

Vol. 14 No 2 2010



JOURNAL *of* EDUCATIONAL MEDIA AND TECHNOLOGY



JEMT

DESIGNING INTERACTIVE COMPUTER SOFTWARE FOR TACKLING ABSTRACT CONCEPTS IN CHEMISTRY

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Abstract

Computers have been found to be invaluable and indispensable educational tools. As emphasis shifts to the use of computer technology in education, educators, educational technologists and science, technology and Mathematics teachers in general are faced with the challenges of not only being computer literate but taking a step further to explore and develop ways in which the computer can be used to solve educational problems. Chemistry as a science subject has always appeared abstract to students at the secondary school level and thus many of its concepts appear difficult. It is envisaged that Computer Assisted Instruction could enable students of chemistry understand the so-called "difficult concepts" better. This paper discusses the use of computer assisted interactive software in helping students understand "difficult concepts" in Chemistry and suggests an approach to the improvisation of such software in which the teacher identifies the causes of the difficulties and incorporates the tutoring on the difficulties into a highly interactive Computer Assisted Instructional software designed to develop students understanding of such concepts. The paper presents a model of the design of Interactive Software on Atomic Concepts and recommends that the Nigerian educational Technologist, science, technology and Mathematics teachers should get more involved in the production of such educational materials.

Introduction

The Educational system must be qualitative in order to impact on the learners for self development. The novel trend in the teaching and learning process is to make learning not only interesting but also real and relevant to the learners needs. This demands the utilization of varied strategies and resources that could meet each learner at the point of their need. Computers have been found to be an invaluable educational tool as emphasis is shifting to the use of computer both in the developed and developing nations. Educators, educational technologists and science teachers are faced with the challenge of not only being computer literate but taking a step further to explore and develop ways and means of utilizing computers in education. In developing nations, computer-based instructions (CBI) have constituted an effective method of instructional delivery. Instructional computer applications and software packages that meet the needs of these nations' learners are being produced by them. Chemistry by its nature has many abstract concepts and demands diverse resources, and teaching strategies to make it concrete and enhance the understanding of these concepts. Students find science subjects difficult especially physical sciences because it is dominated with abstract concepts that are not within their every day experiences (Njoku, 2004). Interactive computer software are available in chemistry, these software are most of the time manufactured by foreign companies. Although, these software are designed to enhance the learning of chemical concepts, they may not specifically be relevant to the needs of the Nigerian Chemistry students nor are they drawn from our local background.

Improvisation is the act of selecting, composing or providing a substitute for something that is not available or accessible (Ekpo, 2009). Improvisation is done also when the material to be used does not suit the teachers' need for that particular lesson. Chemistry educators and educational technologists as well as science teachers could design means of tackling the abstractness of chemical concepts, thus making these concepts un-demanding, by the development of software that tutor students on the abstract or so called, "difficult concepts" in Chemistry.

This paper deliberates on an approach to designing teacher-made interactive computer software that could help the students understand abstract concepts in chemistry.

Computer Assisted Instruction in Learning

Computer Assisted Instruction (CAI) can be effectively applied to facilitate the achievement of our educational objectives and goals. Educational Technologists have identified many areas in which CAI can be most effective in enhancing learning such as in physical sciences, in the use of simulation (Van der Wal & Van der Linde, 1991), in improving laboratory experiences, teaching of writing skills and diagnosis of students' progress in acquisition of skills and also for easy visualization of concepts (McConneel, 1991).

Interactivity is defined, by Milhiem (1996), as the two-way communication that can occur between the instructional medium (in the case of computer) and the learner. Several authors have identified important components of interactivity as:

- immediacy of response so that the learners can retrieve information when needed without delay.
- non-sequential access to information.
- adaptability, where communication is based on audience needs or requests.
- bi-directional communication where both the learner and computer present information.
- grain-size, (the length of time between user responses), where learners are able to frequently interrupt presentations or initiate actions.
- feedback and a variety of user options. (Milheim, 1996).

A computer assisted instruction which involves an interactive programme should be able to accept and judge responses from learners and provide subsequent feedback based on the responses made by the learners. It should also provide the learners opportunity for drill and practice. These components of interactive computer instruction assist the learner in maintaining and mastering knowledge and skills.

The computer assisted instruction presented in this paper is founded on the observation that students starting 'O' level chemistry initially find the atomic concepts rather abstract and difficult to comprehend. The computer assisted instruction is designed to enable the student interact with the information within this concept for more effective learning.

Abstract Concepts in Chemistry

The term abstract is described as not concrete: not relating to concrete objects but expressing something that can only be appreciated intellectually, while concrete on the other hand is solid and real: able to be seen or touched because it exists in reality, not just as an idea (Encarta, 2008). We find that at the secondary school level some students are not able to "appreciate intellectually" those concepts that they are not able to see or relate with, such as three dimensional structures presented on paper, or spatial movement, those done by electrons in the course of chemical reactions. These can pose difficulties for such students in understanding certain concepts in chemistry thus leading to the so called "difficult concepts". Topics in Organic Chemistry like Benzene, Alkanoic Acids, Amines, Alkanoates, cellulose, plastics, and resins have been identified as difficult to teach by teachers, this could be mainly due to the fact that these concepts are abstract to both teacher and students (Njoku, 2004; Ekpo & Udo, 2005). Reporting on the assessment of the Science graduates produced from Nigerian Universities, Okebukola (2005) revealed that certain topics in chemistry such as rate of reactions, equilibrium system, nuclear reactions, enthalpy changes, redox reactions, among others are found difficult by Science graduates. Invariably this will translates to the learners.

Adesoji (1992) in Ekpo and Udo (2005) also agree that certain topics and concepts in science curriculum have been tagged difficult either because teachers find them difficult to teach or students find them difficult to understand. Problems with abstraction can be solved by not only trying to making the concepts concrete but also providing the students with enough opportunity to practice with the concepts so that they can achieve mastery. This will enable the learners apply the knowledge and skill in other topics in the subject. This can be done very effectively and meaningfully through CAI software.

Approach to Tackling Abstract Concepts in Chemistry

As suggested above, difficult concepts in Chemistry arise as a result of students' inability to "intellectually appreciate" such concepts. This poses a challenge to Chemistry educators. In this computer era most youths are relatively computer literate. They spend time fiddling with the computer for entertainment. They can also be encouraged to study with the computer. If CAI software are made interesting and captivating, they will keep the learners interested. The task that lies ahead

for Chemistry educators and educational technologists is to decipher what makes certain topics difficult and design appropriate CAI software to meet the needs of the learners in our secondary schools rather than depend on foreign produced software. This paper, presents an interactive computer assisted instruction on the Atomic Concepts. The design of this software has arisen from the observation that, although secondary school students who are starting to learn Chemistry appear to understand the atomic structure, they do not understand it enough to apply it to other topics in chemistry. This concept being, the foundation of Chemistry on which most of the other concepts are built, should be well understood and mastered by these students. This software has been designed to help the beginners in chemistry to achieve mastery in Atomic Concepts.

Design of an Interactive Computer Assisted Instruction on Atomic Concepts

Goal

This computer assisted interactive instruction is designed to enable the student master the concepts associated with the atom so as to set a proper foundation for further study of other concepts in chemistry.

Core Objectives

Therefore, by the end of the instruction, the student should be able to:

- (i.) list the components of the atom and their characteristics.
- (ii.) draw the structure of an atom.
- (iii.) show the distribution of electrons in the shells of an atom.
- (iv) write the electronic configuration of an atom of a named element

The software has been designed using the Instructional Systems Design (ISD) methodology and incorporates into its programme the essential attributes and components of an interactive instruction such as:

- (i) high interactivity, the learner is not allowed to remain passive for more than two screen displays.
- (ii) the learner is given opportunities to respond to text materials and the learners' response mode is varied from multiple choices to true or false and so on.
- (iii) feedback is given to the learner after each response.
- (iv) errors in students' response are anticipated and processed.
- (v) the objective of the lesson at each level is known to the learner as the instruction progresses.

Learners Characteristics

This lesson is designed for Senior Secondary year 1 (SS1) students who have just started a course on 'O' level chemistry and are computer literate.

Instructional Strategy

The instruction being interactive is divided into several levels. The students after studying the text display at each level are expected to make responses to the drill exercise at the end of each level. The drill exercises are followed by feedback whereby incorrect responses are directed back to the text materials and the correct responses are encouraged with practice and enrichment exercise to ensure mastery. The learner can then proceed to the next level. The first level starts with a test of entry behavior/motivation.

This is shown in the flow diagram below:

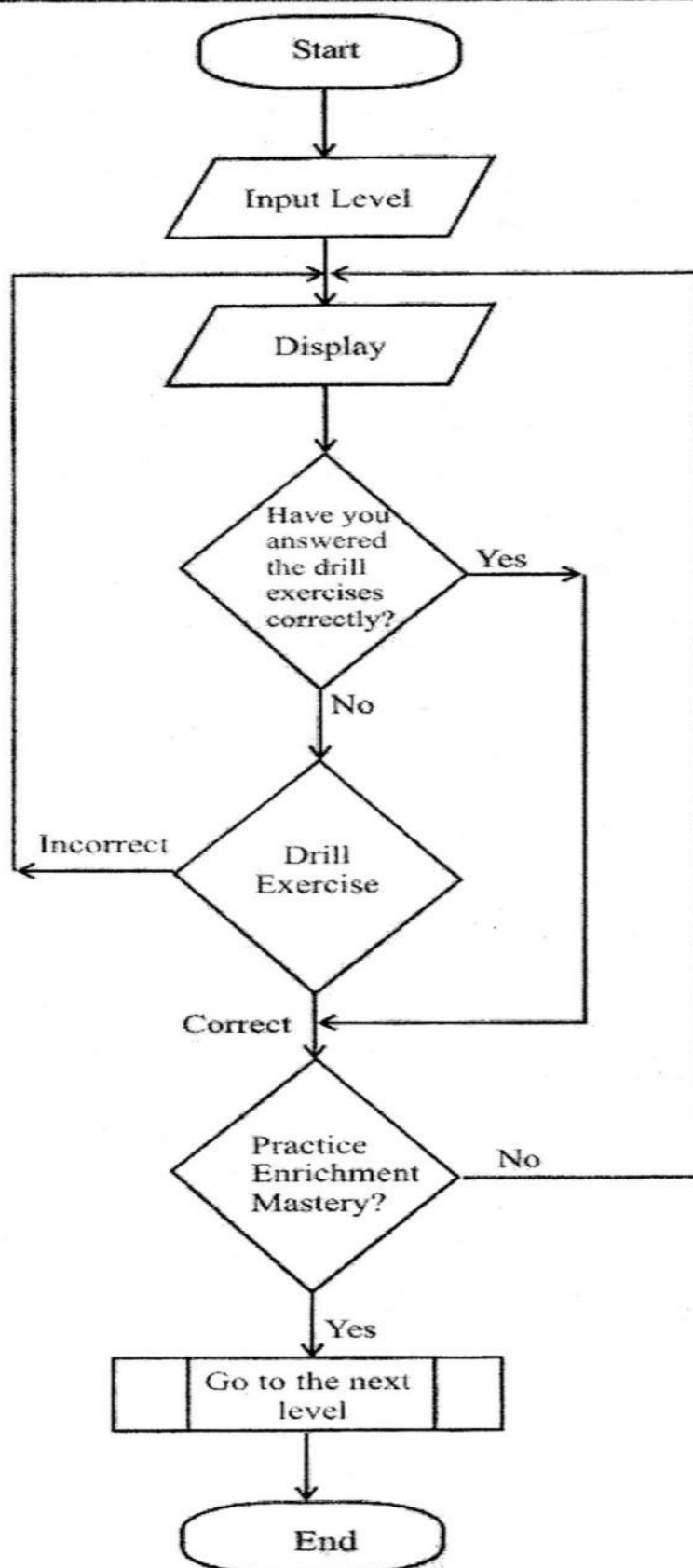


Fig. 1: Computer assisted interactive instruction model

Conclusion

This interactive instruction is hoped, will make the concept interesting and assist learners, especially computer literate beginners in 'O' level chemistry, to master the atomic concepts. Nonetheless, there is much to be done. Many more concepts which chemistry learners find difficult can be developed into interactive CAI software.

Recommendation

The Nigerian educators, especially educational technologists and the teachers are familiar with the unique needs of the Nigerian learner's at all levels of education and in every subject area. They should thus, be more involved in the production and promotion of home-made educational materials that can meet the needs of Nigerian learners.

References

- Adesoji, F. A. (1992). Statistical approach to the teaching of collision theory in relation to rate determination in chemical reactions: A paper presented at the STAN National Chemistry Workshop, March 16 -21.
- Ekpo, J. U. & Udo M. E. (2005). Teachers' perceived difficulties in senior secondary Organic Chemistry. *The Jos Journal of Education*, 7(1), 114- 122.
- Njoku, Z C. (2004). Effective use of model for science and technology instruction. *Journal of Science Teachers Association of Nigeria*, 2(13),23-28.
- McConnel, D. (1991). Computers, Electronic Networking and Education; some American experience: *Educational Training Technology International*, 28(3), 171-187.
- Microsoft Encarta (2008) Microsoft Cooperation.
- Milheim, W. D. (1996). Interactivity and Computer-Based instruction: *Journal of Educational Technology Systems*, 24(3), 225-233.
- Okebukola, P. A. (2005). The race against Obsolete- Science : Enhancing the relevance of STAN to the National development. Memorial lecture of the 2005 Annual Conference of STAN. Jos, Plateau State .August 17.
- Van der Wal, R. W. E. & Van der Linde, H. J. (1991). Computer assisted Science instruction – an experience in developing communities within the South African context: *Educational Training Technology International*, 28(3), 188-195.