CODING AND ENCODING DIFFICULTIES IN ORGANIC CHEMISTRY NOMENCLATURE AMONG FIRST YEAR DIPLOMA STUDENTS IN ABUBAKAR TATARI ALI POLYTECHNIC, BAUCHI, NIGERIA

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ABSTRACT

The aim of this survey was to highlight the difficulties of coding and encoding in organic chemistry nomenclature among first year Diploma students of Abubakar Tatari Ali Polytechnic, Bauchi, Nigeria. The study adopted convenience sampling method to draw 30 students who have just completed their senior secondary school programmes from various secondary schools in Bauchi State, Nigeria. Questionnaire was the major instrument for data collection while simple percentage was adopted for the analysis. The study revealed the fact that the organic chemistry was taught to the students towards the end of their chemistry course, thereby giving them little or no time to master the subject. Hence, it was recommended among others that organic chemistry should be introduced earlier preferably; about the second term of senior secondary school one to run concurrent with the inorganic aspect of chemistry.
Keywords: *Coding, encoding, organic chemistry, students.*

INTRODUCTION

Organic Chemistry is the study of large numbers of compounds which contain the element carbon. In the last 50 years or more, scientists have discovered many new compounds. The synthesis of these new compounds from simple molecules has produced a lot of new substances and they vary from explosives to drugs. The ordinary senior secondary school chemistry in its elementary study of organic chemistry requires the student to be able to name simple organic compounds from its structure and in a like manner write out the structure of a compound when the name is given. This is what is referred to as coding and encoding in this research. Chemistry and chemical symbols are inextricably linked and therefore the learning of chemistry depends on the learners' ability to use the required symbolic language with some degree of comfort; other learners find this extremely challenging (Barke, 1982). This research assessed the ability of the students who had sat for the Senior Secondary School Certificate Examination, and are now first year diploma students in the polytechnic, to use symbolic language in Chemistry.

The Problems Students experience with learning Organic Nomenclature: Science instruction should be self pacing in order to assist the concrete operational students (Chiapetta, 1976). In the teaching of chemistry, it was suggested that the teachers have to be sensitive to the needs of the learners. Cognitive structures determine how

information is processed by the learner. Danili and Reid (2004) suggested that the processes necessary for the understanding of chemistry are different from the processes required to comprehend everyday events. They studied the effects of working space and found out that learning of all new information will fail if the working memory space is overloaded. This will occur if the students are given too much information at once. It was further suggested that chunking or grouping pieces of information together can be used to reduce the demands on the amount of information to be held in the working memory. Students therefore, should be encouraged to develop their own chunking techniques.

The use of Second Language in the Teaching of Chemistry: The difficulties in the learning of chemistry can be precicpitated by a lack of chemistry language skills (Ver Beer and Louters, 1991; Marais and Jordan, 2000; Danili and Reid, 2004). Teachers particularly in rural areas are sometimes poorly qualified in both their scientific content and their command of English. The text books often present a great challenge to their understanding and so communication between the teacher and the student becomes a problem. Many students schooling in the rural areas have their mother tongue, the general language of the geo political zone, and then English, which is the lingua franca in Nigeria to contend with.

Many are not well grounded in the English language and so this factor has hindered the smooth teaching, learning and understanding of the subject matter. The teaching and learning process is hindered due to a communication barrier brought about by language problems. Sometimes in Bauchi (North Eastern Part of Nigeria), chemistry is taught to some students in Hausa in order to facilitate learning of the subject matter, and because not all concepts can be translated effectively, a partial transfer of knowledge is affected. Secondly, the final chemistry examination will be written in English language anyway, so the teaching of the subject in another language should not be considered as an option to an effective teaching of the subject matter. The main objective of this study was to find out the problems encountered in coding and encoding in organic nomenclature, and to find out if the skills required for this task can be improved within the framework of teaching the course.

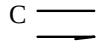
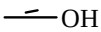
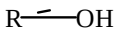
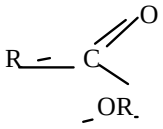
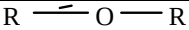
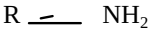
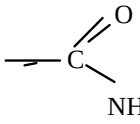
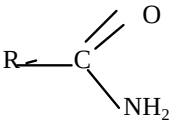
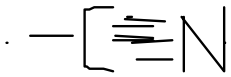
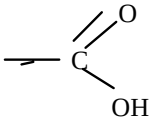
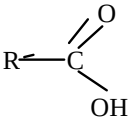
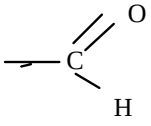
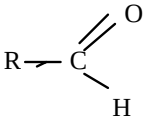
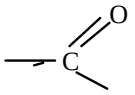
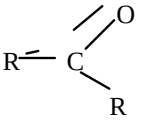
METHODOLOGY

The research adopts a survey design. The sample is a convenience sample, comprising 30 students who have just completed their Senior Secondary School Examination programmes from several secondary schools within Bauchi State in Nigeria. Structured questionnaire was used to collect the data. The questionnaire had 2 sections A and B. Section A had 10 questions comprising of organic structures and the students were expected to give the names (coding). In section B, the names of organic compounds were given, of which the students were expected to figure out the structure (encoding). It was administered for 45 minutes. Simple percentage was used to analyse the data collected for the study. From the responses, the researcher was now able to propose a way of complementing the teaching of coding and encoding skills to the students.

RESULTS AND DISCUSSION

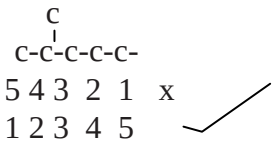
Points to note while teaching Organic Nomenclature: The following should be clearly pointed out to the student:

1 The various homologous series and functional groups should be clearly spelt out

Class of homologous series	Functional group	General formular	Surfix
Alkanes			-anes
Alkenes			-enes
Alkynes			-ynes
Haloalkanes			-
Alkanols			-ol
Esters			-oate
Primary amines			-amine
Amides			-amide
Nitriles			carbonitrile
Carboxylic acid			-oic acid
Alkanals			-al
Alkanones			-one

2 Substituents are attachments to the parent structure and this could include the alkyl group (R). The "R" has a general formula of C_nH_{2n-1}. R could also be a more complex group than an alkyl group. The IUPAC nomenclature allows the substituent to have the substituent on the lowest numbered carbon atom.

For example:



2- methylpentane and not 4- methylpentane

If n = 3, then C_nH_{2n-1} will be $C_3H_{(2x2)-1}$

= CH_3 — Methyl

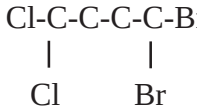
Likewise, C_2H_5 — Ethyl

C_3H_7 — Propyl

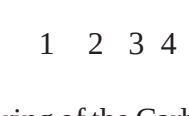
C_4H_9 — Butyl

3 Naming the "Prefix": When more than one of the **same** substituent group is present, it is named as di- for two, tri- for three, tetra for four, etc. If more than one prefix is present, then the alphabetical order is considered, for example:

4 3 2 1 1,1-dibromo-4,4-dichlorobutane



and not

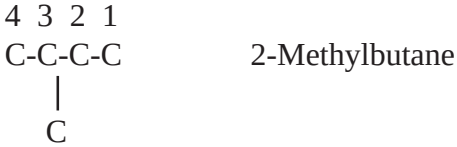


1 2 3 4 1,1-chloroomo-4,4-dibromobutane

4 Numbering of the Carbon atom (the parent structure): The IUPAC convention is to number all the Carbon atoms in the longest chain starting from the end which is closest to the branch i.e the functional group, for example:

Examples of some named organic compounds:

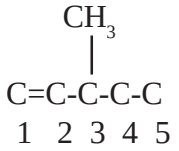
a. C-C-C-C-C Butane



b. 2-Methylbutane

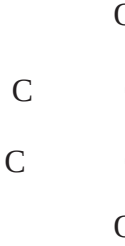
c. $CH_3CH_2NH_2$ Ethylamine

d.



4-methylpentene

e.



Ethane dioic acid

Note: 1 carbon atom present in a compound is represented by meth, 2 = eth, 3= prop, 4 = but etc.

5. When the name of the compound is given and the structure is demanded, it will require the student to work backwards, for example, ethanoic acid.

Solution: a. "oic" acid means a carboxylic acid so -COOH is present.
b. "eth" means a prefix with two carbon atoms -C-C (and this includes the carbon on the functional group)
c. Summing up to -C-COOH

Taking another example, 3-Chloropropan-1-ol.

Solution a. "ol" means an alcohol, so -OH is present, and in the number "1" position.
b. "propan" means a compound with three carbon atoms.
c. 3-Chloro" means Chlorine is on the third position in parent structure of the compound summing up to -Cl-C-C-C-OH.

From the copies of the questionnaire administered, 10% of the total number of students scored evenly in sections "A: coding" (that is, name an organic compound from the structure) and "B: encoding" (that is, write out the organic structure from the name). 56.8% scored better in section A, while 33.2% of the students scored better in section B. Again, within the framework of the test proper, none of the candidates scored up to 50% in the content. This goes to show that there is a general problem of a lack of understanding of the organic nomenclature as a whole. Some of the students attributed it to inadequate time spent on teaching of organic chemistry. They stressed the fact that the organic chemistry is taught towards the end of their chemistry course, thereby giving them little or no time to master the subject. Some complained of not being taught at all.

CONCLUSION

The problem of late introduction of organic chemistry was identified from the results. This can be addressed by introducing organic chemistry earlier that is, about the second term of SSS I, to run alongside the inorganic aspect of chemistry. This can be included in the time table as "organic chemistry" clearly spelt out. This will erase the problem of not teaching the course at all due to inadequate time, and give adequate room for mastery since it will be considered by the student as a fresh subject. Secondly, to allow for the students to be well grounded in the organic nomenclature, a lot of assignments should be given intermittently, even after the topic has long been treated. Group discussions should be encouraged amongst the students. The weaker students and those having the language barrier problems should be encouraged to learn from their peers in group discussions during their private study. The *lingua franca* should not be compromised during the classroom teaching as the final examinations are not going to be written in their native languages. However, points to note while teaching organic nomenclature have been itemized to improve both coding and encoding skills.

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