International Journal of Engineering Research and General Science Volume 3, Issue 2, March-April, 2015
ISSN 2091-2730

Game Based Intelligent Tutoring System

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Abstract- A lot of research and development is happening in the past few years on the use of computers as teaching tools. Importance of change in teaching and evaluation methods is required these days because of significant growth of Internet. Because of the Internet many students spends their most of the time on playing online games, we decided to develop these games which can be used to motivate and increase involvement of students in learning activities. Game-based learning is teaching-learning strategy composed of software applications or products that use games for learning or educational purposes. Because it is an Intelligent Tutoring System, it contains an Artificial Intelligence component which makes inferences about the learners' strength and weakness based on his performance and knowledge level.

Keywords: Problem with current e-learning technique, Intelligent tutoring system, ITS modules, Personalized Tutoring, Meeting students and instructor goals, strategies of ITS, Game based learning, Characteristics of Games

1.Introduction

Educational Technology (ET) is the efficient organisation of any learning system adapting or adopting methods, processes, and products to serve identified educational goals. Modern ET has its potential in schools, in the teaching of subjects, in examinations, in research, in systemic reforms, and, above all, in teacher education, overcoming the conventional problems of scale and reach through online, anytime, anywhere.

Alternative models of education such as distance and open-learning, on-demand education and other such flexible models of learning. Flexible systems, futuristic curricula, and a twenty-first-century career orientation have become a necessity for today's young people. There is an urgent need to convince the educational system, which should play an important role in engineering the teaching-learning situation and to make it a more meaningful experience for both teachers and their pupils.

Computers have become an integral part and personality of the present generation and they like to embrace all the things in the scope of this modern technology. This modern generation is much more advanced and smarter than their teachers in terms of usage of modern technical gadgets. They want the computers to be there for all their tasks including academic related activities. Keeping in mind the psychology and interest of the modern learner, many universities and educational institutions have focused on integrating the modern technology with education. In fact, a lot of research is happening on the use of computers as teaching tools. The goal of this project is to build an Intelligent Tutoring System (ITS) framework which can guide students and help them to learn quickly and intelligently. The ITS framework built monitors the behaviour of each learner and then adapts itself to the learner level. More importance is given to the user experience to make it highly interactive.

2. Problem with current E-learning Technique

- Most instructional technologies consist of a repository for lecture notes with a possible feature of a message board discussion forum

- Prensky (2001) described this method of online training as "enormous step backward" while Klaila (2001) described it as "the worst of all possible alternatives".

3. Intelligent Tutoring System

Why ITS?

-There is a practical need for one to one teaching environment.

-Studies show that students can learn up to 3 times faster in a one to one setting than in the traditional classroom

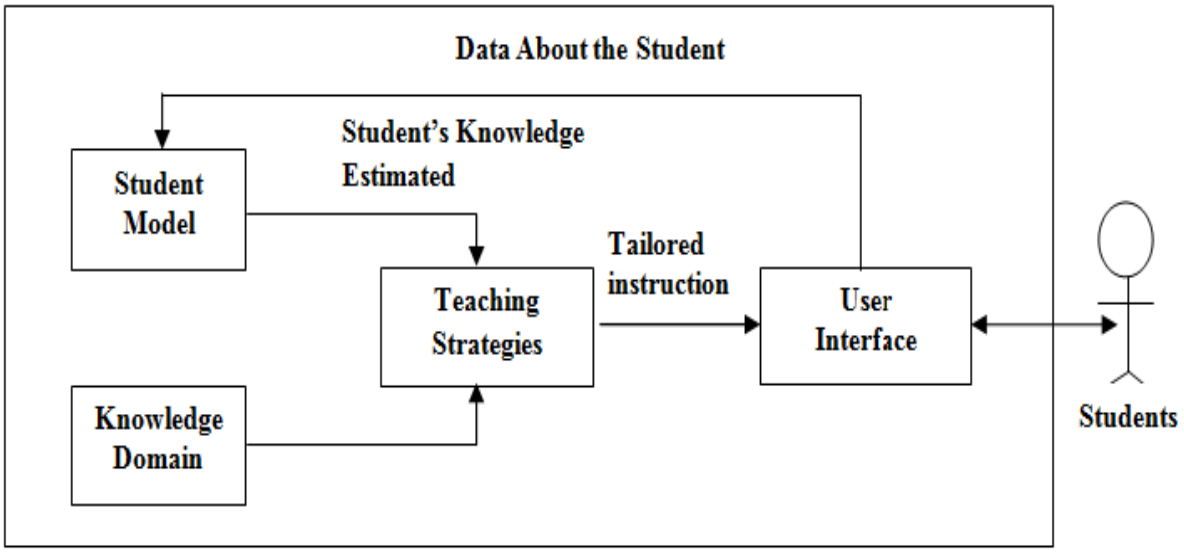
-Also, tutoring systems are interactive and hence more "interesting" than traditional text books.

An Intelligent Tutoring System (ITS) is any computer system that provides direct customized instruction or feedback to learners, i.e. without the intervention of human beings, while performing a task. Thus, ITS implements the theory of learning by doing.

ITSs are used in many domains such as in traditional education, distance learning and training. It is a multidisciplinary area.

One reason that ITS is such a large and varied field is that "intelligent tutoring system" is a broad term, encompassing any computer program that contains some intelligence and can be used in learning. ITS is an outgrowth of the earlier computer-aided instruction or CAI model, which usually refers to a frame-based system with hard-coded links, i.e. hypertext with an instructional purpose.

The traditional ITS model contains four components: the domain model, the student model, the teaching model, and a learning environment or user interface. ITS projects can vary tremendously according to the relative level of intelligence of the components. For example, a project focusing on intelligence in the domain model may generate solutions to complex and novel problems so that students can always have new problems to practice on, but it might only have simple methods for teaching those problems, while a system that concentrates on multiple or novel ways to teach a particular topic might find a less sophisticated representation of that content sufficient.



When multiple components contain intelligence, homogeneous or heterogeneous representations can be used. ITS can also be classified by their underlying algorithm. One well-known category is the *model tracing tutor*, which tracks students' progress and keeps them within a specified tolerance of an acceptable solution path.

3.1 ITS Modules

- **Domain Module**

The domain module is the knowledge management system and represents the content knowledge that the student is acquiring. All the concepts that the system pretends to transmit to the student are stored in this module. This module is at the heart of an intelligent tutoring system and provides the basis for interpreting student actions.

- **Student Module**

The student module is a record of the student's knowledge state. It stores information that is specific to each individual learner. All the student behaviour is recorded in the system and used for "reasoning" and adapt the domain module to the learner's needs.

- **Teaching Module**

The teaching module provides a model of the teaching process. It acts as a virtual instructor, presenting the contents in an appropriate sequence, based on the student's knowledge and his learning style. This is an interactive process and this module has the mission to explain the concepts to the student given several points of view and supporting all the learning process. For example, information about when to review, when to present a new topic, and which topic to present is controlled by the teaching module. As mentioned earlier, the student module is used as input to this component, so the pedagogical decisions reflect the differing needs of each student.

- **Interface Module**

The interface module communicates and interacts with the student. It control the dialogue and the screen layouts of the system. To develop a good interface module it is necessary to consider the usability issues of a user computer interface, because this module interacts with the user and the other components of the system. If the interface fails all the other modules fail too.

3.2 Personalized Tutoring

Research has shown that better learning outcomes result from one-on-one tutoring. It presents different content for different students depending on their individual needs and preferences. But one-on-one interaction is not possible due to very large student-to-teacher

ratio. Also, the cost and time investments required for one-on-one tutoring in any learning environment makes it very difficult to implement in today's realities. This is the reason why we need to use computers as teaching tools.

There are numerous benefits of using electronic tutors in education. These tools

are called as Computer-Aided Instruction (CAI) systems. A student can learn at his own pace at anytime of the day. They provide hands-on learning on an individual basis to each student. They can be more effective than traditional text books because they can provide a higher level of interactivity through the use of visual and audio simulation. The main drawback with these systems is they are static systems and do not adapt itself according to the intelligence of the learners. This is why the need for Intelligent Tutoring Systems arises. ITS has the ability to adapt itself depending on the domain and the cognitive profile of a student. Intelligent tutoring systems can personalize learning for a diverse generation of students with changing needs. It provides a more convenient, less expensive solution by keeping the costs down and more effectively using instructor's time.

3.3 Meeting Student and Instructor Goals

An Intelligent Tutoring System can also benefit instructors to manage learning objectives. For example, Web Study or Angel Learning has an integrated course management system which allows an instructor to view the progress of students learning objectives for the entire course through a dashboard reporting feature. These type of electronic tutoring systems can help instructors determine what material is presented to each student and create rules to release additional materials to students based on their assessment results. Ideally, a student and an instructor can see immediately what progress the student is making towards a learning objective. It is exciting to think that presentation of course content can adapt in response to student performance and be driven by the combined goals of student and instructor.

4. Intelligent Tutoring System Strategies

One of the advantages provided by our Intelligent Tutoring Systems(ITS) is it allows a flexible pedagogical approach according to the cognitive ability of a learner. This flexibility is enhanced using multiple learning strategies that can be successively triggered depending on the progression of learning. The following four teaching strategies are used to build our ITS.

The ITS framework built includes the following four teaching strategies:

1. Socratic Questioning
2. Scaffolding
3. Guided Discovery and
4. Game-based Learning

4.1 Socratic Questioning

Socratic Questioning is an approach in which teaching-learning is performed in the form of question and answer. It is a kind of series of questioning in which an original question is splitted into more than one low level questions. It is just like bottom up approach. In this strategy we start from the question which student or learner knows and goes to our target questions which we want to teach him.

Socratic Questioning is basically a dialogue conversion between the teacher and student. First, instructor starts the question and student responses. In return, instructor reformulates a new question according to the response given by student. Questioning and answering is structured systematically to reach an ultimate goal.

4.2 Scaffolding

Scaffolding also known as Instructional scaffolding is a learning process designed to promote a deeper learning. Scaffolding is the support given during the learning process which is tailored to the needs of the student with the intention of helping the student achieve his/her learning goals. The best and most effective use of instructional scaffolding helps the learner figure out the task at hand on their own. Once students build knowledge and develop skills on their own, elements of the support are removed.

According to McKenzie (1999), the defining features of successful scaffolding include clear direction, purpose, and expectation. Results include on-task activity; better student direction; reduced uncertainty, surprise, and disappointment; increased efficiency; and palpable momentum.

4.3 Guided discovery

Guided discovery, also known as an inductive approach, is a technique where a teacher provides examples of a language item and helps the learners to and the rules themselves. Guided Discovery is characterized by convergent thinking. The instructor devises a series of statements or questions that guide the learner, step by step, making a series of discoveries that leads to a single predetermined goal. In other words the instructor initiates a stimulus and the learner reacts by engaging in active inquiry thereby discovering the appropriate response.

Guided discovery is regarded by many teachers as an important tool. It encourages independence, makes learning more memorable, and if analysis is done in groups is a meaningful communicative task.

4.4 Game based learning

Game based learning (GBL) is a branch of serious games that deals with applications that have defined learning outcomes. Generally they are designed in order to balance the subject matter with the gameplay and the ability of the player to retain and apply said subject matter to the real world.

GBL uses competitive exercises, either pitting the students against each other or getting them to challenge themselves in order to motivate them to learn better.

Games often have a fantasy element that engages players in a learning activity through a storyline.

4.4.1 Definition of GBL

Game-based learning (GBL) refers to different kinds of software applications or products that use games for learning or educational purposes. These game applications are also termed as serious games. They can be anything from simpler games to games which use 3D graphics to provide opportunity for learners to take on virtual presence in virtual world.

"The underlying idea is that students learn better when they are having fun and are engaged in the learning process".

The main characteristic of an educational game is the fact that instructional content is blurred with game characteristics. The game should be motivating, so the learner repeats cycles within a game context. While repeating the act of playing the game, the learner acquires the knowledge through thought, experience, and the senses which result from interaction with and feedback from the game play.

Garris et al. suggested that the learning outcomes occur outside of the game during reflection and debriefing. The following figure describes the debriefing process between the game cycle and the achievement of the learning outcomes.

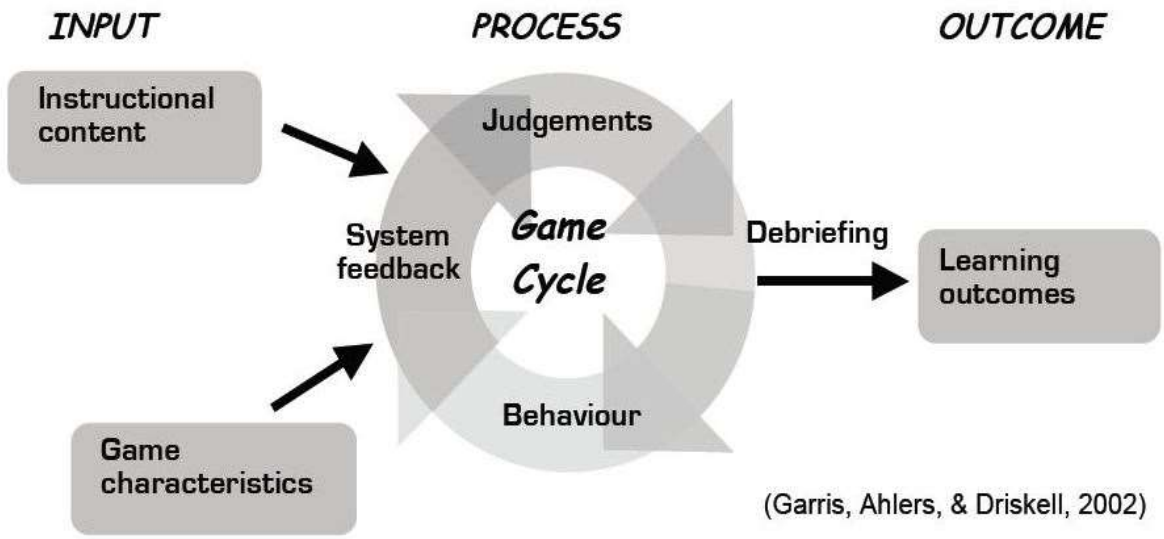


Figure 4.1: Learning Process in GBL

The debriefing process provides a link between simulation and the real world. It connects game experience and learning by drawing a relationship between the game events and the real-world events. This process of study in a game is described by Kolb et al., as "doing, reflecting, understanding, and applying".

4.4.2 Characteristics of Games

Malone (1981) summarized four essential characteristics or elements for computer games to answer the question of what makes a computer application enjoyable to operate: fantasy, curiosity, challenge and control.

Fantasy stands for the virtual world or the scenario in which the activity is embedded. Games involve imaginary worlds and nothing outside the game is relevant. The activity inside the game has no impact on the real world. The fantasy in the context of the game leads to greater interest on the part of the student as well as increased efficiency of learning.

Curiosity is embedded into the game by the continual introduction of new information and non-deterministic outcomes. The different types of rules help the players to reach the goal of the game. This includes the use of randomizing to add variety to the game. Malone emphasizes that environments should be neither too complicated nor too simple with respect to the end-user's existing knowledge.

Challenge is provided within each appropriate level of difficulty. If the activity level of difficulty is too low, students lose interest and the same occurs if the activity level is too high relative to the student's abilities. The challenge should be incorporated by introducing multiple levels or goals with progressively increasing the difficulty levels.

The students ***control*** the game environment by making the decisions and choices. This opportunity to make choices has direct consequences and helps to solve the confronted tasks and problems.

5. Conclusion

The ultimate goal of the project is to have a system with minimal human intervention in which students can learn and get instant feedback and hints. This project is only a rest step towards achieving that goal. The modular architecture ensures that each module can be extended and developed independently. This opens up a lot of avenues for future research and development.

Given our society's increasing need for high quality teaching and training, computer-supported education is becoming critical to complementing human tutoring in a large variety of fields and settings. Research in Intelligent Tutoring Systems leverages advances in Artificial Intelligent, Cognitive Science and Education to increase the ability of computer supported education to autonomously provide learners with effective educational experiences tailored to their specific needs, as good human tutors do.

The system must be evaluated from both a design perspective and from an Educational Technology perspective. Evaluation must be done for each module and also for the whole integrated system. The interfaces must be evaluated for the user experience. As mentioned earlier, a flawless user experience is crucial for the success of the system as an effective learning tool because a bad interface could lead to cognitive overloading of the student's working memory.

Over all, the effectiveness of the system as a learning tool should also be evaluated either in a laboratory setting with a control group or by subject experts.

REFERENCES:

[1] Paper on *"What is Intelligent Tutoring System?"* by Reva Freedman published in *Intelligence* 11(3): 15–16(Fall 2000)

[2] Paper on *"ITS: New challenges and directions"* by Cristina Conati published in the year 2009

[3] Paper on *"Educational Technology "* by Head Publication Department: *P*. Rajakumar Published at the Publication Department by the Secretary, National Council of Educational Research and Training.

[4] *"Development of Intelligent Tutoring System Framework For Game-based Learning"* by Praveen Kumar under the guidance of Prof. Sridhar Iyer.

[5] "Constructivist Vs Traditional: Effective Instructional Approach in Teacher Education" by Abida Khalid and Muhmmad Azeem at International Journal of Humanities and Social Science vol. 2, No. 5, March 2012.

[6] Aleven, V.; McLaren, B.; Sewall, J.; and Koedinger, K. R. 2009. Example-tracing tutors: A new paradigm for intelligent tutoring systems. *International Journal of Artificial Intelligence in Education, 19*: 105-154.

[7] Arroyo, I.; Woolf, B.P.; Cooper, D.G.; Burleson, W.; and Muldner, K. 2011. The Impact of Animated Pedagogical Agents on Girls' and Boys' Emotions, Attitudes, Behaviors, and Learning. In Proceedings of the 11th IEEE Conference on Advanced Learning Technologies. Athens, Georgia.

[8] Baker, R.S.J.d. 2007. Modeling and Understanding Students' Off-Task Behavior in Intelligent Tutoring Systems. In Proceedings of ACM CHI 2007: Computer-Human Interaction, 1059-1068. San Jose, CA.

[9] Baker, R.S.J.d.; Corbett, A.T.; Koedinger, K.R.; Evenson, S.E.; Roll, I.; Wagner, A.Z.; Naim, M.; Raspat, J.; Baker, D.J.; and Beck, J. 2006. Adapting to When Students Game an Intelligent Tutoring System. In Proceedings of the 8th International Conference on Intelligent Tutoring Systems, 392-401. Jhongli, Taiwan.

[10] Learning Theories Knowledgebase. (2008). Constructivism at Learning-Theories.com. Retrieved February 21st, 2012 from http://www.learning-theories.com/constructivism.html

[11] Lord, Thomas R. 1997. *A Comparison Between Traditional and Constructivist Teaching in College Biology.* Innovative Higher Education. Vol. 21, No. 3:197-216.

[12] [Shute and Glaser 1990]. Shute, V. J. & Glaser, R. (1990). A large-scale evaluation of an intelligent discovery world: Smithtown. *Interactive Learning Environments,* 1, 51-77.

[13] Capuano, N., Marsella, M., Salerno, S. (2000). ABITS: An agent based Intelligent Tutoring System for distance learning. Proceedings of the International Workshop on Adaptive and Intelligent Web-Based Education Systems, ITS 2000