# A simulated student-player in support of the authoring process in a knowledge-based authoring tool for educational games

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## Abstract

*This paper describes an agent that has been incorporated as an evaluation component into a knowledge-based authoring tool for educational games. The agent is meant to simulate the behaviour and memory of a student and aims at helping authors to evaluate the courses that they have authored before these are delivered to real students. Authors may try their course using the simulated student-player and they can see what a real student is likely to learn and remember after each lesson. In case authors are not completely satisfied with the result they may redesign the whole course or some parts of it. Such components are very useful for authoring tools because they encourage and facilitate multiple iterations of the design process and thus ensure better quality of the resulting software applications.*

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## 1. Introduction

An important factor that affects the inclusion of educational software in the educational process is the degree of its acceptance by human instructors who may decide to use it or not as an assisting tool for their classes. Human instructors usually need customisable software so that they can adapt it to the needs of their courses. On the other hand human instructors should not have to be computer experts to be able to perform such adaptations. Thus, a good solution for human instructors is that of authoring tools. These tools may provide many facilities in terms of presentation and reasoning of the resulting applications but are meant to be used primarily by human instructors-authors for the provision of content.

Existing commercial authoring tools may be very good at giving the instructional designer facilities to produce visually appealing and interactive screens, but usually behind the screens is a shallow representation of content and pedagogy [1]. A solution to this problem is the use of the technology of Intelligent Tutoring Systems (ITSs) in authoring tools. Indeed, ITSs may provide detailed reasoning concerning the students' needs and progress and thus render the applications highly individualised. This is mainly due to their student modelling component, which has become a core or even defining issue for ITSs [2]. One problem of ITS authoring tools that has been overlooked so far is that they are difficult to evaluate. One important aspect of the evaluation process concerns the authoring procedure of the human instructors. Prospective authors should be given the facility to evaluate the courses that they have authored so that they may redesign several aspects that they are not completely satisfied with.

In view of the above we have developed an evaluation component for VR-INTEGATE [3], which is an authoring tool that generates ITSs in the form of educational Virtual Reality games. The evaluation component is an agent that acts as a simulated student-player and is meant to be used by instructors-authors to evaluate the courses that they have authored before these are delivered to real students. Thus, authors are given the opportunity to fine-tune the virtual worlds of the ITSs that they have created so as to have better results for the real students.

## 2. The simulated student-player as an evaluation agent in the authoring tool

VR-INTEGATE is an authoring tool that may be used by human instructors to generate ITSs that function as educational Virtual Reality (VR) games. More specifically, the generated educational applications have the reasoning mechanisms of ITSs, such as student modelling and adaptive tutoring and can be operated by students as VR adventure games. The reason for the selection of VR games as the way of operation of the ITSs is to render the educational applications more engaging and motivating for students who are actually acting as players.

In the resulting ITSs from VR-INTEGATE, the ultimate goal of a student-player, is to navigate through a virtual world and find the book of wisdom, which is hidden. While players are navigating through the virtual world, they meet animated agents who lead them to places where they can read lessons about the domain being taught. Moreover, the player has an inventory list, which

may contain certain objects that could be of help during the game.

During the authoring process, after the teacher finishes describing a new virtual world s/he may ask the simulated student-player, which acts as an evaluation agent, to "play" the virtual game using different student profiles. These student profiles contain long-term characteristics of real student-players that have played in other parts of the game-course, which had been previously authored and used by students. These profiles may have been stored in the students' PCs which may be different from the author's PC. However, they can be collected through the Internet. In the end the teacher views the results and may choose to modify the virtual world's content, so as to emphasise some parts of the theory more than others, or s/he may find a mistake in the flow of the lesson which s/he may wish to correct. With that tool, the teacher may actually have a measure of the virtual lesson's efficiency before taking it to class. This allows an iteration of the authoring process of the ITS and thus ensures better quality of the resulting educational application.

The evaluation agent is an application that given a student profile, starts "playing" the virtual lesson inside the ITS, simulating a real user's reactions. The agent incorporates a cognitive model, which is based on cognitive psychology and in particular on Ebbinghaus' research about memory [4]. This model calculates and simulates the retention and memorisation capabilities of a student and gives the teacher an insight on the proportion of the information that is actually learnt by a student-player, during the Virtual Lesson.

Thus, the simulated student-player at first starts "walking" inside the virtual world. When it encounters a part of the theory, it uses the cognitive model to store that information inside its "mental" library. It then continues its "walk". When it faces one of the "guards" and it tries to answer the riddle. To do this, it checks its "mental" library for the part of the theory that is needed for the specific riddle, it then checks the information with the cognitive model, deciding whether it "remembers" the fact or not. To decide if it actually remembers the fact, the retention factor of the specific information should be higher than the student's retention factor. If it is, a correct answer is generated; else a wrong one is given. In the case of a wrong answer, the simulated student-player acts according to the student's profile which indicates whether the student would go back to revise the theory or would use one of the available items inside his/her inventory to bypass the guard. Eventually the agent will finish the virtual lesson.

In that way the teacher may evaluate the efficiency of the lesson s/he has created. If the agent's results are not the desired ones, s/he may change the lesson's layout, theory content and/or quantity to better highlight the parts of the theory that s/he wants to.

Simulated students have been created and used in past ITSs mainly to assist the learning process of students. For example, the mode of the simulated co-learner has been considered quite important by many researchers for the purpose of improving the educational benefit of tutoring systems [4]. However, simulated students have not been used in authoring tools as evaluation components. Such evaluation components can be very useful because they allow multiple iterations of the design process and thus may ensure better quality of educational applications.

## 3. Conclusions

In this paper we described an agent which acts as a simulated student-player in ITSs that function as games and are generated by an authoring tool. The simulated student-player is meant to be used as an evaluation component of the ITSs that teachers-authors may create through the use of the authoring tool. Such a component contributes a lot to the design process of courses since teachers may try the lessons that they have created using the simulated student-player to receive feedback, which otherwise they would receive if they tried their lessons on their real students. However, evaluating a course on real students is not fair for them since they would have to suffer the consequences of all the possible mistakes that a prospective author may have made and would have corrected if s/he had realised earlier.

## 4. References


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