Multi-Tutor Game: Electronic Game Worlds for Learning

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Introduction

Educational software has to be used by students for learning. Therefore educational applications have to be as attractive as possible to increase the engagement of students. To this end many educational software researchers employ several aspects of multimedia technology to improve the aesthetics and the appeal of educational software. However, there is a whole imposing culture of computer games that has not been exploited sufficiently for the purposes of education, although it is widely acknowledged that children and adolescents are fascinated by computer games. For example, Papert (1993) acknowledges the fact that the greatest amount of children's time with the computer is devoted to playing games and Griffiths and Hunt (1995) who conducted a study among adolescents, found that approximately one third of the subjects of their sample played computer games every day and the same amount played once a month.

Since children and adolescents are quite happy to spend many hours playing games then why not use the game culture for the purposes of education? Indeed there are many researchers who encourage this entertaining aspect of education (e.g. Inkpen 1994; Sedighian 1997; Amory et al. 1998). For the purpose of this kind of research, a tutoring system that incorporated games on multiple domains was developed. The system is called Multi-Tutor Game and provides many virtual reality worlds for adventure games in four domains, namely biology, history, spelling and mathematics.

General Framework of Games

Each game in Multi-Tutor Game is designed for a specific application domain and has a different virtual reality world associated with it. However, the games have much in common. First, they are designed based on the same principles related to the "aura" (Griffiths 1995) of the game, which is typified by characteristics such as music, lights, colours and noise. This aura has been designed by taking into consideration the preferences of the students and the fact that these games should primarily be educational vehicles. As a result of the student preferences, the Multi-Tutor Game has features that are quite common in virtual reality adventure games. Such features include dungeons, dragons, castles, keys etc. Moreover, they have the same basic story, where the player tries to reach the "land of knowledge" and find the treasure, which is hidden there. However, to achieve this, the player has to obtain a good score, which is accumulated by all four domains. The idea behind this is to motivate students to have a good standard in lessons which are different from each other.

Each domain is taught in a different virtual world. History is taught in a virtual world of lands with castles and warriors; biology is taught in a virtual water world; spelling is taught in a virtual world of woods and the domain of mathematics is taught in a virtual world of planets of the outer space. However, the student-player has to go through all four worlds to accumulate the required score for reaching the land of knowledge. The order by which the player goes through the virtual worlds does not matter for the outcome.

In all four worlds there are animated agents that communicate with the players. There are two types of animated agent, the advisor and the guard of a passage. Animated agents, who act as advisors, lead the student to lessons that s/he has to read. On the other hand, guards of passages ask questions to players in order to let them continue their way into the passage and receive more points for their total score. If a student does not know how to answer a question s/he may ask for help. In such cases, the advisor helps the student give the correct answer and thus the student may continue his/her way into the passage but s/he does not receive any points for the total score.

Common User Model

Multimedia educational products are often criticized that they do not support the learner well nor exploit the capability of the medium (Laurillard 1995, Montgomery 1997, Moore 2000). Therefore many researchers aim to make their multimedia systems more "intelligent" and adaptive to the learner's demands, abilities and knowledge (Hasebrook and Gremm 1999). To this end, the Multi-Game Tutor incorporates a student modelling component. In fact, although the games are of different domains there is one student model for each player of all four domain-games. This means that a particular student who is going to play in all four games has to log-in to identify himself/herself. Then each game contributes both domain-dependent and domain-independent information about the particular student to his/her long-term individual student model. For example, a student may be consistently making a lot of spelling mistakes when s/he is typing answers to questions posed by the game. This is a domain-independent feature of the student concerning the student's carefulness or carelessness when s/he types answers. This kind of feature is recorded in the student model and is updated constantly in all four domains. Another student feature, which is updated in all four domains concerns the student's spelling skills. If a student makes spelling mistakes in the game worlds of history, biology and mathematics, this affects his/her student model regarding his/her spelling skills and reduces his/her score in the spelling game world. However, naturally there are other domain-dependent errors, which may only be made in the corresponding domain game.

For each domain there are pre-defined categories of error that the system knows about. Thus, when a student gives an erroneous answer, the system performs error diagnosis. Then s/he is given a mark, which is translated to points for the student's score, depending on the severity of his/her error. For example, if the system diagnoses that the student has only made a typographic error then s/he is given almost full points for his/her answer. However, if s/he gives a totally irrelevant answer then s/he receives almost no points for this answer. At the end of the game, the student may see an analysis of his/her total performance together with some advice adapted to his/her particular case. The student is encouraged to try the game again if s/he has not managed to achieve the ultimate goal of reaching the land of knowledge and finding the hidden treasure.

Formative Evaluation

The Multi-Tutor Game aims at increasing students' engagement by providing a popular and motivating virtual reality game environment. In this way, it aims at being more effective in teaching students than other educational software and traditional media of education. In order to assess the educational effects of the game, we conducted an evaluation among school children, who were asked to use the game. The evaluation aimed at showing what the learning effects of the educational computer game were in comparison with educational software, which did not involve any games. Moreover, it aimed at assessing the motivating effects among students to learn while playing. The results of the evaluation were very encouraging in terms of the comparison between the game and the software without a game and in terms of using the game as an assisting tool in the classroom teaching.

In particular, high-school students showed that they liked the game when they were asked to use it in their classroom. Moreover, in the interview they gave after using it, the majority of students stated that they preferred the game settings for their assessment rather than conventional tests set by their instructors. However, many students also pointed out that the virtual environment worlds needed some improving to let the game become even more adventurous and competitive to commercial game products.

Conclusions

In this paper we described the Multi-Tutor Game, an educational virtual reality game that teaches history, biology, spelling and mathematics. The virtual reality game provides an attractive and motivating environment for students to learn and assess their knowledge. Indeed, the game culture is very popular among students but has not yet been sufficiently exploited for the purposes of education. In this sense, the Multi-Tutor Game aims at addressing this issue. Moreover, the fact that there are four domains interconnected in one game aims at encouraging students to achieve a good level of knowledge at lessons which have not necessarily much in common. Thus the Multi-Tutor Game aims at promoting the students' motivation to work harder irrespective of the domain being taught. The Multi-Tutor Game has been evaluated among school students and the results of the evaluation were very encouraging with respect to its primary aims.

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