar with numerouschemical reactions that govern human life, as well as to know how they can bealtered by chemical means. The engineer, whether he specializes in civil,mechanical or electrical aspects of his profession, deals with materials. Hemust know their properties and their behaviour under varying conditions. Eg.Why does steel corrode, and under what conditions does it corrode leastrapidly? The agriculturist is faced with all these problems and more. Besidesthe

chemistry of life processes and the chemical behaviour of structuralmaterials, he needs to understand the complex chemical make-up of soils and itsinfluence on growing plants. In relation to other sciences, chemistry is one ofthe cornerstones of such sciences as geology, biochemistry, pharmacy,microbiology, zoology and botany. Without chemistry, how can one, for example,unravel the mystery of photosynthesis, respiration and the structure ofchlorophyll, all encountered in the study of biology?

Theimportance of chemistry is underscored by the fact that to obtain any appliedscience degree in agriculture, pharmacy, medicine or engineering in anyuniversity in the world, the candidate must have passed chemistry in the WASSCEand UTME and must have studied chemistry to a certain level in the university.This fact is important and should, therefore, be adequately noted. We haveoften seen students who go through the secondary school either blindly orwithout proper guidance as to the importance of chemistry. It is only when suchstudents wish to enter the university does it dawn on them that they shouldhave taken chemistry more seriously. The chemist is found in all facets of thecommunity and so job opportunities are quite high. A chemist is employed inchemical industries such as breweries, cement factories, drug companies, foodindustries, oil companies and in government establishments like institutions oflearning, ministries of defence, environment, education, agriculture,technology and internal affairs.

Organicchemistry which is an aspect of chemistry is a component of the chemistrycurriculum. The curriculum content which was prepared by the ComparativeEducation Study and Adaptation Centre (CESAC) and presented to a nationalcritique workshop organized by the Federal Ministry of Education Science andTechnology (FMEST) in 1984 was aimed at satisfying the chemistry requirement ofthe senior secondary school programme in the new National Policy on Education(NPE 2004).

The objectives of the chemistry curriculum are to:

1. facilitatea transition in the use of scientific concepts and techniques acquired inIntegrated science with chemistry;
2. providethe students with basic knowledge in chemical concepts and principles throughefficient selection of content and sequencing;
3. showChemistry in its inter-relationship with other subjects;
4. showchemistry and its link with industry, everyday life, benefits and hazards;
5. providea course which is complete for pupils not proceeding to higher education whileit is at the same time a reasonably adequate foundation for a post-secondarychemistry course (NPE 2004).

The fundamental principles of chemistrycovered in this curriculum include: particulate nature of matter; periodicity,chemical combination, quantitative aspects of chemical reaction; rates ofreaction; equilibrium, carbon chemistry and industrial application ofchemistry. It is recommended that the guided discovery approach resting on theactivity of the students be

used in teaching. This instructional approach isrecommended to ensure that learners are provided with continuous experiences inskills of defining problems, recognizing assumptions, critical thinking,hypothesizing, observing, collecting and recording data, testing and evaluatingevidence, manipulating variables, generalizing and applying generalizations.Assessment instruments should include multiple choice items, structured shortanswer questions, essay questions and rating scales wherenecessary.

A reviewof students' achievement in Senior Secondary Certificate (SSC) examination inchemistry showed a pathetic trend of performance compared to other sciences(see Appendix i). Many factors such as mathematical aspects of chemistry, poorteaching methods, lack of instructional materials, lack of interest etc areresponsible for students' poor performance in chemistry (Anaekwe, 1997; Njoku1997 Ajah; 2004). The West African Examinations Council Chief Examiners (2008)reported that candidates concentrated mainly on familiar questions thatdemanded recall of facts and were unable to apply their knowledge of scientificprinciples to answer other questions. Other areas of weakness according to theChief Examiners report include poor mathematical skills, inability to writechemical formula correctly, poor spelling and poor understanding of thestructures and properties of organic compounds.

Theyreported that the candidates answered organic chemistry questions poorly. Eventhose who answered the questions failed to draw correct structures and givecorrect International Union of Pure and Applied Chemistry (IUPAC) names of theorganic compounds. The Chief Examiners recommended that the candidates couldperform better if instructional materials are used in teaching them. Theinstructional materials are the ones whose production and usage are activityoriented, pupil centred, interesting, intellectually stimulating and innovativeand are capable of creating interest and ultimately affecting learning behaviourof students. Such materials include models, mock-ups, simulations e.t.c.

The useof models has been found to enhance achievement (Diovu, 2006) but there is noevidence on which of the two types of model is more effective. It is thereforepertinent to find out which of the model types that will improve students'interest and achievement in organic chemistry, hence this study on effect ofteacher made models and students made models on students' achievement andinterest in organic chemistry. Nachmias and Nachmias (1992) described a modelas a likeness of something, a representation of reality. In the context of thiswork, a model is a three – dimensional instructional material which the teachercan use in place of the real things which may be too heavy, too complex, tooexpensive or too dangerous for teaching and learning.

Teachermade models within this context refer to the models that are made or producedby the teacher and are used for teaching and learning. Conversely, thestudents' made models are the ones that are made or produced by the studentsand are equally used for teaching andlearning.

Interestis an activity that drives or motivates the individual for action (Eze, 2003).According to Njoku (1997), interest in an activity or object can be sustaineddepending on what the individual whose interest is engaged stand to gain orlose by so doing. Hilard, Atkinson and Atkinson in Olikeze (1999:21) definedinterest as “a persisting tendency to pay attention and enjoy some activities;or content is of interest if it is pleasing or engages one’s attention. Theresearcher defines interest as a persistent zeal of wanting to know or learnabout something or object.

Manystudies for example (Rusell, 1970; Burke, 1983; Chauhan, 1987; Agwu, 2004; Ede,2005) show that interest plays a major role in any undertaking as it influencesdevotion to duty, fairness, hard work, endurance discipline etc. Obioma andOhuche (1984) reported that students performed significantly better in thoseareas they had interest in and performed poorly in area they lacked interest.Research works have shown that there are differences in students’ interest bygender in science (Bajah and Bozimo, 1989; Balogun, 1985; Chidolue, 1983; Ifeakor2003; Nworgu, 1990; Olikeze, 1999). Bajah and Bozimo (1989) indicated that boysshow greater interest in sciences than girls. Chidolue (1983); Ifeakor (1999)noted that girls show greater interest in sciences than boys while Balogun(1985) and Eze (2003) indicated that Nigerian Secondary School Students havelow interest generally in sciences.

Somescience educators have been worried about achievement of females inscience courses. The differences have been considered to pose problems in scienceand technology. For barely two decades now, there have been researches into thenature and origins of gender differences in achievement in sciences (Okoye,2009). Oriaifo (1990) carried out one of such studies. The study examined thepattern of performance among male and female students in science. The resultshowed that there is a significant difference in the performance of boys andgirls in school science in favour of the boys. The researcher decried the rateat which female secondary school students avoid science and noted that it willnot make for the nation building.

Joseph(1996) surveyed gender differences in senior secondary school performance inchemistry in Akwa Ibom State. The result revealed a significant genderdifference in favour of males. This trend may be attributed to the fact thatfemales regard science subject as intellectually complex and task oriented.This is also consistent with the findings reported by Ezeaku (2006) who workedon sex and environment as factors in physics achievement. The researcher foundthat males achieve better than females irrespective of schoollocation.

Reactingto the observations above, Ezeugbor (2008) suggested that the reason for genderdifferences in science achievement could be attributed to the way science istaught in our secondary schools which tends to contribute significantly togender gap in science achievement and interest. To this effect, the researcheris poised into finding a lasting solution to the issue of gender gap inachievement in science subjects especially chemistry. This may be achieved byinvolving the students in the production of the instructional

materials(models) that they are taught with.

Statement of Problem

There isa growing concern in Nigeria over the decline in students' performance inscience subjects especially at the secondary level of education. One ofthe science subjects in which students perform very poorly is chemistry. Thepoor performance especially in chemistry has been blamed on such factors asmathematical aspects of chemistry, absence of instructional materials andinadequate use of the available ones, teacher-centred method, lack of studentsactive participation, lack of interest etc. The use of instructional materialsin teaching and learning makes learning interesting but more interesting andpermanent when three-dimensional materials like model areused.

Followingthe recommendation by the Federal Ministry of Education Science and Technology(FMEST, 2000) that models be used to teach chemistry, model has been used andfound to facilitate and enhance achievement, but there is no evidence of anycomparison between the model types relative to senior secondary schoolstudents' achievement and interest in Organic Chemistry. The present studyexplores this situation. Therefore, the problem of this study is: what is theeffect of teacher made model on the academic achievement and interest ofsecondary school students in organic chemistry relative to the students' typeof model?

Purpose of the Study

The general purpose of the study is to find out the effects ofteacher made model and students'-made type on students' achievement andinterest in organic chemistry. Specifically, the study sought to:

1. ascertain whether differencesexist in the mean achievement scores of students taught using teacher mademodel and students' made model.
2. ascertain whether differencesexist in the mean interest scores of students taught organic chemistry withteacher made model (TMM) and Students' Made Model (SMM)
3. find out the interaction effectof model type and gender on students' achievement in organic chemistry asmeasured by their mean achievement scores.
4. find out any interaction effectof model type and gender on students' interest in organic chemistry as measuredby their organic chemistry interest inventory.

Significance of the Study

Thesignificance of this study is discussed on the basis of its theoretical andpractical perspectives. On the theoretical perspective, this study is anchoredon some psychological theories that account for how learning takes place. Thestudy also has a philosophical relevance.

The useof model is anchored on the cognitive theory of learning. In this study,opportunities are created for students to be exposed to making and using modelfor the purpose of understanding organic chemistry. The models of organiccompounds thus provide the basic

structures and opportunities for intuitivethinking. The use of models acts as a bridge between the cognitive structureand the incoming information. This thus facilitates meaningful learning. Thecognitive field theorists hold the view that when students are exposed toexperiences that can enable them to find out by themselves the solutions tospecific problem, they tend to develop problem solving skills as well as gainconfidence in their abilities to learn. In the present study, students wereexposed to making models and such models were used to teach them some selectedtopics in Organic Chemistry and their achievement scores compared with that ofthe achievement of students taught with the teacher made models.

The study has a philosophical relevance. The recommendation foruse of models is based on the new secondary school chemistry curriculum. Thecurriculum has been recognized to be problem-solving oriented in order toenable it achieve the set objectives of the national educational goals whichderives from the country's philosophy of education.

In orderto achieve these national educational goals, the teaching methods, content,objectives, evaluation of the new secondary school chemistry curriculum wereall designed and focused on the training of the child to be able to tackle thepresent day problems.

Themethodological guide specifically recommended the use of models, games andsimulation, fieldwork and local studies, field observation, data collection,projects and increased use of instructional materials (Federal Republic ofNigeria 2004). The guide also stressed that such strategies recommended arethose that will facilitate the achievement of the set national educationalgoals linked to the national philosophy. This study which focused on two typesof model is therefore, relevant for the achievement of the national goal basedon the country's philosophy of education.

There aresome practical usefulness as derivable from this study. The following peoplewill benefit from the results of this study namely: the teachers; the students,curriculum designers and the Ministry of Education/government. The findings ofthis study would likely create interest and consciousness in the teachers onthe adoption of models for the teaching and learning of Organic Chemistry andother areas of Chemistry. Similarly, the result of this study shall be usefulto teachers and other educational agencies with respect to improvisation ofinstructional materials for teaching and learning. It will equally expose theteachers to other forms of assessing the students other than the pen-and-papermethod.

On thepart of the curriculum designers, in the course of curriculum designing,planning, revision and modification, these experts shall utilize the relevantdata based on the findings of this study. For instance, pieces of informationon the skills in the teaching and learning of organic chemistry and theconcepts associated with the use of models shall be utilized in the appropriatestages of curriculum planning, modification or revision.

Similarly, the findings of this study shall be useful to the ministry ofeducation/government.

The findings will provide information which couldsensitize the government/ministry of education on the need for workshop,seminars, refresher courses, conferences on the best ways to create awarenessin the teachers on the strategies for the teaching and learning of organicchemistry. The study could yield convincing empirical evidence for the moderntechniques of teaching organic chemistry.

Scope of the Study

Thestudy focuses on finding the effects of teacher made models and students' mademodels on secondary school students' academic achievement and interest inorganic chemistry. The content coverage includes hydrocarbons which consist ofalkanes (paraffins), alkenes (Olefins), alkynes (acetylenes) and alkanols. Theresearcher's choice of these topics is because of their importance inunderstanding organic chemistry generally. They are the rudiments for properunderstanding of organic chemistry and they are amongst the topics that posedifficulty to students (WAEC Chief Examiners Report 2003 – 2008). Finally, thestudy is delimited to Senior Secondary II (SSII) students in Nsukka EducationZone of Enugu State. SS II students were used because they are most likely todevote attention to the study compared to the SS III students who are preparingfor their SSC examination. Moreover SS II chemistry students were used becausethe topics hydrocarbon and alkanols are within the SSII chemistry curriculum.

Research Questions

Thisstudy was guided by the following research questions.

1. What are the mean achievementsscores of students taught organic chemistry with teacher-made model and thosetaught with students'-made model?
2. What is the difference betweenthe mean interest scores of students taught organic chemistry with teacher-mademodel (TMM) and students'-made model (SMM)?
3. What is the interaction effectof model type and gender on students' achievement in organic chemistry asmeasured by their mean achievement scores?
4. What is the interaction effectof model type and gender on students' interest in organic chemistry?

Hypotheses

The following hypotheses were formulated and were tested at 0.05level of significance.

HO_1 There is no significant difference in the mean Organic Chemistry AchievementTest (OCAT) scores of students exposed to TMM and SMM.

$H0_2$ The interest scores of students exposed to TMM and those exposed to SMM do notdiffer significantly.

$H0_3$ There is no significant interaction effect of model type and gender onstudents' achievement in Organic chemistry.

$H0_4$ There is no significant interaction effect of model type and gender onstudents' interest in organic chemistry.

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