# Conceptual Model to Incorporate Serious Games Mechanics in Intelligent Tutoring Systems

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***Abstract*—Potential of Game Based learning is huge because people are already engaged in playing entertainment game and multiple intelligent tutors have been designed for teaching various domains and topics. The Challenge is to develop a model to overcome and to fill the gap between serious game and ITS and through which learning activities would become more organized and meaning full. This research demonstrates a conceptual model which describes how game mechanics used in serious games and can be incorporated in intelligent tutoring systems to provide more effective learning. Multiple researches conclude that intelligent tutoring systems are effective but due to boredom students don't find it interesting to engage with it for a long duration. The purpose of this model is to combine the features of serious games and learning engine of intelligent tutoring systems. A model with combine's features of both fulfils the needs of students by engaging them in game with complete duration required and to achieve the learning purpose.**

***Keywords*— Boredom, Effective Learning, Intelligent Tutoring Systems, Serious games.**

## I. INTRODUCTION

THIS paper describes a Model Named G-ITS authoring users by an architecture to design a system that would be overcoming the limitations of serious games and ITS. In order to organize learning activities more and to enhance the user experience we integrate the gaming techniques and learning engine (ITS existing architecture) with ITS. Furthermore through previous work done on serious games and ITS discussed below we have found some limitations that will be overcome in proposed architecture.

According to [1] current changes in education are related with artificial intelligence, cognitive science and the web, due to artificial intelligence it's much easier now to engage student in learning activities through gaming activities, else the boredom element faced by students led them away from the learning purpose which is actually the basis of serious games and Intelligent tutoring systems. Our problem statement and challenge is exactly to present a system to students that fulfills the purpose of both serious games and ITS. To make students feel and play with the interface they deal with in Serious Games and the leaning engine that works in intelligent Tutoring systems makes the system more effective for learning purpose and to maintain their learning activities.

Technology and Computer Science plays a remarkable performance in in reshaping the state of educational system. Much work has been conducted by researchers [2] for making advances in educational technology in this field. The use of computer games provides an opportunity for student interaction, experimenting, learning by doing, building up skills, creative thinking, decision making, over learning, adaption to learner ability collective and collaborative learning.

Games are actually the fun part in nowadays people life's and it has been observed that people who are often reluctant to put efforts in their studies are enthusiastically willing to put numerous hours in playing modern computer games [3]. It has been suggested repeatedly that embedding games into education can be a way to improve students' affect, interest, and motivation towards education, and in turn improve their learning [4]–[6]. In particular, it has been suggested that games lead to positive affect states [7], physical and mental changes that take place as a person experiences an emotion [8]. Similarly However, while it is commonly hypothesized that educational games will lead to better affect and motivation than non-game-like learning environments [4], In many cases, educational games have been studied in relation to relatively weak comparison conditions, such as paper worksheets with no feedback [9] and games with key features ablated, such as a decontextualized math game called "Math Game" [10]. One important factor may be how educational games are designed. [11] Argues that many educational games are designed as "chocolate-dipped broccoli", failing to integrate fun elements with learning content. [12] Correspondingly find that educational games that alternate between game play and didactic instruction fail to promote motivation and engagement. However, the best way to design educational games is not yet clear. [13] Kafai argues that effective educational games must integrate subject matter into the game fantasy context in an intrinsic fashion. Ainsworth and Habgood, by contrast, argue that connection between the subject matter and game play is not as important as integration of the subject matter and core game mechanic [14].

Focusing on general perception of games, as well as past theoretical accounts about their benefits, it might have been reasonable to hypothesize that students would be on-task more often in the game, and would experience more engagedconcentration and delight within the game. [15]. As the percentage of user engagement in serious games is high

because of its interface and game mechanics used but serious games comparatively losses its stability if comes to performance and maintaining student's state of learning as in Intelligent Tutoring system. On the other Hand, ITS is strong because of its architecture and possess a high level of learning but due to its boredom factor its pushes student to left the learning activities before required duration.

By Analyzing the limitations of both It appears that both environments successfully engage students, but in different ways. Students experienced more continuing engagement in gaming environment. However, ITS appears to lead to more experience of delight. [15].Our principal contribution is to overcome this gap and to make an architecture that fulfills the limitations of both.

This leads us to propose us G-ITS model which possesses the characteristics of both serious games and ITS overcoming the weaknesses of both. Goal is to work on effective learning and increase the percentage of user engagement by proposing a strong architecture through which any system can be developed with multiple domains fulfilling the same characteristics. This model facilitates the user of various domains and effectively allowing the same components to be plugged in with different domain knowledge bases. The ITS shell can be used which effectively allowing the same tutoring components to be plugged in with different domain knowledge bases.The next section discusses some related works. Section III, outlines our proposal. We showed a worked example in section IV.

## II. Related Work

In As our research area based on Serious Games and Intelligent Tutoring systems both, Section 2.1 covers serious games, Section 2.2 covers intelligent tutoring Systems and section three will be about negative and positive areas of both.

### *A. Serious Games*

The starting point is what actually the serious game is, we have multiple definitions and there is no singleton definition of the concept with different people but commonly all following same kind of architecture. Usually serious games refer to games used for training, advertising, simulation, or education that are designed to run on personal computers.

In [16] "Serious Games: The application of gaming technology, process, and de-sign to the solution of problems faced by businesses and other organizations. Serious games promote the transfer and cross fertilization of game development knowledge and techniques in traditionally non-game markets such as training, product design, sales, marketing, etc."

Fig. 1 shows a conceptual model in UML class diagram notation. Because this is a conceptual model, it can be used as a framework that visually represents the arrangement of the serious game elements. The elements of this framework will be briefly explained from left to right.

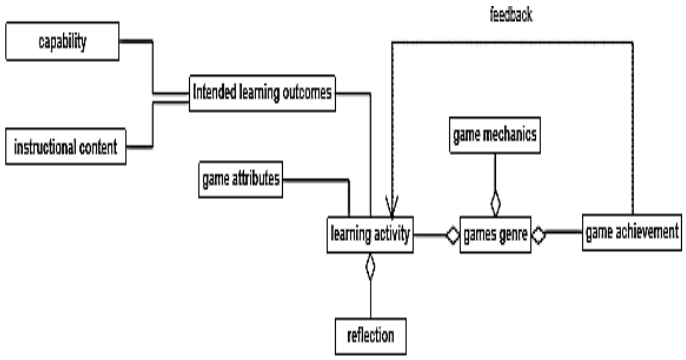


Fig. 1. The Serious Games Framework

The capability is the learner capability to be learned in the game, and the instructional content is the subject matter that the learner is required to study. Both are components of the intended learning outcomes, which is the aim of playing the serious game. Game attributes function as support for learning and engagement. Game attributes and intended learning outcomes are the components that relate to the game's learning activity. The game genre is the type or category of the game and identifies the kind of environment for the set of activities to be played within the game world. The game mechanics are the components that give more engagement and more enjoyment to the game.

### *B. Intelligent Tutoring Systems*

Intelligent tutoring systems (ITSs) are computer programs that are designed to in-corporate techniques from the AI community in order to provide tutors which know what they teach, who they teach and how to teach it. AI attempts to produce in a computer behavior which, if performed by a human, would be described as 'intelligent': ITSs may similarly be thought of as attempts to produce in a computer behavior which, if performed by a human, would be described as 'goad teaching' [17].

A General ITS Architecture is defined in Fig. 2, multiple architectures models have been proposed and followed but majority follows three major building blocks in different ways that are the pillars of ITS. Namely Domain Module, Student Module, Expert Module/Teacher Module.

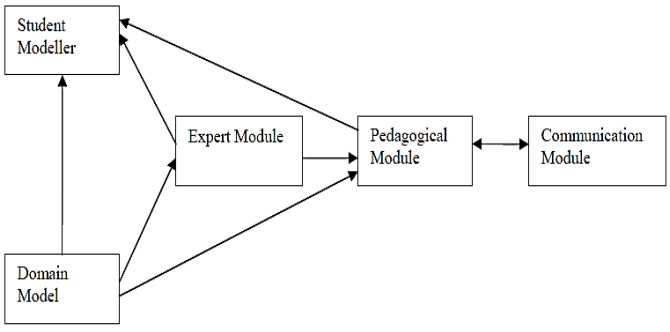


Fig. 2.ITS Architecture

*1) Domain Module*

Model contains concepts, rules, problem solving strategies of domain to be learned and it also contains the representation of expert knowledge.

*2) Student Module*

Student model can be considered as an overlay on domain model and also be as core component of ITS dealing with student leaning states and their learning process evolution. As student progresses step by step through problem solving process the system engages, user presented in different states of learning so this module basically deals with the cognitive states of student.

*3) Teaching Module*

The tutor model accepts information from the domain and student models and makes choices about tutoring strategies and actions [18]. At any point in the problem-solving process the learner may request guidance on what to do next, relative to their current location in the model.

By Comparing two environments we also gets an opportunity to understand the student behaviors as well regarding disengagement associated with differences in learning . Games has an advantage of fun, user engagement, game techniques on the other hand Intelligent tutoring systems are more effective for learning different domains but their boredom and frustrating factor push users away.so we actually focus on factors that can be combined and possess the positive factors of both It is advisable to keep all the given values.

## III. Our Proposal

To fill in the gap, described in the previous section, we propose G-ITS, Mod-el. G-ITS is designed to provide effective learning and to help designers of serious games and ITS developers to combine these two technologies, as the concept of personalized learning through ITS taking a big place if it comes to learning so over-coming the weaknesses of both by the proposed model that merging the modules of serious games and ITS. Fig.3 shows our proposed architecture. Using our architecture, a serious game can be linked with an ITS, such that the gaming part can be handled separately and the learning modules can be designed separately. This approach will help in increasing modularity which in turn will reduce complexity involved in the development effort. Architecture contains the following components: Student module, Domain module, Teacher /Pedagogical, and Communication Module (Interface Module).

This model will be adapted by Serious Games and ITS developers, when goal is to develop a system that provides the Usefulness of both of both architectures efficiently. As our Proposed architecture is independent of pedagogicaldomain. Therefore, it can be used to design SG with different ITS.

### *A. Expert Module*

The Expert module contains the knowledge of domain to be taught and the rules and relation among the concepts that will be imparted by tutor module later. As it is Generic Architecture defined domain model can contain the knowledge of multiple domains e.g. Mathematics, Medical Assistance Courses. Problem Generator is a part of Expert module that will be generating problems through a defined algorithm. Problem Solver part will be having the solutions part and dealing with the solutions of specified domain. Problem selector will select questions and tasks defined in questions pool as per defined questions related and connected to each task.

### *B. Student Module*

Student model in our architecture contains the specific information on an individual student (Personal data, Logs, Progress) or all the Students that uses application for their individual needs. There is nothing to do Student model with itself rather it actually provides information to teacher or pedagogical module.

### *C. Teaching and Pedagogical Module*

This module actually decides what next is to be provided to student. It collects information from domain and expert models to make a decision. This module basically models the teaching style that will be applied to students. For Example, may favor examples over the representation of static text it may also take both high and low level of decisions such as a low one is the level of difficulty of practice exercises and high one is to decide should student move to next topic of curriculum or not. Module is also responsible to provide proper feedback to student through feedback generator.

### *D. Teaching and Pedagogical Module*

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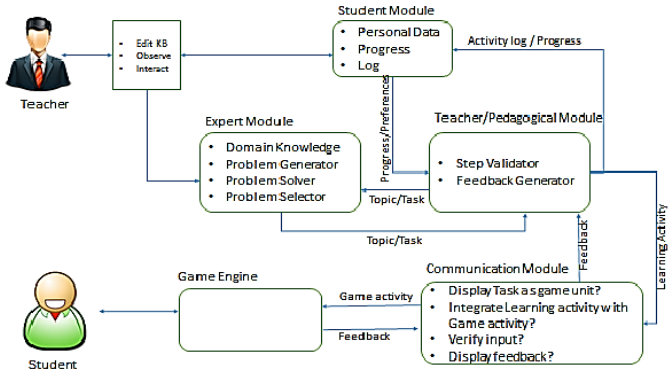


Fig. 3. Proposed Architecture

### *E. Communication Module*

Also known as the interface module, it interacts with the learner, displaying information and accepting input from the student. And mainly responsible for the tasks below.

The task that has been taken, saved and identified by pedagogical module that will be displayed as a task in communication module for trainee interaction and each task will be taken as a game unit for students that will be defined already in a table according to user experience and level of student earning phase, all the interaction data and steps made by system will also be stored in system student module. Learning's Activities will be integrated with game activities, the task to be done represented as a gaming activity E.g. to solve an equation you need to go through a certain steps and clear the levels.Verify input will be he phase in which students given input to solve or user data will be verified by pedagogical module.Once the user input will be verified by pedagogical module feedback will be provided by feedback generator according to user interaction data saves in student module.

## IV. WORKED EXAMPLE

Goal: Player task is to reach the palace that is near the bridge and to cross the bridge player needs to solve the given equation solved successfully player will find a way to palace.

### *A. Steps Followed by Student*

*1)* Once registration will be done and user information will be stored into data base.
*2)* User will be logged in with registered user id on progress logs will be maintained
*3)* User will be directed to Units (Task defined above).
*4)* If User selects Unit II to play before playing one message will be provided "you need to clear Unit I First".
*5)* User will select Unit 1 and clicks on Play button.
*6)* Instructions will be given and user will be asked to Proceed.
*7)* Player will be asked to select correct input values from buckets given.
*8)* E.g., User needs to select an operator but if he selects variable
*9)* Button will appear with a text "Do you wants to take a hint".
*10)* User will click on hint button and hint text will be appear according to hint matrix. E.g. in this scenario text appears "Oops! It's not a variable try with an operator "
*11)* User will try again and select and incorrect operator "+".
*12)* Hint will be appeared "Good! You are almost there try with a negative operator".
*13)* Go you have done it! Proceed with the next step.Once he is done with all the steps and he will find way to palace and reward points will be given to player.
*14)* Logs will be maintained E.g. (Log in time, Log out time).
15) Score will be maintained and %age will be calculated by scoring matrix and will be stored student model

TABLE I: QUESTIONS POOL

| Question ID | Task /Level | Question to be Solved |
|---|---|---|
| **1** | **1** | **x-3=5** |
| **2** | **2** | x + -6 = 9 |
| **3** | **3** | 2x = 10 |
| **4** | **4** | 14 = -2x |
| **….** | **…** | |
| **…..** | **….** | |

TABLE II: FEEDBACK GENERATION

| Task/Level of Hint | Low | Medium | High |
|---|---|---|---|
| 1 | 1 | 2 | 3 |
| 2 | 1 | 2 | 3 |

TABLE III: HINT MATRIX

| Task/ Q. ID | Task/ Question | User Input | Input value | Level of Hint | Text Provided |
|---|---|---|---|---|---|
| 1 | x-3 =5 | Variable | x | 1 | Oops! It's not a variable try with an operator |
| 1 | x-3 =5 | Incorrect operator | + | 2 | "Good! You are almost there try with a negative operator". |
| 1 | x-3 =5 | Correct Operator | - | None | Feedback "Go you have done it! Proceed with the next step" |

TABLE IV: STUDENT MODEL

| Student ID | Student Name | Login Date and Time | Log Off Date and Time | Total time Taken | Game unit | Difficulty level | No of hints taken |
|---|---|---|---|---|---|---|---|
| 14183 | Hina | 25/10/ 2015 11.45 am | 25/10/ 2015 12.30 pm | 45 minutes | 1 | Easy | 0 |

TABLE V: SCORING MATRIX

| Unit | No of hints Taken | Score | Percentage |
|---|---|---|---|
| 1 | 0 | 100 Points | 100% |
| 1 | 1 | 90 Points | 90% |
| 1 | 2 | 80 Points | 80% |
| 1 | 3 | 70 Points | 70% |
| 2 | …. | …. | …… |

## V. CONCLUSION

Considering both the environments and user's experience in Serious games and intelligent tutoring systems we conclude that user remains engage in both, but with different perspectives and to combine the factors that engage students in both we present our proposed model that increase the percentage of user engagement.

A limitation of the study we faced is faced is that the games and intelligent tutor differed among multiple dimensions, though the content was highly similar this is the general difficulty to conclude the actual result that what exactly is the major difference that makes different percentages of user experiences in these two environments.

But as Intelligent Tutoring Systems and serious games become a great source of teaching in students learning and used widely and popular in every age of users and having in view the pros and cons of both we still have areas that need to be covered and worked on. But as usage is getting low by the students because of the factors discussed above which results in lack of interest or motivation and monotony.

So our proposal is Integrate the artificial intelligence techniques and gaming techniques to cover these factors , proposed model incorporates the same modules for student knowledge (Student , Expert/Tutoring , Communication) and specific game elements such as game aesthetic (student model's module), game mechanics and dynamics (tutor model's module), game awareness (execution module), game feed-backs (visualization module) and game designer (authoring module) and mechanics of serious games used in module and Communication module. Through which we can say we are including and covering the users of both the environments to experience the features of both that would high the percentage of user engagement, motivation, learning experience.

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