

## EXPERT SYSTEMS ADVANCES IN EDUCATION

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**Abstract:** Expert systems are a well known area of Artificial Intelligence and have a huge impact in various fields of life. An expert system is a computer application that solves complicated problems that would otherwise require extensive human expertise. To do so, it simulates the human reasoning process by applying specific knowledge and interfaces. Expert systems also use human knowledge to solve problems that normally would require human intelligence. Education system will be revolutionized with the introduction of expert systems in this field because of the following: (1) educational planning and decision making ability, manage student records, student counseling, and special education programs; (2) teacher training and education, specifically, identifying training needs and using computer assisted instruction to teach information and skills; and (3) intelligent tutoring systems that guide students through instruction according to their individual strengths and weaknesses. Expert system are beneficial as a teaching tools because it has equipped with the unique features which allow users to ask question on how, why and what format. It is concluded that while expert systems in education have great potential, they remain un-established as a useful technology due to a lack of research and documentation. This paper argues that the concepts and techniques used in the development of expert systems should be expanded and applied to the field of education, particularly in the area of intelligent tutoring systems.

**Keywords**— Artificial Intelligence, Expert System, CAI, ITS, IPTS.

### 1. INTRODUCTION

The traditional classroom teaching method may be most popular teaching methodology these days and may remain on top for quite some years. The traditional chalk and talk method have several shortcomings including limited time spent on various topics, limited access to teachers and difficulty in transferring lecture information to the real world situations. Because of all these drawbacks innovative and interactive learning methodologies are gaining importance and so is the use of expert systems in the field of education. In the modern era, teaching requires more knowledge of multiple concepts and complex relationships, enhanced interaction with students where they can explore more with the course materials. However, computer-based training already has a relatively long history and has been shown to positively influence the amount of material learned, the time taken to learn it, and the enjoyment of the learning experience[1]. The rapid accessibility of high-tech graphics, animation, video and sound capabilities and the proliferation of multimedia authoring software have made it very easy to quickly produce impressive presentations and interactive modules. The introduction of Artificial Intelligence in the field of education can provide deeper levels of interaction of students with course material. Artificial Intelligence (AI) based techniques have found wide applications in educational field, where knowledge is always evolving and characterized by uncertainty[2].

An *Expert System* uses human knowledge captured in a computer to solve problems that ordinarily require human expertise. Expert System may also be

defined as an intelligent computer program that uses knowledge and inference procedures to solve problems that was difficult enough to acquire significant human expertise for their solutions. Expert system typically consists of various components like Knowledge base, Inference Engine and User Interface, etc.

Knowledge Acquisition Facility is basically responsible for acquiring knowledge from knowledge base conveniently and efficiently. The Knowledge base stores all relevant information, data, rules, cases, and relationships used by the expert system. Inference Engine seeks relationships and information from knowledge base and creates set of rules to make an intelligent decision[3]. Explanation Facility provides opportunity to the user or decision maker to understand how the expert system arrived at certain conclusions or results. Expert is an individual whose expertise and knowledge is captured for use in an expert system. An expert system may acquire knowledge from one or more experts for any particular application. User Interface makes interaction of expert system easy with the users.

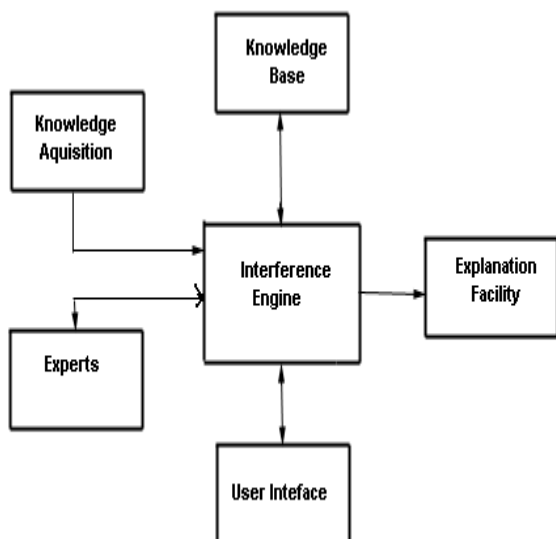


Fig 1. Configuration of an Expert System

It also allows user to query the system and receive the results of the query. As the expert system works on the knowledge acquired from an expert, it asks same sequence of questions that an expert would. An expert system should also be able to make appropriate guesses if definite rules are not identified regarding any specific problem[6]. In this paper we have discussed some expert systems being deployed for education purposes and discuss their pros and cons.

## 2. APPLICATIONS

The basic need of an expert system arises when there is a potential risk that an irreplaceable human expert of any domain will leave the organization. The organization will be adversely affected in this situation. Thus expert system is needed which can capture such domain specific knowledge and expertise which is rare and priceless[8]. This expertise will be very constructive for training and development to share the wisdom of human experts with larger number of people. With the development of Artificial Intelligence and expert systems, their usage is widespread in various fields including education. Some popular expert systems implemented for education include Computer Aided Instruction (CAI), Intelligent Tutoring Systems (ITS), Intelligent Pascal Tutoring System (IPTS) and BiMOS.

**2.1 Computer Aided Instruction (CAI)** - The best application candidates for expert systems are those dealing with expert heuristics for solving problems. The most popular expert system across the globe is Computer Aided Instruction (CAI). The brilliant idea of CAI is since 1950s and was developed primarily in USA and UK. CAI is still evolving in European and Asian countries and gaining popularity. CAI simulates the teaching approach of an experienced teacher but still it is not regarded a true expert

system. It is based on teaching individual students according to their learning speed and abilities. They are best for independent study and distance learning[5]. Depending on the usage, CAI is implemented in two ways. The first way is supplementing the classroom teaching where the sessions are small in duration and dependent on the teacher. This way is known as Adjunct CAI which aids the teacher to explain the topic to the students in a fascinating way. Other approach acts as a substitute for the teacher and the sessions are normally bigger in duration. This way is recognized as Primary CAI and it is independent of the teacher. The CAI system is developed in three stages: Conceptual, Design and Implementation.

1. **Conceptual Stage** - It defines any innovative idea or concept to meet a need. The CAI system may be goal-oriented, while need, curiosity and innovation establish goals. Every goal determined refers to a group of people to whom it is related. A considerable outcome of this stage is the project grounds. After requirements are known and goals are identified, the next step is to convert this conceptual design into reality.
2. **Design Stage** - It involves development of objectives, choice of instruction model and choice of coding language to bring the concepts to reality. The purpose of design stage is to review design decisions independently as well as their impact on other components of the model in terms of expected goals.
3. **Implementation Stage** - After the design stage, system is ready for coding in any selected language. After coding, various components of system like system output, working logic, branching strategies and student interface are tested individually and integrated to meet system requirements. The maintainability and portability of the system is a major part of the implementation stage.

CAI is vastly popular because of motivation that it provides for the students to learn. CAI uses games, puzzles, colorful graphs and sounds to keep the student attentive until the end of session. CAI provides opportunity to track individual learning records as intelligent students may take on more challenges while dumb students can do more learning before proceeding on. CAI also allows students to explore the subject by submitting queries and getting answers on the spot[5]. CAI system uses multimedia to speed up the learning process in a friendly way. Moreover, CAI is also economical than traditional teaching.

**2.2 Intelligent Tutoring System (ITS)** - Although CAI offers interactive learning and individually emphasis on students but still it is not that effective as the human tutoring, that is where Intelligent

Tutoring System (ITS) comes into picture. This expert system was primarily developed to help first year engineering student gain deep understanding of fundamentals to be able to follow the more advanced topics in the engineering fields. This expert system is based on fuzzy logic and it gives significant flexibility in presenting the information and responding to individual student needs. ITS is highly useful for motivating students and enhancing their performances. Learning time of students for any topic is decreased dramatically by using ITS. ITS will assist student in their learning by using adaptation techniques to personalize with the environment, prior knowledge of student and student's ability to learn. Moreover ITS will keep a check on student's progress and also guides the next step in training for individual students. Another unique feature of ITS is its 24\*7 availability to students that is they can learn anytime and anywhere[4]. Typically, ITS consists of four major components namely the student model, the pedagogical module, the domain knowledge module, and the communication module. However, one additional component named as expert model is also considered to be indispensable part of ITS.

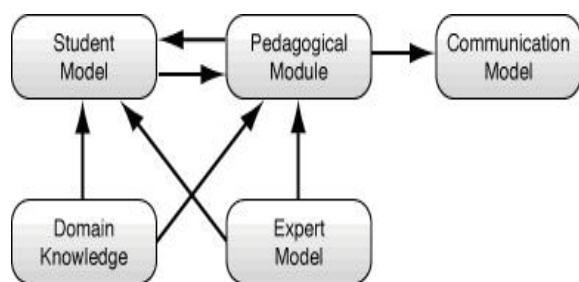


Fig 2. Components of Intelligent Tutoring System

The Student model is responsible for storing individual performance records of every student to keep track of his/her learning. Pedagogical Module describes the teaching process model, which include detailed information about when to review, when to present a new topic, and which topic to present next time. Domain Knowledge is the knowledge the tutor is sharing with the students. It also finds out a suitable way to represent explicit and implicit knowledge so that it easily scales up to larger domains. Communications Module is accountable for interactions with the learner, including the dialogue and the screen layouts, are controlled by this component. Expert Model is an extension of the domain knowledge. It also includes information like modeling how someone skilled in a particular domain represents the knowledge. The popular ITSs are those who teach procedural skills; the goal is for students to learn how to perform a particular task. These ITSs that are designed according to these doctrines are called cognitive tutors. Some examples of cognitive tutor are LISP tutor and SHERLOCK. Other ITSs concentrate on teaching concepts and "mental

models" to students. These ITSs require a larger domain knowledge base and are generally known to as knowledge based tutors. Usually, tutors that teach procedural skills use a cognitive approach, while tutors that teach concepts and frameworks use knowledge based approach where a superior knowledge base and better communication with users are required. The major drawback of designing ITSs is the time and cost required. Moreover, a large team including computer programmers, domain experts, and educational theorists, is needed to create just one ITS.

**2.3 Intelligent Pascal Tutoring System (IPTS) -**

Since the first development of CAI program, a lot of research has been done on CAI to build up expert systems which are more efficient and fast. In 1970s, a new breed of CAI became popular: Intelligent Computer Aided Instruction (ICAI) which is widely used for educational rationale. One of the ICAI that is particularly used for teaching Pascal computer language is Intelligent Pascal Tutoring System (IPTS). This expert system is used for independent teaching of Pascal to computer scholars[7]. IPTS not only teaches students in a brilliant way but also keeps a student database for checking individual performance and learning ability. It also provides the student an exercise environment to adopt a more practical loom towards learning Pascal. IPTS also contains an immense knowledge base for solving queries of pupils while learning.

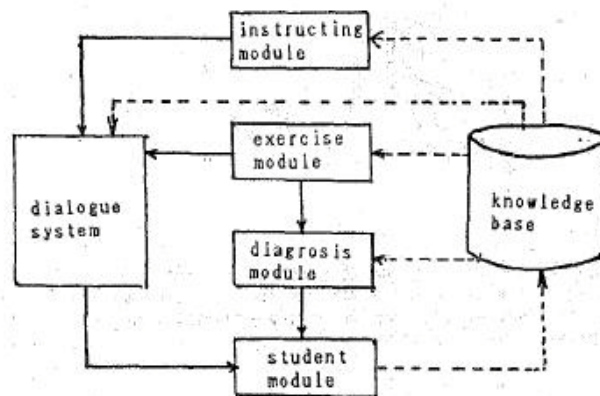


Fig 3. Components of IPTS

Instructing Module classifies and execute tutoring process including learning, review and evaluating. Exercising module is liable for providing a learning and convenient way for students to widen their programming skills. Diagnosis module does diagnosing, analyzing and explaining student causes and types of errors in Pascal programming. Student Module handles the record of students and track of student's learning. Dialogue system is similar to the user interface which helps better interaction of system with the learners. IPTS uses a new teaching method i.e. Tutor around Students, which combines dialogue between system and students, teaching materials to make heuristic decision and teaching

steps. Moreover, IPTS also provides an opportunity for students to find errors in the program and also debug too correct those errors.

### 3. 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 systems have many benefits are:

1. Increase the probability, frequency, and consistency of making good decisions.
2. Help distribute human expertise.
3. Facilitate real-time, low-cost expert-level decisions by the no 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 investigations 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 queries and find out their solutions.
11. Expert system also gives a congenial way to find out errors and fix them.

### 4. CONCLUSION

The paper shows that expert systems are gaining importance 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 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 systems focus on each student individually and also keep track of their learning pace. This behavior of expert system provides independent 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 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.

### 5. REFERENCES

- [1] O. N. Garcia, R. A. Perez, B. G. Silverman, et. All, "On Teaching AI and Expert Systems Courses", *IEEE Transactions on Education*, Vol. 36, No. 1, FEBRUARY (1993).
- [2] Russell, Stuart., Norvig, Peter. *Artificial Intelligence A Modern Approach*. Upper Saddle River, New Jersey: Prentice Hall, 1995.
- [3] O.N. Garcia, "An overview of expert systems and how they are developed," in *IEEE Symp. Policy Issues Info. Commun. Tech. Medical Appl.*, Rockville, MD, Sept. 89, 1987.
- [4] F. Hayes-Roth, "Knowledge-based Expert Systems: A tutorial," *IEEE Computer*, Sept. 1984.
- [5] Kaiser & Javaid, "The development of CAI: An Expert System in Education" *US Department of Education*, 1985.
- [6] Z. Chen, "Impact of Expert Systems: The Technique Dimension," *IEEE Technology and Science Magazine*, Oct. 1991.
- [7] Y. Cheng, Q. Hu & J. Yang, "An Expert System for Education: IPTS," *IEEE Computer*, 1988.
- [8] M. Stefik, *et al.* "The organization of expert systems, A tutorial," *Art. Infelligence*, vol. 18, no. 2, pp. 135-173.