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Multimedia Design for the Teaching and Learning of Organic Chemistry to Encourage Independent Learning

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Abstract:- This research introduced a new approach to teaching into the classroom of Computer/ Chemistry students in Federal College of Education (Technical), Asaba. A design activity in a technology-based and inquiry-oriented learning environment was developed and tested among year two N.C.E. students. The materials and their effect in the interaction between lecturers and students was described along with the adjustment required as lecturers became facilitators and students became independent learners.

I. INTRODUCTION

Multimedia design, a technique in teaching process is the act of integrating multiple forms of media into the teaching classroom. It is used in video games, informative books, websites and many other interactive applications. In the teaching of chemistry, teachers are expected to have a good level of competence and mastery of the subject before introducing it into the class setting. The main objective of teaching chemistry/computer in higher institution is to enable the students develop their own knowledge and skills in chemical science and project the effort in education to be useful to themselves and the society. Multimedia design is a teaching process that shows that some general application and principles of technology are applied into teaching and learning process (American Association for the advancement of science 1990; Manzur 1996). They therefore, are of the opinion that teachers should always actively involve students in their own learning, promote student discussion, group activities and help student develop problem solving skill.

A better way to motivate students to learn is through inductive learning, where the teacher/instructor begin by presenting to students a specific challenge e.g. a case study to analyse experimental data and interpret it etc. This will make student to quickly recognize the need for fast skill and conceptual understanding. Bransford, Brown, and Cocking (2001) provides strong support for inductive teaching method. Also, Felder and Brent (2004) affirmed that the challenges provided by inductive teaching method serves as a precursor to intellectual development. Learning chemistry through design activities provides a structured learning environment in which students work together in pairs, cooperatively as a teaching group in order to incorporate inquiry activities. Lecturers would like to incorporate inquiry-based active learning method and technology into their classroom.. Multimedia learning in a truly central fashion, found out that technology could facilitate inquiry-based learning in a way that will benefit both students in their learning of content and skills. Also, will make teachers have increased repertoire of teaching practices.

This research was centered on interactive web pages that link to activities, databases and design studies that were coordinated and has sets of hands-on-small scale laboratory. In the classroom, students had their computer connected to a server, using databases to select a general formula to write the molecular formula for alkanes, differentiate the groups of alkanes, understand the geometry of these groups and name the alkanes. This then was used for three lessons on alkanes discussing the preparation, reactions and reaction mechanisms of alkanes. The researchers used ChemDiscovery, a technology-based chemistry course was used deliberately to help teachers cope with the problem of meeting the needs of students of varying abilities and interests and to prepare their students for the demands of the information age (2, 3).Chemistry is perceived as a difficult subject to teach and learn by both teachers and students. This is almost close to the truth because it is a molecular science in which many of the concepts and process are not visible to the eye. To solve these problems, chem/discovery came to being to avail them of the difficulty. Chem/discovery is a new approach to teaching of chemistry in a technologically designed environment which facilitates inquiry-based learning. It makes students to become independent learners and teachers become facilitators. Chemi/discovery employed a set of synergetic learning strategies to carry out the function and its curriculum uses technology to implement these strategies through interactive design of a virtual world.

II. STATE OF THE PROBLEM

One of the approaches to motivate student to learn is through inductive learning. Chemistry is a molecular science in which many of the concepts are not visible to the eye that was why we introduced new approach of multimedia design for learning (Chemistry/Discovery) into the NCE classrooms. Although time and effort required to adapt to this new way of teaching and learning may be daunting which with time will facilitate inquiry-based learning that makes students become independent learners and teachers as the facilitators.

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III. GOALS AND OBJECTIVES

The goals and objective with which chem/discovery was introduced were as follows:

- To facilitate inquiry-based learning.
- To benefit students in their learning content and skills.
- To create an interactive web page that linked to activities, database and design studies that are coordinated with a set of hands-on-laboratory activities.
- To enable students identify their assumption, use critical and logical thinking to solve problems, construct explanation and as well consider it as an alternative explanation
- To benefit teachers in their increased repertoire of teaching practices
- To enable students support each other's learning and reinforce their own by offering explanation and critiquing the explanation of each other.

IV. REVIEW OF LITERATURE

Design activities are not ordinarily encountered by students, yet, its process plays an important role in science especially chemistry. Mapova, Ushakor & Think (1998), Ushekor and Technos (1999). Chemistry discovery curriculum originally known as Chemistry quest was developed by the University of North Canada by group of chemistry professors, educationists, technologists, specialists in software, teachers and students. It encompasses a set of synergies to facilitate learning environment in a technological manner.

V. MATERIALS AND METHODS

A. Learning Chemistry Through Design Activities

Chemistry discovery was developed by a research team in School of Secondary Education (Science) in Federal College of Education (T), Asaba, Delta State and a multimedia developers. The Tetfund funded the research as an effort to incorporate multimedia experience into the chemistry classrooms as a new innovation in the department Chemistry/computer in FCE (T) Asaba Delta State, Nigeria. The course was centered on interactive web pages that linked to activities and databases, which were coordinated with a set of materials to facilitate inquiry-based learning. One of the goals of the Chemistry/discovery was to facilitate inquiry-based learning that benefit students in their learning content and skills, create an interactive web page that linked to activities, database and design studies which will enable students identify their assumption, use critical and logical thinking to solve problems and for students to support eachother's learning and reinforce their own by offering explanation and critiquing the explanation of each other which enhance cooperative learning among them.(4) explained that Inquiry – based learning requires students to ask questions, formulate hypotheses explain them and test it with the current scientific trend using chemical laws, theories and rule to check and draw conclusion on their own findings instead of consulting textbooks.(5) Buttressed that In fact, this will enable them communicate their findings to their counterparts for critique and explanation among themselves to attain success. In the process, students worked independently under the supervision and motivation from the teacher being a facilitator instead of sitting down listening to the usual lecture method and do as I say by the lecturer. Also lectures were presented based on their request which they listen to and do assignments to support themselves in their investigation. Chemistry is a molecular science in which many of the concepts are not visible to the eye, being the reason we introduced Chemistry Discovery, new approach of multimedia design for learning into the NCE IIclassrooms in order to model and visualize the general chemical formula, reactions and the reaction mechanisms of the alkanes. The students were engaged in inquiry through authentic science and design activities, learning independently or cooperatively, self-constructing meaningful learning (from computer feedback to problem-solving and problem-constructing strategies)etc. Technology is always used to implement these strategies through the interactive design of a virtual world.Although time and effort required to adapt to this new way of teaching and learning may be daunting which with time will become more perfect among the students as well as the lecturers.

The chem/discovery consisted of threetopics that showcase reaction mechanisms in alkanes. To complete these Quests, students must understand the alkanes, types of reaction engaged by the alkanes, generate a reaction pathways and must be able to indicate the reaction mechanism present between their chemical reactivity. The Chemistry discovery course matched the provision and requirement of the minimum standards for NCCE in Nigeria for teaching content and assessment.

Quest	Content	Motivation
1	-To design the molecular structures for Alkanes	-The general formula
2	- To design the reaction mechanism of sodium ethanoate and soda lime - To design a reaction mechanisms showing heterolytic and homolytic reaction involving free radical reactions that requires initiation, propagation and termination steps	- Reaction of decarboxylation organic acid salt heated with soda lime to generate alkanes and carbon dioxide -.Halogenation reaction between alkanes and the halogens especially Chlorine.
3	The design of reaction mechanism continued on chemical reactivity.	- Explanation of combustion reaction and cracking.

Table 1: The Three Quests of ChemDiscovery

- **ChemDiscovery is delivered on a website containing the designs and hands-on laboratory manual.**

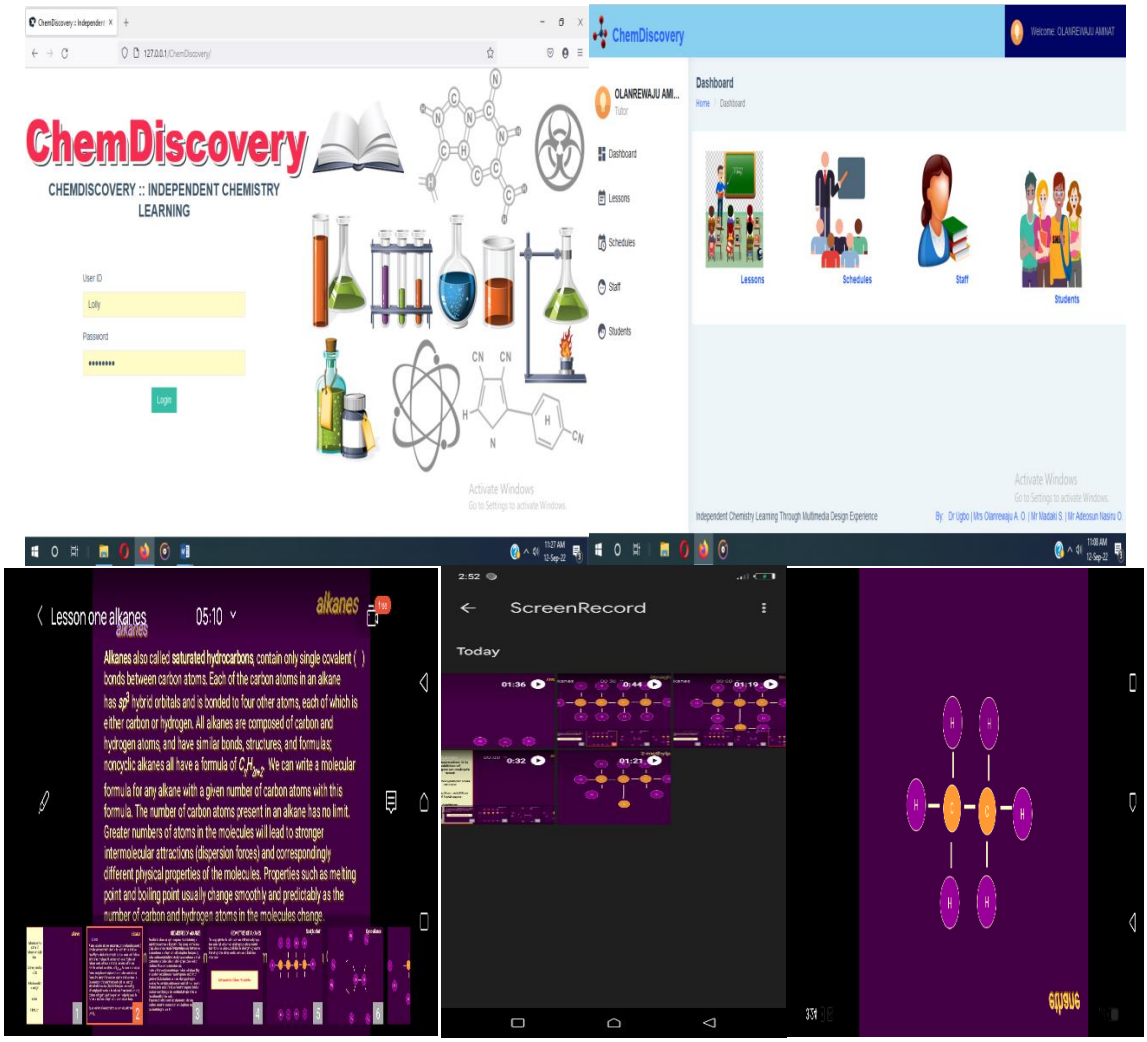

Fig. 1: Students use this animation to select a general formula to write the molecular formula for alkanes differentiate the groups of alkanes, understand the geometry of these groups and name the alkanes

B. How Chem Discovery Works

Each Quest formulated learning goals that students could meet directly through the activities or by first exploring the motivation tools which allow students to enter the world of organic chemistry of alkanes. The students chose their starting point and designed a unique pathways through the learning environment. The Chem/Discovery designed activities involved students to understand the needs and their responsibilities to check databases, designed them, and evaluated their predictions by performing hands-on laboratory experiments. As they carry out their design projects, students became engaged in authentic scientific practices. That is, students using ChemDiscovery work like scientists with the aid of course learning tools in Table 2.

The Inquiry Steps	Use These Supported Learning Tools
-Search for structures of the alkanes.	-Hands-on labs -Resources and databases
-Search for the reaction mechanisms of the chemical reactivity of Alkanes	-Hands-on lab -Resources and data base
-Search for impact of Alkane on the environment	-Resources provided

Table 2: Learning Tools Provided by the ChemDiscovery Learning Environment

Chem Discovery assessments included both traditional tests and evaluations of inquiry skills, the assessments required students to design, model, and construct structuresand showreaction mechanisms in order to evaluate student ability to use scientific databases.

C. A Typical Class

A day is a typical class for Chemistry/discovery classroom. It begins when the lecturer introduced the learning objectives for a topic and relate them to a previous work. She then gave each student a navigation checklist to fill in. Each student mapped out a learning pathway and began to work with the hands-on-laboratory or solve the problem presented by the computer. Some of the activities were completed on the computer and printed out for the teacher to review. Others were completed on worksheet using the resource and database on the computer i.e. they used the general formula of akanes in the data base to predict the structure and bond designs of alkanes, showed reaction mechanisms of the chemical reactivity of Alkanes.

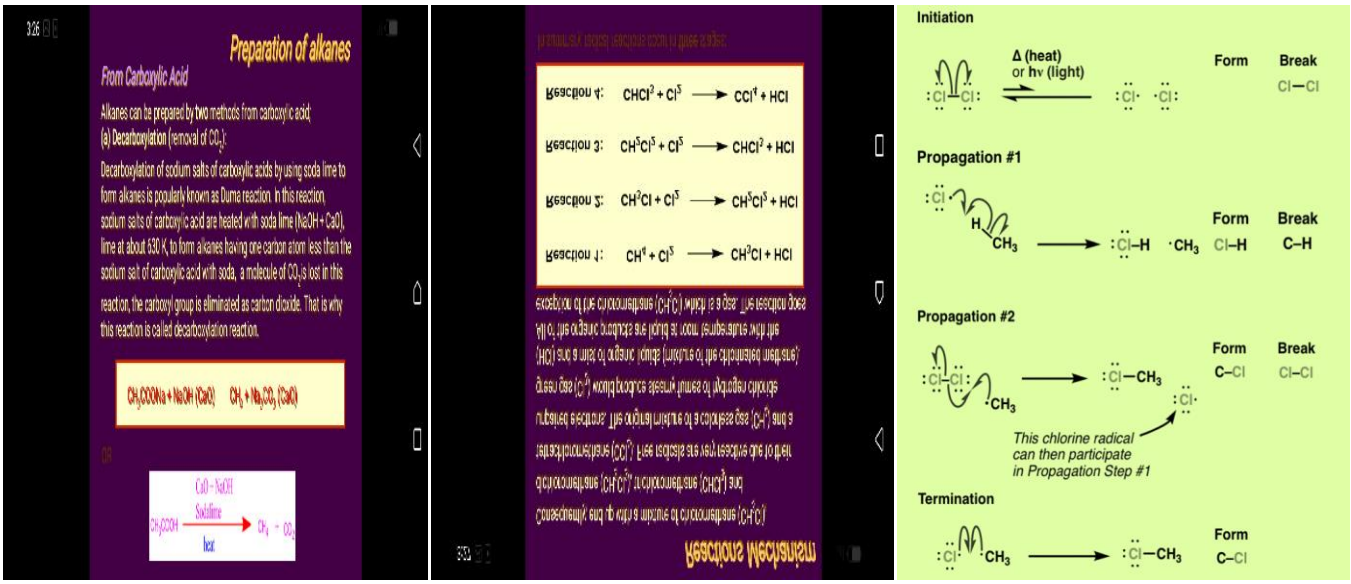

Fig. 2: Students used this animation to model the reaction mechanismof decarboxylation organic acid salt heated to soda lime to generate alkanes and carbon dioxide. Also the .Halogenation reaction between alkanes and the halogens especially

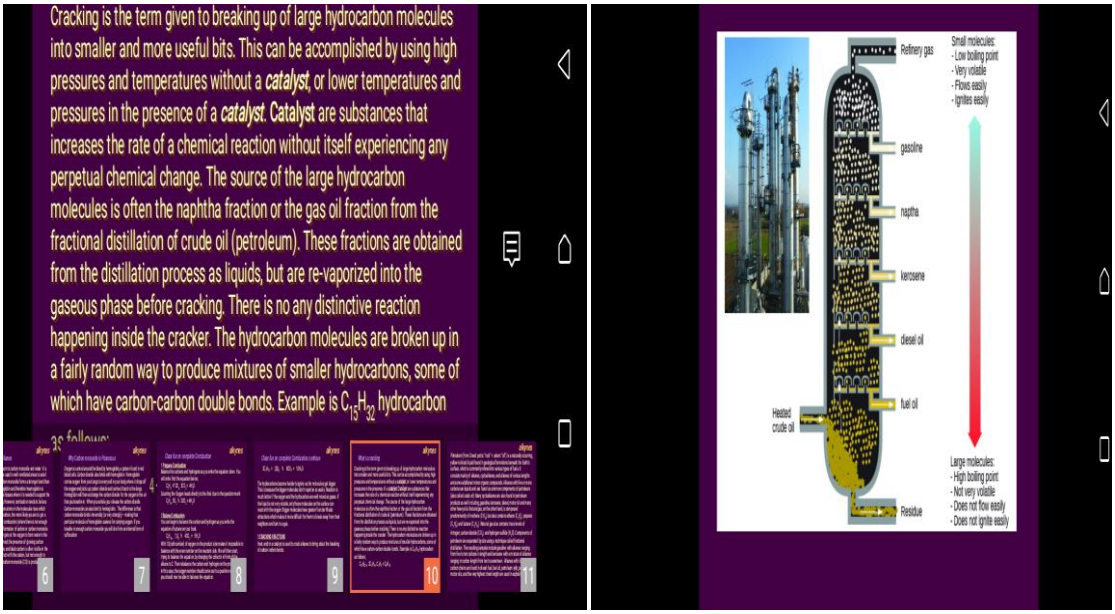

Fig. 3: Student used this menu to understand the explanation of combustion reaction and cracking

For example, in Quest 1(tab. 1), students used this animation to write the molecular formula, differentiate the groups of alkanes, understand the geometry of these groups and named the alkanes. Also in Quest 2(Fig. 2), they used the animation to model reaction mechanism of the chemical reactivity of Alkanes, used worksheet to complete molecular-level drawings of reaction mechanisms. After students have worked on their assignments for a while the teacher reviewed the main points of the lesson.

D. The Classroom Impact

During field of testing for Chemistry discovery, three aspects of learning were investigated as follows;

- The level to which teachers and students adapted to the new approach
- The problems encountered during implementation.
- However, teachers kept daily journals in which they report their experiences and concerns. Website was developed, animations added and hosting to run the curriculum. Observer noted that the integral use of technology in the classroom change the focus of students-teacher interaction from a teacher-led lecture to student-led. The lecturer spent more timeas facilitator. What has evolved is a dynamic learning environment in which both instructor and student continuously refine their knowledge through web access. The availability of world-wide access to informational resources has caused the lecturers involved to restructure the chemistry 221 course so that informational support of content is not only text based, but also web-based. One of the biggest differences between a Chem/Discovery classroom and a traditional classroom is the extent to which students learntindependently. Students who were used to more traditional learning environments, with textbooks and lectures, found independent learning a challenge and needed more guidance to begin. There was much more coherent, cohesive understanding of how it all went together. The students had to learn how to learn in a whole new dimension, no longer given the knowledge that is important but search and research for themselves. The new innovation obviously frustrated them but made them better learners at a later time

VI. CONCLUSION

Previous studies have shown that students will learn with new technologies and find unique advantages to learning with molecular modeling tools and simulations when they have control over the modeling and simulation process (12,13, 14, and 15). The findings from field test of this new approach to teaching chemistry were consistent with those studies. A primary goal of the field test evaluation was to discover whether using a computer-centered inquiry curriculum fosters independent student activities. Both observer reports and lecturers' journals implied that the students were not only working independently but will become more successful learners in the future. Students success depend more onactive learning strategies than those used by immature learners (16). They connected new knowledge to what they have already known, they organized and reviewed their knowledge and monitored their understanding, while immature learners used more passive learning strategies. This study suggests that interactive multimedia courseware may be able to help teachers to provide a learning environment that encourages the development of active learning strategies by requiring students to learn independently.

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