Expert System: A Requirement for Educational Development in Jammu and Kashmir

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Abstract: **The use of expert system as a tool in teaching and learning process in Jammu and Kashmir's educational system is very much desirable because of its tough terrain, unpredictable weather and difficult topography as it will facilitate teaching learning process. The shift from traditional chalk and talk approach towards Computer Assisted Learning (CAI) in our classrooms is welcome innovation but the use of expert system which is an integral part of the CAI has not been fully utilized. An expert system is a well known application of artificial intelligence which is sub field of computer science. An expert system is designed to enhance the availability of knowledge required in educational system. In developed nations, expert system is very useful in teaching courses such as engineering, mathematics, earth sciences, distance tutorial lesions and etc. Jammu and Kashmir cannot afford to leave behind in the adoption of CAI in teaching and learning. Expert system has lot of benefits especially to the students, trainers and the educational institutions. This paper suggests that effective introduction of expert system in teaching and learning process in Jammu and Kashmir to be adopted as its advantages over traditional chalk-talk method is innumerable.**

Keywords- **Artificial Intelligence, Computer aided instructions, expert system, intelligent tutoring system, tutor, tutee, Knowledge Engineer, domain knowledge.**

I. INTRODUCTION

The expert systems have been in the news from the year 1980 when the business application of the expert system was found out by scientist and programmers. Expert systems are one of the branches of artificial intelligence, which is a kind of computer science that you can use to develop and design programs and simulate the aspects of human intelligence. An expert system is a computer program that uses knowledge and reference procedures to solve problems that are difficult enough to require significant human expertise for their solution(Townsend, 1987). Simply stated, expert systems are computer programs designed to mimic the thought and reasoning process of human expert.

Most expert systems are developed via specialized software tools called shells. These shells are equipped with an interface 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 user friendly interfaces, for manipulating lists, strings and objects, and for interfacing with external programs and databases. These shells qualify as languages, although certainly with a narrower range of application than most programming languages.

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 microcomputer 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 any time 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 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 the 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 Gracia, 2002) and hybrid based techniques (Prentzas, hatzilygeroudis, koutsojannis, 2001).

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

Ability of the expert system to adaptively adjust the training for each particular student on the basis 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 systems can be developed for many kinds of applications involving diagnosis, prediction, consultation, information retrieval, control, planning, interpretation and instruction (Edmunds, 1988; Liebowitz and DeSalvo, 1989; Peart, 1989). Expert system has been used in several fields including computer animation(Victor Yee, 1995), computer
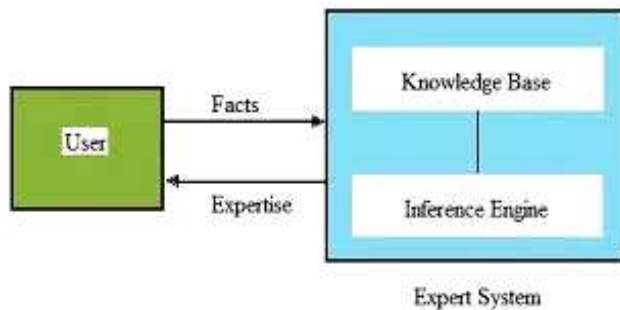
science(Heather Christine Markham, 2001), engineering (Zorica Nedic, Vladimir Nedic and Jan machotka, 2002), language (Expert System in language teaching), and business study. Other than that expert system also is used as a tool in teaching mathematic related subject.

II. HOW DO EXPERT SYSTEMS WORK?
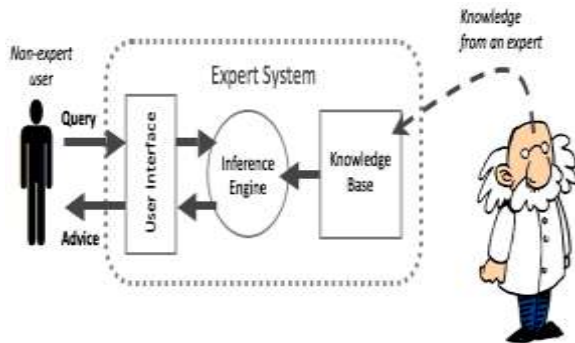
(Fig. 1)

III. COMPONENTS OF EXPERT SYSTEM

(Fig. 2)

An expert system is made up of three parts viz. user interface, knowledge base and an inference engine. The major components are:

Knowledge base--the software that represents the knowledge.

Inference engine--the reasoning mechanism.

User interface--the hardware and software that provide the dialogue between people and the

computer.

1. **Domain expert**--the individual who is considered an expert.
2. **Knowledge engineer**--the individual who acquires and represents the knowledge.
3. **Explanation facility**--the software that answers questions such as "Why" and "How."
4. **Blackboard**--a workplace for storing and working on intermediate information.
5. **Reasoning improvement**--a facility (not available commercially) for improving the

reasoning capabilities of an ES.

6. **User**--the non-expert who uses the machine for consultation.
7. **Hardware**--the hardware that is needed to support the ES.

A user interface- This is the system that allows a non expert user to question the expert system and to receive the reply. The user interface should be as simple as possible. In educational expert systems, the potential users are the tutors and the tutees (students)(Darlington, 2000). Both tutor and tutee interact with the system through an interactive interface where user queries pertaining to particular subjects are created and the system is then commanded to compute and decide on the solution or advice to the query. The system is equipped with the unique feature which allows user to ask questions on how, why and what format. Student's tutorial and additional material can be requested and passed on to the student easily over the interface. In addition, revision and self assessment is expertly conducted between the system and the student and thus better preparation for the student examination. The non expert user queries the expert system. This is done by asking the question or by answering the questions asked by the expert system.

A knowledge base- This is collection of fact and rules. The knowledge base is created from the information provided by the human experts. The important thing in the structure of the expert system is that, the knowledge base is independent from all other components of the expert system which makes it flexible to accept changes without affecting the whole system. It is the responsibility of the expert in the particular domain to research and compile data to fill into the knowledge base for use by the expert system. As the system matures, new rules may be added and existing ones may be amended or deleted from the knowledge base with the use of knowledge acquisition module. In addition some material may become obsolete and thus there is need to update the standard material since education system is dynamic. In addition, expert knowledge is formally represented in a knowledge base which means that the system cannot forget unlike what the humans do with the passage of time.

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

IV. KNOWLEDGE ENGINEERING

This is the art of designing and building the expert system and the knowledge engineers are its practitioners. Theoretically, a knowledge engineer is a computer scientist who knows how to design and implement programs that incorporates artificial intelligence techniques. Today we have two ways of building an expert system. Either 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 a human expert or a group of experts and learns what the expert knows and how they reason with their knowledge. The engineer that translates the knowledge into a computer usable language and designs an inference engine, a reasoning structure, which uses the knowledge appropriately. He also determines how to integrate the use of uncertain knowledge in the reasoning process and what kind of explanation would be useful to the end user.

Domain knowledge consists of both formal, textbook knowledge and experiential knowledge- the expertise of the experts. Human experts make mistakes all the time (people forget things, etc.) so you might imagine that a computer based expert system would be much better to have around. However, expert systems can face some problems because of certain reasons viz. if they are presented with totally unexpected data. i.e can't easily adapt to the new circumstances, it can be difficult to use when a non expert user make mistakes during input data, the resulting advice could be very wrong. Expert systems have no common sense i.e a human user tends to notice obvious errors, whereas a computer would not.
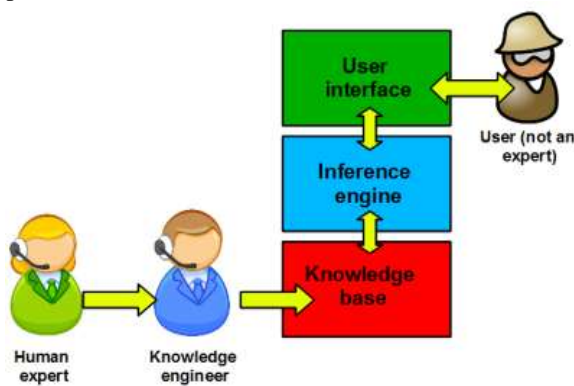
(Fig.3- Role of *Knowledge Engineer*)

V.BENEFITS OF THE EXPERT SYSTEM.

In order to determine the advantages of Expert system, we will have to evaluate it with the only comparison term available- Human Expert.

1. Availability – on any suitable computer hardware
2. Cost- the per user cost is greatly lowered
3. Danger- may be used in environments hazardous for humans
4. Permanence- will last indefinitely (depending upon the hardware)
5. Multiplicity – more expert systems may cooperate to increase the level of expertise.
6. Reliability- provides a second opinion to human experts, mediate opinions.
7. Explanations- the expert system may always explain how it reached the conclusion.
8. Response- may provide fast or real time response for critical applications.
9. Emotional- in real time or emergency situations, the expert system will always provide unemotional and complete response.
10. Database- may be used to intelligently access a database (data mining)
11. Tutoring- may be used as an intelligent tutor: explain reasoning, etc.

To fully explore the potential of applications of artificial intelligence and expert systems in the field of education, let us carve up the field into a two by three matrix.

presence of incomplete, inaccurate and inadequate

1.Benefits to the students (tutee)

The systems better performs simulations and aid practices better than 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 learners can visualize. Expert systems are reproducible and thus making them readily available for consultation by students at every stage and permits the students to analyze the reasoning process. Finally, solved examples and all form of guidelines are readily available to the students for revision purposes.

2.Benefits to the trainers (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 explanations where a trainer has difficulties in illustrating concepts.

3.Benefits to the institutions (schools/colleges/universities)

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

VI. LIMITATIONS OF THE EXPERT SYSTEMS

Although the expert system technology has progressed substantially, it would a mistake to overestimate the abilities of the technology. Deficiencies of the current expert system include:

1. The lack of casual (or deep) knowledge. The expert systems do not have a real understanding of the causes and effects in a system, mainly it is much easier to program expert systems with a shallow knowledge, based on empirical and heuristic knowledge. Designing an expert system based on basic structures, functions and behaviors of objects takes a lot more effort and the resulting system is lot more complex. (more difficult to maintain and upgrade).

2. Dealing with uncertainties. Human experts recognize the limits of their knowledge and can qualify their expertise when the problem reaches their so called limit of ignorance. An expert system, unless this problem is explicitly catered for, will make confident recommendations even in the

User	Tool	Tutor	Tutee
Student	**1** Commercially produced expert systems used to solve problems (JOB - AID) _____ Student learns by repeated use	**2** Intelligent computer-assisted instruction (ICAI) _____ Intelligent database search assistant (EMBEDDED TRAINING)	**3** Use of LISP or PROLOG in schools Students construct expert systems for the domain under study
Teacher/ Instruction Designer/ Author	**4** Stand-alone expert systems on instructional design, decision making, planning, controlling, etc. _____ Intelligent authoring systems for CAI	**5** Intelligent embedded training in school applications software _____ Intelligent teacher-training systems	**6** Teacher/Subject matter expert constructs expert systems on specific domains to use in modes 1 and 2

data.

3. The current expert system cannot make analogies i.e cannot generalize their knowledge in order to reason about the new situations in the way the people can. Rule induction may help the system achieve only some types of new knowledge.

4. Knowledge is not always readily available.

5. It can be difficult to extract expertise from humans.

6. There are frequently multiple correct assessments.

7. Time pressures.
8. Users have cognitive limits.
9. ES works well only within a narrow domain of knowledge.
10. Most experts do not have an independent means to validate results.
11. Vocabulary is often limited and difficult to understand.
12. Help from knowledge engineers is difficult to obtain and costly.
13. Potential for lack of trust on the part of the end-users.
14. Knowledge transfer is subject to biases.

An example and good demonstration of the limitations of an expert system is 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 the development of the operating system. Microsoft has designed their expert system to provide solutions, advice and suggestions to common errors encountered while using their operating systems.

VII. THE SUCCESS FACTORS OF EXPERT SYSTEM

Success factors are:

1. Level of knowledge must be sufficiently high.
2. Expertise must be available from at least one expert.
3. The problem to be solved must by fuzzy.
4. The problem must be narrow in scope.
5. The shell must be of high quality and naturally store and manipulate the knowledge.
6. The user interface must be friendly to novice users.
7. The problem to be solved must be difficult and important enough to justify the development of a system.
8. Knowledgeable developers with good people skills are needed.
9. The impact of the ES must be considered.
10. The impact should be favorable.
11. Management support is needed.

VIII. RECOMMENDATIONS

I make the following recommendations after presenting general overview of the expert systems in general and expert systems in education, particularly in the state of Jammu and Kashmir.

1. There should be a massive awareness and promotion of expert system in J&K's educational system.

2. There should be an effective introduction of experts at all levels.
3. In order to make a balance between student teacher ratios, expert system should be adopted as a strong assistance for repeated study and understanding.
4. There should be continuous research and documentation on expert system towards improving the knowledge base of the system.
5. In all those far flung areas of the state where availability of teacher is difficult at all times of the year, expert system could play a pivotal role.
6. Due to poor weather conditions, bad road links and poor rail connectivity, the probability of a teacher reaching his place of work is very low. In those situations, where a teacher is not available but students are available, expert system could play a very important role.

IX. CONCLUSION

The paper explains that expert systems are very important in the field of education. They are becoming integral part of education and all disciplines are accepting them as a better way of teaching. Few studies shows that expert system may act as an assistor or substitute for the teacher. Expert system focuses on each student individually and also keep track of their learning pace. This behavior of expert system provides independent learning procedure for both teacher and student, where teacher acts as mentor and students can judge their own performance. Expert system is not only beneficial for the 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 systems for education are here to stay.

It is concluded and recommended that the use of expert system in academics is encouraged so that education and knowledge is disseminated to nook and corner of the state, irrespective of geographical disadvantages.

REFERENCES

1. Nwigbo Stell N and Agbo Okechuku Chuks, Expert system: A catalyst in education development in Nigeria, Proceedings of the 1st international technology, education and environment conference(c), African Society for scientific research (ASSR).
2. Alberico, R.(1990) AI/expert system(www.google.com)
3. Boss, R.W(2003), what is an expert system www.Ericdigest.org/pre 9220/expert.html
4. Darlington, K.(2000) The essence of expert system, Pearson Education

5. Giarratano, JC & Riley,G(2005) Expert system, principles and programming, Journal of sustainable development in Africa(volume 12, No.3,2010)

6. N.Garcia, R.A . Perez, B.G. Silverman, et all (1993) Teaching AI and Expert system. www.google.com

7. Savita K., Akhil K,(2011) Expert system advances in education, Manog Barnela, www.google.com

8. Romiszowski, A. (1987). Artificial intelligence and expert systems in education: Progress, promise and problems. *Australian Journal of Educational Technology*, 3(1), 6-24. http://www.ascilite.org.au/ajet/ajet3/romiszowski.html

9. Ovidiu S. Noran, The evolution of expert system, www.cit.gu.edu.au/~noran.

10. Chapter 10 Artificial Intelligence and Expert Systems: Knowledge- Based Systems 10-8,www.google.com

11. Artificial Intelligence, Articles on AI, www.intelligence.worldofcomputing.net/ai-branches/expert-system.html

12. ITGS news, www.itgsnews.com/2012/09/creating-expert-system.html

13. IGCSE ICT, www.igcseict.info/theory/7-2/expert.html