Learning with Interactive Stories

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Abstract. Several frameworks and platforms are used for learning or for building virtual environments for game-based learning. In games based on virtual worlds an enormous amount of knowledge is exchanged. But we believe compared to games stories provide more explicit knowledge transfer. For that reason we developed an Interactive Digital Storytelling (IDS) Platform called *Scenejo*, which we use to build examples for different learning showcases. We present our first experiences and discuss challenges for the successful building of interactive storytelling applications.

Keywords: Game-based learning, virtual environments, Interactive Digital Storytelling, Scenejo

1. Introduction

Game-based learning describes the application of computer games for learning, or, as Marc Prensky has put it, it "is precisely about fun and engagement, and the coming together of and serious learning and interactive entertainment into a newly emerging and highly exciting medium" [1]. James Paul Gee [2] has analyzed that computer games are new media that let children and adults experience a learning effect while enjoying themselves. Game-based learning is somehow related to the field of edutainment that especially targets to lead children to scientific topics.

There are a lot of different approaches to Game-based learning. Different kinds of games that are used or especially developed for learning purposes exist. Some of these commercial games follow behavioristic approaches like *Mathematikus*,

Physicus, *Informaticus,* etc. (part of a whole games series), or simulations such as *Making History* or exemplary *SimCity*.

Frequently, teachers and researchers experiment with commercial gaming platforms and virtual worlds for education. An often applied platform is *Neverwinter Nights* [3], a massively multiplayer online role-playing game (MMORPG). An example for adoption is the project *Altered Learning* [4] that has been accomplished at West Nottinghamshire College in Mansfield, England. At a level appropriate to the learner, teachers give access to scenarios where a learner is confronted with tasks and puzzles she should solve. In agreement with Sanford et al. [5] the game has been modified to the specific needs of this project, and teachers do exactly know about tolerance and prospects of the game and how to instruct the students.

Another example for the utilization of commercial games for learning is *Revolution* [6]. *Revolution* is a multi-player role-playing 3D game based on historical events of the American Revolution. Students have an opportunity to experience the daily social, economic, and political lives of the town's inhabitants. The game is designed to be played in a 45-minute classroom session in a networked environment, which means students can interact with other players. Players can collaborate, debate and compete within this historical simulation that maintains historical suspension of disbelief with graphical and behavioral accuracy. Moreover, players can listen to non-player characters (NPC) that talk to one another about the events taking place. This example shows how students could "teach" themselves by exploring the virtual world of ancient America in groups.

Not only game platforms are used to create "playful learning" scenarios. Currently prevailing is the adoption of virtual realities, first of all *SecondLife* (SL).

Virtual realities are computer-based simulations of a three-dimensional environment for multiple users. Users can inhabit this simulated reality via avatars. These avatars interact with each other. MMORPGs are using virtual realities as an environment.

Also specialized frameworks and platforms have already been developed for building a specific virtual learning environment. Based on these commercial products games can be build similar to MMORPGs or virtual realities like SL. But theses games then are specially designed for usage in a particular field of interest.

Fig.1: Example application of *Olive* simulating a case-study for firefighters [7]

One example for such a platform is *Olive* by Forterra [7] (Fig.1). *Olive* is used for building game-based scenarios in the fields of corporate, medical, defense & intelligence.

2. Problems of Game-based Learning Approaches

While the idea of combining learning with play and games is intriguing and many people are currently trying to follow this vision, the realization of successful game-based learning applications is not really simple. There are various examples illustrating the different problems.

Most of today's commercial learning games can hardly convince as successful game-based learning solutions. In general, these applications fall into two classes: those stressing learning, and those putting the focus on the game idea. While applications from the first class usually lack the targeted levels of fun and playfulness, applications from the second class typically fail to integrate learning and learning elements successfully. In general, these applications incorporate learning elements in term of the presentation of glossaries or texts covering subjects that are necessary to solve a problem in the game. However, most often these problems seem artificial, and, thus, these applications often fail to provide the necessary motivation to analyze the additional documents (examples are applications such as *Mathematikus*). In general, such approaches usually fail to take up state-of-the-art educational theories and constructive elements, limiting learning to behavioristic approaches. Jantke comes to similar results in his review [8].

Trying to utilize the tension provided by computer games, McDivitt tried to apply an off-the-shelf computer game from the genre of history and strategy to learning in history classes in school. In his study he could proof that such games were well accepted by students and that a certain increase of knowledge in history on the specific time-frame could be observed. On the other hand, students also acquired wrong understandings for historic facts, resulting in a failure of this experiment [9].

Very recently, the *Arden* project, a large project started to implement a game-based learning endeavor comparable in quality to commercial games, also admitted it's failure to provide the targeted fun and gaming due to a late consideration of real game elements during the development. [10].

In general, the question on how to integrate learning successfully with elements of play and games is unsolved. Gee [2] provided a list of 36 principles relevant to learning with games. However, he did not address the aspects of fun and drama that a game should also provide.

Applications coming a bit closer to those visions of game-based learning are typically those incorporating strong elements of simulation that provide real "choices" to the user [11] where she can observe the effects of decisions directly and, thus, can develop other levels of understanding. Simulations are well accepted as valuable tools to support learning (see for instance Schank [12]). However, a good simulation does not necessarily provide the wanted levels of fun and motivate for further exploration. Also, it is difficult to provide learners adequate support and guidance in such environments, and their development is complex and costly.

3. Interactive Digital Storytelling

The concept of Interactive Storytelling has the potential to become a paradigm for future interactive knowledge media. It couples dramatic narrative with interactions of users, providing highest forms of engagement and immersion. It also stands for the connection of games and stories by utilizing inherent structural elements of both. Artificial characters taking the role of actors within a plot play an important role in the concept of Interactive Storytelling.

Digital storytelling agents can achieve more than simply being single virtual guides and virtual tutors, which are commonplace today in a variety of software products. As in stories, their role could be to interact with each other as a set of characters to present a dramatic storyline; and as in games, they have the potential to serve as all sorts of sparring partners for players to interact with, such as representing the bad guys, or companions who ask for help.

Interactive Storytelling Principles

Independently from the actual content, there are design problems to solve concerning the dynamics of real-time interactive storytelling systems. At the same time, drawing from dramatic storytelling principles gives new possibilities to design the conversations in a way that fits the target group and provides some entertainment and fun. An interactive story that involves several characters has to fulfill the following requirements, thereby confronting the storyteller with open design issues:

- **Characters and story world:** Characters with complex interpersonal relationships interest people. However, it takes a great deal of time to relay these issues through dialogue. For an E-learning application, these relationships still can be of some use in the sense that several characters can take roles (the Smart and the Dumb, the Teacher and the Buddy, etc.). For good storytelling, the combinations of characters induce much of fun and interesting dialogues, and also assign a role for the student. Mostly, good designed characters live in an accordingly designed world that matches their goals and personality, sketching a special not normal situation.
- **Hook:** The audience shall be captivated within the first few moments by something that makes them stay and be interested in the details of the main objective of the story. According to the target group, there can be a theme from folktales or interpersonal relationships. The main design question here is how much fiction is appropriate.
- **Agency:** It is very important that the students perceive themselves immediately as active participants with a direct influence on the dialogue itself. This has to be communicated within the first few moments, by the interface or by the dialogue.
- **Dramatic arcs:** If a hook has been presented, there should be a satisfying story resolution to each student's individual experience. It is an important design issue to manage the different individual time for the interactive parts, while not ending a lesson within a certain timeframe but without a resolution of the story.

- **Usability:** Interaction shall be possible with text-based input, as well as through actions. According to the target group and its age and the context of the task, text input is not always appropriate. Therefore there is a demand to design alternative interface hardware, especially for younger children with no writing capabilities, to replace the input of numbers, given words and sentences. Within our project, these issues are planned but not yet implemented.

The result of the overall work is dependent on all of these and even more aspects. The achievement of any storytelling educational application will depend on a successful integration of these design issues with the mechanics that the runtime platform can provide. The platform for interactive dialogues shall be able to let authors define characters with personality, choose a story model to decide on possible dramatic arcs and turns in learning concepts, and define interactions that are integrated within the written dialogue.

4. Technological Approaches

Successful implementations of intelligent conversations with animated virtual characters are rare, and there is no real success on the entertainment market to date. One of the few examples examining a middle course between the two approaches of linear stories and emergent behavior is M. Mateas' and A. Stern's *Façade* [13]. It is based on a specialized dialogue management system and allows users to participate in a predefined and pre-recorded conversation between virtual characters. However, the system's design is focused on a specific scenario and authoring is currently supported for programmers only. *art-E-fact* [14] and *Scenejo* present similar integrations of simulation and plot. In contrast to *Façade*, an authoring system is central to the way a story is built in *art-E-fact*. Defining digital conversations, Storywriters start with a story graph of explicit dialogue acts, similar to branching. They provide more complex interactions by adding rules and chatbot patterns within nodes of the graph.

Beside this implementations, we want to mention *Fear Not!* [15] by Ana Paiva et al.. This system is based on synthetic and empathic agents. It is being developed to tackle and eventually help to reduce bullying problems in schools. This is one of the first interactive storytelling applications used in an educational context.

Scenejo

Scenejo [16] is our technological approach to develop a framework for interactive storytelling applications for learning. *Scenejo* enables such playful simulations of dialogues between several conversational agents and multiple users. As mentioned above, *Scenejo* employs animated virtual characters and current chatbot technology as the basis for text-based interactions. The result is an emerging dialogue, influenced by the users' inputs and the bots' databases of possible lines matching a text pattern coming from either a user or another bot. The bots also take into account parametric settings and scene descriptions provided by an author.

Fig. 2: Main application window of *Scenejo* showing the dialog history and two actors

With *Scenejo*, we follow a similar goal as in *art-E-fact*, but start at the opposite end. From the start, we use chatbot text patterns to provide free conversational interaction with users, and in a bottom-up way, we introduce a story graph allowing writers to line up conversational scenes and their parameters.
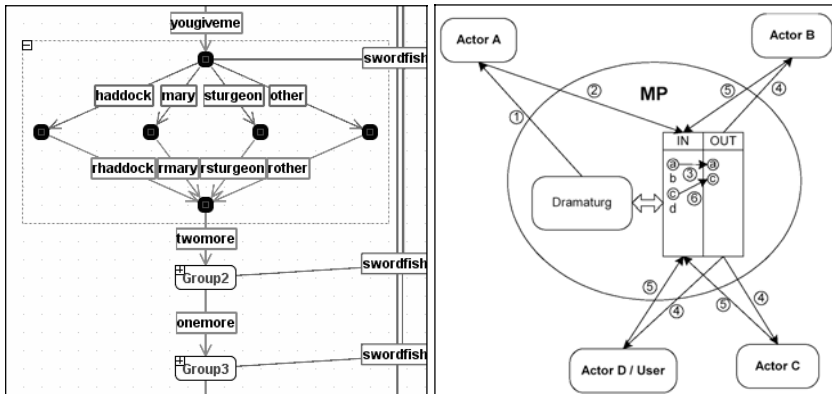

Fig. 3: Left: Graphical representation of a dialog graph described in [17].
Right: Schematic drawing of the communication concept of implemented components:
Meeting Point with Dramatic Advisor and Actors

5. Discussion

Does *Scenejo* meet the challenges of playful learning? To date, only partially, there are still a lot of open tasks. One of the open questions is how to simply control the agents and media at all. At the moment, we are working on a simple to use graphical programming language for describing dialogs, events and, as mentioned, to control applied elements. Identifying elements of digital storytelling leads to another problem. Currently, no common technological standard does exist.

Not only technological questions have to be answered. We also have to stress that Interactive Digital Storytelling is about the development of a new genre. At present, we do not know what good interactive stories are and how multi-branch stories should be designed. However, answers to these questions are preconditions for applying IDS successfully in the field of learning.

First experiments are however promising. The *Killer Phrase game*, a small and simple educational game on rhetoric and communication could be implemented successfully based on the Scenejo framework. So far, it has shown that there is a potential for designing successful games for learning involving virtual actors based on digitally implemented agents [18]. But there is a need for further technical development.

As mentioned above, authoring represents a central problem in today's approaches to IDS. Similar to the developments in Multimedia and the World-Wide-Web, interesting and convincing contents can only be expected in a wider scale if appropriate and easy to use authoring tools are available that allow non-experts in the field and especially non-technician to fully exploit the potential of the medium. In the context of education and learning this means that educators and teachers need to be enabled to express their ideas of interactive learning stories and game-based learning contents. Further application scenarios may develop, when usability of such tools reaches a level where students and children as novice users may utilize such authoring tools. This would allow collaborative learning scenarios in the sense of group storytelling, allowing students to tell their own stories, exchange and integrate them with others, take different roles and play a scene, and reflect on the different aspects expressed in such interactive endeavors. Experiences in this direction are very limited. Nevertheless, rethinking subject topics and processes in terms of interactive stories has already proven to be a valuable concept in learning [19].

Still, a high degree of usability will not be the only problem to solve. The already mentioned aspects of a very new genre make it difficult to foresee all requirements for authoring tools for IDS. We certainly may assume that new metaphors for describing and visualizing such contents need to be found. From experience we know that progress in such new contexts can best be achieved based on small development steps and frequent evaluation of concepts and prototypes. Scenejo may well be understood as one of the first steps in this direction.

6. Conclusion

We discussed the differences between game-based learning and Interactive Storytelling and have shown some disadvantages of the game-based approach. Also we have described how Interactive Storytelling could be a valuable approach for learning. In conclusion the question comes up, whether Interactive Digital Storytelling should be preferred to the game-based learning approach.

Also, we introduced *Scenejo* as a first step towards an implementation of Interactive Storytelling concepts and presented our first experiences. Current problems have been identified and discussed, too.

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