Expert System a Modern Tool for Teaching and Learning

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Abstract: *The use of expert system as a tool in teaching and learning process in Nigerian educational systems is very much desirable as it will facilitate teaching and learning process. The introduction of computer aided instructon (CAI) in our classrooms is a welcome innovation but the use of expert system which is an integral part of CAI has not been fully utilized. An expert system is a well known area of artificial intelligence designed to enhance the availability of knowledge required in the educational system. In developing countries, expert system is very useful in teaching courses such as engineering, mathematics, earth sciences and distance tutorial lessons. Nigeria cannot afford to be left behind in the adoption of CAI in teaching and learning. Expert system has a lot of benefit especially to the students, trainers and educational institutions. The disadvantages notwithstanding, this paper suggest that effective introduction of expert system be adopted as its advantages over traditional chalk-talk method is innumerable.*

Keywords: *Artificial intelligence, Computer aided instruction, Expert system, intelligent tutoring system, Domain knowledge.*

I.   INTRODUCTION

An expert system is computer software that attempts to act like a human expert on a particular subject area. It uses a knowledge base of human expertise for problem solving, or to clarify uncertainties where normally one or more human experts would need to be consulted. Knowledge based expert systems, or simply expert system use human knowledge to solve problems that normally would require human intelligence. It has been noted that in this period of information age, that the use of expert system can improving teaching and learning in the educational institution to enhance knowledge delivery and acquisition. This may be attributed to the introduction of Information and Communication Technology (ICT), Fisseha (2011) noted that ICT is contributing to change in teaching practices, school innovation and community service. He also emphasized the need for the learning of entirely new skills needed for a developing (knowledge) economy, development of technological skills and increase innovativeness in schools and access of community members to adult education and literacy.

Lucy, Obert and Lemias (2010) pointed out that the introduction of e-learning has contributed immensely to the improvement of the learning environment for both the learner and tutor. They authors also went further to noted their findings, which emphasized the role that expert system played to help University students and lecturers in Zimbabwe where brain brain has affected the quality of teaching and learning. The rules and data governing the use of expert system can be called upon when needed to solve problems. Conventional computer programmes perform tasks using conventional decision making logic containing little knowledge other than the basic algorithm for solving that specific problem and the necessary boundary conditions. This programme knowledge is embedded as part of the programming code, so that as the knowledge changes, the programme has to be changed and then rebuilt.

Knowledge based system collect the small fragments of human know-how into a knowledge-base which is used to reason through a problem using the knowledge that is appropriate. A different problem, within the domain of the knowledge-base, can be solved using the same programme without reprogramming. The

ability of this system to explain the reasoning process through back-traces and to handle levels of confidence and uncertainty provides an additional feature that conventional programming does not handle.

Most expert systems are developed via specialized software tools called shells, these softwares can provide much of the duties of tutors through provision of expert advice and decisions while lecturing (Lucy *et al,* 2010). These shells are equipped with an inference mechanism and require knowledge to be entered according to a specified format. They typically come with a number of other features, such as tools for writing hypertext, for constructing friendly user interfaces, for manipulating lists, strings, and objects and for interfacing with external programmes and databases. In educational field, many of the expert system's application are embedded inside the Intelligent Tutoring System (ITS) by using techniques from adaptive hypertext and hypermedia. Most of the system usually will assist students in their learning by using adaptation techniques to personalize with the environment, prior knowledge of student and student's ability to learn.

In terms of technology, expert system in education has expanded very consistently from micro computer to web based (Woodin, 2001) and agent-based expert system (Vivacqua and Lieberman, 2000). By using web-based expert system, it can provide an excellent alternative to private tutoring at anytime from any place (Markham, 2001) where internet is provided. Also, agent based expert system surely will help users by finding materials from the web based on the user's profile. Supposedly, agent expert system should have capability to diagnose the users and giving the results according to the problems. Besides the use of expert system in technology, it also had tremendous changes in applying of methods and techniques. Starting from a simple rule based system, currently expert system techniques had adapted a fuzzy logic (Starek, Tomer, Bhaskar and Garcia, 2002) and hybrid based technique (Prentzas, Hatzilygeroudis, and Koutsojannis, 2001).

According to Markham (2001), expert system are beneficial as a teaching tool because it is equipped with the unique features which allow users to ask question on how, why and what format. When it is used in the class environment, surely it will give many benefits to students as it prepare the answer without referring to the teacher. Besides that, expert system is able to give reasons towards the given answer. This feature is really great as it can make students more understanding and confident with the answer. Expert system also provide excellent alternative to private tutorial. The system is usually developed using Java technology, thus making it interoperable and independent platform (Markham 2001).

Ability of expert system to adaptively adjust the training for each particular student on the bases of his/her own pace of learning is another feature that makes expert system more demanding for students. This feature is used in teaching engineering students. It should be able to monitor student's progress and make a decision about the next step in training. Expert system has been used in several fields of study including computer animation (Victor 1995), computer science (Heather, Christine, and Markham, 2001), engineering (Zorica, Vladmir and Machotka 2002), language (Expert System in Language Teaching) and business study. For computer animation production, expert system has been used as a guide to develop and design 2D and 3D modeling packages. Other than that expert system also is used as a tool in teaching mathematics related subject.

How do expert systems work?
An expert system is made up of three parts:

A user interface: This is the system that allows a non-expert user to query (question) the expert system, and to receive advice. The user-interface is designed to be simple to use as possible. In academic expert systems, the potential users are tutors (trainers) and the tutees (students) (Darlington, 2000). Both interact with the system via an interactive interface where user queries pertaining to a particular subject are created and the system is then commanded to compute and decide on the solution or advice to the query. It is equipped with the unique features which allow users to ask question on how, why and what format. Student's tutorials and additional materials can be requested and passed on to the students easily over the interface. In addition, revision and self assessment is expertly conducted between the system and the student and thus better preparation for student examinations. The tutor also uses the interface to the system to create queries on what to expertly deliver to students as well as setting parameters on computer aided student assessments, tests and marking. The actual training or instructing which is supposed to be done by the instructors can easily be conducted by expert system on the student's pace and thus effective dissemination of data as the student interacts with the system. The non-expert user queries the expert system. This is done by asking a question, or by answering questions asked by the expert system.

A knowledge base: This is a collection of facts and rules. The knowledge base is created from information provided by human experts. The knowledge base is independent from all other components of an expert system which makes it flexible to accept changes without affecting the whole system. It is the duty of the experts in particular domain to research and compile data to fill into a knowledge base for an expert system to meet demand of expert ideas in areas where they are falling into short supply. As the system matures, new rules may

be added and existing ones maybe amended or deleted from the knowledge base with the use of the knowledge acquisition module. All these are normally done to take into account inventions, innovations and discoveries as technology improves. In addition, some material may become obsolete thus there will be need to update to standard material in a knowledge base which means that the system cannot forget unlike what humans do with the increase in time.

An inference engine: This acts rather like a search engine, examining the knowledge base for information that matches the user's query. The inference engine users the query to search the knowledge base and then provides an answer or some advice to user.

Knowledge engineering
This is the art of designing and building expert system, and knowledge engineers are its practioners. Knowledge engineering is an applied part of the science of artificial intelligence which in turn, is part of computer science. Theoretically, a knowledge engineer is a computer scientist who knows how to design and implement programmes that incorporate artificial intelligence techniques. Today there are two ways to build an expert system. They can be built from scratch, or built using a piece of development software known as a 'tool' or a 'shell'. A knowledge engineer interviews and observes human expert or a group of experts and learns what the experts know, and how they reason with their knowledge. The engineer then translates the knowledge into a computer-usable language, and designs an inference engine, a reasoning structure, that uses the knowledge appropriately. He also determines how to integrate the use of uncertain knowledge in the reasoning process, what kinds of explanation would be useful to the end user.

Accumulation of knowledge of a task domain is the province of domain experts. Domain knowledge consists of both formal, textbook knowledge, and experiential knowledge – the expertise of the experts.

Can expert system make mistakes?
Human experts make mistakes all the time (people forget things, and so on) so you might imagine that a computer-based expert system would be much better to have around. However expert systems can face some problems.
- Can't easily adapt to new circumstance (example, if they are presented with totally unexpected data, they are unable to process it)
- Can be difficult to use (if the non-expert user makes mistakes when using the system, the resulting advice could be very wrong).
- They have no 'common sense' (a human user tends to notice obvious errors, whereas a computer would not).

Benefits of expert system
Expert systems offer an environment where the good capabilities of humans and the power of computers can be incorporated to overcome many of the limitations. Expert system has many benefits as:
1. Increase the probability, frequency and consistency of making decisions.
2. Help distribute human expertise.
3. Facilitate real-time, low-cost expert-level decisions by non-expert.
4. Enhance the utilization of most of the available data.
5. Permit objectivity by weighing evidence without bias and without regard for the user's personal and emotional reactions.
6. Permit dynamism through modularity of structure.
7. Free up the mind and time of the human expert to enable him or her to concentrate on more creative activities.
8. Encourage investigation into the subtle areas of a problem.
9. Expert system gives emphasis on individual student by keeping record of their learning ability and speed.
10. Expert system provides a convenient environment to ask, query and find out their solutions.
11. Expert system also gives a congenial way to find out errors and fix them.

Benefits to the students (tutee)
The systems better performs simulations and aid practices better from the teaching side. However, the expert systems are normally used in support of other learning/teaching activities such as the problem based learning (PBL). The students learn by repeated use of the concept and they understand, even the slow learner can visualize. Experts are reproducible and thus making them readily available for consultation by students at every stage and permits (indeed always should permit) the student to interrogate and analyze the reasoning

process. Finally, worked examples, and all forms of guidelines are readily available to students for revision purposes. The expert system allows the student more time with the desired subject, this is so since communication between the user is enhanced by an interactive interface, through which queries, student's tutor and additional materials can be requested and passed on to the student easily.

Benefits to the trainer (tutor)

The expert system takes on the tutoring function that is, presenting a series of screens of information, test questions and feedback. Expert systems are also excellent in instructional design, decision making, planning, controlling and collaboration with both the student and trainer. It reduces explanation where a trainer has difficulties in illustrating concepts. Most of the duties of the tutor can be performed by the expert system; these include provision of expert advice and decisions while lecturing (Lucy *et al,* 2010).

Benefits to the college

Professional material is passed on to students by semi-professional staff without compromising standards. This means that the colleges and universities will be able to compete with regional institutions operating under normal economic environment with adequate resources (Fisseha, 2011). In spite of being expensive to develop, expert systems will reduce the quantity of human experts required to deliver teaching responsibilities. However expert system must also check on the students skills and their background in computer usage as they will end up being a block to the learning of the student.

Disadvantages

- The garbage in, garbage out (GIGO) phenomenon. A system that uses expert-system technology provides no guarantee about the quality of the rules on which it operates. All self-designated 'experts' are not necessarily so, and one notable challenge in expert system design is in getting a system to recognize the limits to its knowledge.
- Expert systems are notoriously narrow in their domain of knowledge. An expert system or rule-based approach is not optimal for all problems, and considerable knowledge is required so as not to misapply the systems.
- Ease of rule creation and rule modification can be double-edged. A system can be sabotaged by non-knowledgeable user who can easily add worthless rules or rules that conflict with existing ones. Reasons for the failure of many systems include the absence of (or neglect to employ diligently) facilities for system audit, detection of possible conflict, and rule life cycle management (example version control, or thorough testing before deployment). The problems to be addressed here are as much technological as organizational An example and good demonstration of the limitations of an expert system is the windows operating system troubleshooting software located in the 'help' section in the taskbar menu. Obtaining technical operating system support is often difficult for individuals not closely involved with development of the operating system. Microsoft has designed their expert system to provide solutions, advice, and suggestions to common errore encountered while using their operating systems.

II. CONCLUSION

The paper shows that expert systems are very important in the field of education. They are becoming an integral part of engineering education and even other courses like accounting and management are also accepting them as a better way of teaching. The few expert systems available in the market present a lot of opportunities for the students who desire more spotlight and time to learn the subjects. They present a friendly and interactive environment for students which motivate them to study and adopt a more practical approach towards learning. The study shows that expert system may act as an assistor or substitute for the teacher. Expert system focus on each student individually and also keep track of their learning procedure for both student and teacher, where teachers act as mentor and students can judge their own performance. Expert system is not only beneficial for students but also for the teachers which help them guiding students in a better way. Expert systems offer several advantages over traditional chalk-talk method and is bound to replace it in near future. The bottom-line of the paper is that expert system for education is here to stay.

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