Potential Applications of Digital Storytelling in Education

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ABSTRACT

Developments in the field of computer science are creating new methods of learning and teaching. Digital storytelling is one of those fields, which is offering a new way of to educate people. This paper explores potential applications of digital storytelling on different educational levels and will investigate if there is an interest for these applications on the educational market.

Keywords

Digital storytelling, virtual storytelling, education, edutainment

1. INTRODUCTION

Storytelling is a simple but powerful method to explain complex matters. People tend to pay much more attention for what is told when the information is put into an interesting or exciting story [GJ04]. The best example how powerful storytelling can be is the bible. Millions of people live their life according to this book in which a story is told. A book that has been written many centuries ago, but still is the most printed book in the world. Other examples are the Iliad and the Odyssey by Homer. Both epic stories are both still very popular and have been rewritten many times. In 1988 psychologist Polkinghorne discusses how stories are central to human experience. He tells that narrative is "the primary form by which human experience is made meaningful" [PO88].

Stories have been told as far as time allows us to remember. For the rest almost everything has changed; from the intention of stories to how stories are told. In the middle ages stories were told orally by wandering bards and minstrels. Only in wealthy homes stories were kept on manuscripts. Examples of these manuscripts were primers that taught alphabet through verse. This shows that back then storytelling was already used to educate people. When the print tradition begun in the 1400s books came available for a much bigger audience. Until the 1800s stories for children were mainly used to educate them and provide them lessons what was good and what was bad, but in the 1800s the intention of books shifted to entertaining people without any intention to educate people. In the 1980s new technologies like film, radio and television offered a new way of telling stories. Sesame Street was a new program that educated and still educates children with video narratives

[KM03]. The last development in the way stories are told is becoming more and more interesting. Using computers for storytelling opened a whole new market and the development of applications and systems is growing.

It is difficult to give a precise definition of digital storytelling. The term is used in a lot of different ways. Telling your own stories with the aid of digital media, like digital pictures or digital video clips is one example, but the term is also used for a whole different approaches. One of these approaches is based on the idea that it should be possible for computers to create stories with human interactivity or even autonomously. This approach can be described as an attempt to involve the computer in a small part or even the whole process of story creation and telling. The term digital storytelling in this paper will focus on this approach.

Digital storytelling is a growing business when looking at popularity of games like Sims2 [KO04] and World of Warcraft [SU05] where people together create their own stories in a digital world. The aspect of digital storytelling is limited in these games because the focus is on playing a game and not on a story that has to be told, but it shows that people like to experience stories, which are created digitally.

From pure entertainment to informing and educating people, storytelling can be used in many different ways. With the arrival of the digital era storytelling received a new medium. Storytelling offers a powerful method to educate people. This was already clear in 1400s when they used stories to educate children. The focus of storytelling has shifted from education to merely entertaining people, but with the arrival of this new medium it becomes interesting again to look at the use of storytelling for educational purposes. If you look at the popularity of Sesame Street where children learn through stories, it should be investigated if digital storytelling could be used to educate children and maybe the power of this new medium does not stop here. Maybe digital storytelling offers new ways of learning for older children, pupils and students. But it also should be considered that even if it could offer new possibilities that there has to be interest and support to introduce these new kinds of applications.

In the following sections the use of digital storytelling in education will be explored. In section 2 some research projects of digital storytelling will be discussed to show what kind of research is going on and that there are a lot of different ways to approach digital storytelling. In section 3 some possible applications of digital storytelling will be suggested on different levels of education and the feasibility of these applications will be discussed. In Section 4 opinions of people related to education will be given and discussed. Section 5 will give the advantages of digital storytelling in education. In section 6 the risks of using digital storytelling will be discussed. Section 7 contains the conclusion if there is a future for digital storytelling in the education field.

2. RELATED RESEARCH PROJECTS

Digital storytelling currently has a lot of attention from the research community. This research has given rise to a whole variety of approaches and applications. To illustrate the diversity of the different approaches to digital storytelling nine examples of research projects will be given. The examples will also give a small notion on what may be possible in the future.

Examples 2.1 up to and including 2.4 are application of digital storytelling, but are not connected to education (yet). Examples 2.5 up to and including 2.9 are systems developed to with the intention to educate people in some way.

2.1 Virtual Storyteller

The Virtual Storyteller is a framework for story creation by cooperating intelligent agents. This means that characters that have their own goals and emotions are put together in a digital world and will create a story while trying to get to these goals. So the system does not make use of a pre-defined plot, but to create a story that is interesting is has general knowledge on what makes a good plot. A story is generated and after that presented by a narrator-agent, which tells the story like a traditional storyteller (at this time it is a dwarf) [TFNH03].

2.2 Mixed Reality and Interactive Storytelling

Mixed Reality is the term used to describe the creation of a feeling of composite reality. It is a technology for seamlessly merging the real and the virtual worlds in real time. In combination with interactive storytelling mixed reality gives the opportunity to play digitally in your own story. A prototype that has been developed making use of the idea of mixed reality [CMN04] gives the opportunity to play a scene with James Bond, the Professor and his assistant. A real person plays the professor. That person is captured by a camera and virtually projected into the virtual world (see Figure 1). James Bond and the assistant are virtual actors and interact with the professor. In this way a story will be dynamically created and experienced by a real person.
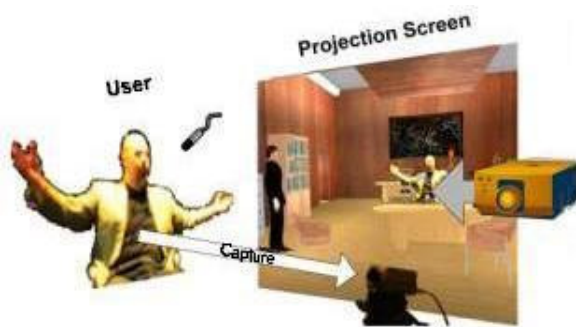

Figure 1. Mixed Reality

2.3 Interactive Storytelling Engine

The Interactive Storytelling engine is a result of several years of work in the field of digital storytelling. The system is based on a game engine for the presentation of the story and the narrative generation variant is implemented by a variant of HTN (Hierarchical Task Network) Planning. This means that every character has its own goals. These goals are divided in smaller sub goals and these smaller sub goals are divided in sub-sub goals and so on until elementary goals (tasks like ´walk to´) are left. It is possible to re-use this engine and develop new interactive storytelling applications on top of these technologies. You can for example create new virtual characters with certain goals or create totally new environments [CCM02] [CCM04].

2.4 Playing Digital Director

In [SGBI02] a multi-level concept that can be used to explore interactive storytelling at varying degrees of flexibility versus predetermination is presented. Instead of an ultimate virtual narrator it is suggested to develop layers of run-time engines that allow authors to work with directions on each layer separately. The goal is to preserve the human author's authority in story creation. An example that is given is the "GEIST-project", which is a project to make use of interactive storytelling during a real city tour. On the actual location of the sight tourist are helped by ghosts, which appear and communicate with the tourist if they reach a certain location. With special equipment (see Figure 2) it is possible to see those ghosts. It is also possible with the use of the equipment to see how sites looked in the old times by recreating them virtually [KSS01].

Figure 2. "GEIST"-equipment

2.5 Rosebud

Rosebud is a system, which uses children's stuffed animals to encourage children to write stories about them. The computer recognises when one of the animals is in front of the computer and prompts the child to tell a story about the stuffed animal. The stories are saved in a personalised storybook. Once a story has been saved the child can choose to enter a revision mode where the computer plays the role of an encouraging listener as well as a teacher, persuading the child to write more or edit a story. When a child chooses a story is finished it can record the story in his or her own voice. The story is saved into the stuffed animal and the child can after that ask the stuffed animal to tell it. This system tries to support children to be creative and to explore the use of language while telling stories [GC97] [CR01].

2.6 Edutainment

Edutainment is a growing area where education and entertainment are combined to create a more entertaining way of learning. In [SEMWC04] a system is described where people can virtually walk in a digital museum and learn more on the presented content through a virtual tour guide. This guide presents the cultural and historical content through non-linear

Figure 3. ICT Virtual Reality Theater

storytelling techniques. This technique is used to create content dynamically and fit to the changing needs of the visiting audience.

2.7 Towards the Holodeck

This project is inspired by the famous Holodeck from Star Trek where people can create a virtual world which looks and feels like real life. The goal of the project is to create an interactive system where people can learn to cope with the sight, sound and circumstances of real world scenarios. A prototype that has been build is able to play a scene where a real person takes the role of an army lieutenant and has to handle a difficult military situation. The system exists out of a large curved screen, three projectors and a multi-channel audio system to create an immersive experience (see Figure 3). First tests with people including army personnel using this prototype where received with enthusiasm [HOLO01].

2.8 Immersive VR Decision Training

In [PHMS03] a concept and practical realization of an immersive VR decision training are described. The scene played in the prototype is a situation where a trainee has to instruct a virtual assistant in a health emergency situation. The system consist out of a rear-projection screen, a simulation control PC and a simulation PC (see Figure 4). The trainee stands in front of the screen and a simulation supervisor takes
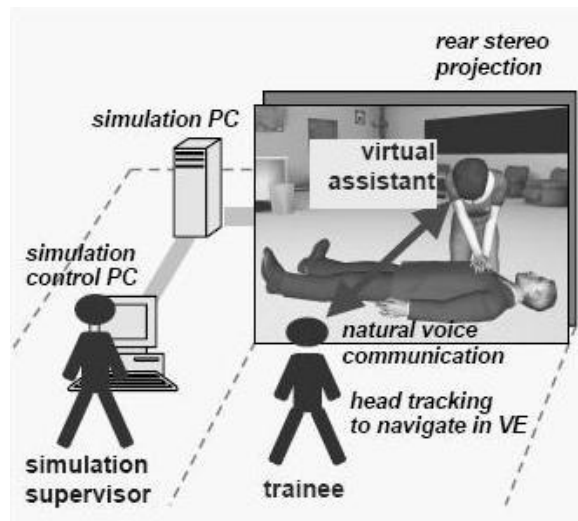

Figure 4. VR Decision Training System

care of the simulation control PC. At this point the simulation supervisor is playing the ears of the virtual assistant and gives him signals which actions he has to take. This is because the development of speech recognition is not far enough to help to create an immersive real life simulation. In the future it should be possible, with the help of digital storytelling techniques, to leave everything to the virtual assistant.

2.9 oTTomer

oTTomer is an interactive story for young children about life on another planet, where they have to help small creatures to free their planet from awful and odious beings. The action takes place in a large room where they virtually experience the story. The idea behind this project is to learn children in a playful way how to work together to solve a problem. The project is at the initial stage: design [VC04].

3. DIGITAL STORYTELLING AND EDUCATION

Some research projects are already exploring the idea of using digital storytelling for educational purposes [MR04] [PHMS03] [VC04] [HOLO01] [GC97] [CR01]. With the help and ideas of people involved in education and digital storytelling some examples of potential applications of digital storytelling are suggested for different levels of education. The suggested applications are based on the recent developments in the field of digital storytelling. The feasibility of each system will be also be explored in the next subsections. It will also be made clear what the influence of digital storytelling is on the system.

3.1 Primary School

Storytelling in combination with computers is already used on a limited scale in primary schools. For example grade-specific educational software programs are used in schools featuring Arthur, a famous cartoon character, and his friends to help with reading comprehension, math, geography and problem-solving [KM03]. A next step along this path would be to provide the computer with some information about what subject has to be learned, on which level and in what kind of story. The computer will generate a story and tell this to a pupil. While the story is told the pupil is asked questions to help characters of the stories with problems they face. For example: a teacher has provided the computer with the information that the pupil has to practise his maths and that he likes stories with knights, dragons and princesses. The computer generates a story that the knight has to kill the dragon in order to marry the princess. While the

knight is on his quest he comes along mathematical problems which has to be solved else he cannot continue with his quest. The pupil helps him with solving those problems so that the story can continue. The scenario with knight, dragons and princesses could be easily changed to other scenarios and also the subject maths could be changed to different subject like learning names of colours to learning the alphabet. Because of the generating ability of the computer pupils can hear a different story every time to keep them interested and excited.

The system could also be developed in such a way that there is no interactivity. The teacher gives the information to the computer and a story is created. In the story the characters tell the pupil for example something about the letter 'a' or the number '1'. This system could be seen as creating Miffy or Sesame Street stories on the fly.

The idea of the system is based on autonomous agents, like the Virtual Storyteller system [TFNH03]. Because of the dynamic story creation this system is able to create many different stories. It is possible to put different agents with certain characteristics, like emotions and goals in all kinds of settings. This is one of the advantages why this system could be used to create this application. Children could even create their own character to play in their story. It is possible to create different kinds of narrators. A traditional narrator is one of the possibilities, but a narrator who also would be able to show pictures or even movie clips could be developed to make the experience more compelling.

The developers[1] of the system indicated that it should be possible to use the Virtual Storyteller [TFNH03] for such a kind of application. They said the biggest difficulty would be to create a presentation-agent who can tell the story in such a way that it becomes compelling. The problem is that a way has to be found to turn the actions of agents in the world they live into a coherent and interesting story. After this the story has to be presented. The easiest way is to let a virtual traditional storyteller tell the text-based story. It would be more complex to create pictures or a movie, because an extra step has to be taken. The text-based story then has to be translated into pictures or movie clips.

The developers told that the system could be developed in the long run, but it will take several years or more to complete such a kind of application.

3.2 Secondary School
Edutainment [SEMWC04] could be used for creating an educational application for secondary school. An example, which you can use it for, is history class. A pupil could go visit Rome in the time it was a mighty empire and walk virtually through the streets guided by a virtual guide, which tells about the history of Rome. Because the student can walk freely through the city the guide has to presents the cultural and historical content through non-linear storytelling techniques. Of course the application could be implemented for a wide variety of important historical events and times.

Another application that could be developed for secondary school is a system that is able to create small scenarios where pupils could practise their foreign languages. Pupils, for example, could be placed in scenarios like finding your way from point A to B or doing shopping in the supermarket. The system can create scenarios on the fly, depending on which

situation has to be practised. The presentation of these scenarios could develop in the future. At first behind the computer talking through a microphone and interacting with digital people on the screen, but in time this could develop to 'really being there' for example with the help of virtual reality.

The first application suggested for is based on the Edutainment [SEMWC04] system. The system gives visitors a virtual tour through a museum about the culture of the Peranakans, who represent an important part in the history of Singapore. The application is limited to this museum, but is should be possible to make a system that is capable of showing different kinds of museums or sites for other subject or locations like World War II or ancient Rome. The digital storytelling is important for this application in the way that the virtual tour guide is of assistance to the pupil. The pupil has the opportunity to ask questions to this guide and the guide will answer with the help of non-linear storytelling techniques. The use of digital non-linear is important, because of that pupils do not have to walk a predefined tour and hear a story that is the same for everybody. At this point only the virtual tour guide can be questioned to tell more about the object. To make it or more educational experience an extra feature could be added to the tour guide and let him ask the pupil about historical facts and figures.

Another project, which is also interesting for this application, is the "GEIST"-project [KSS01]. The "GEIST"-project uses digital storytelling techniques to let virtual ghosts tell about the location or site somebody is standing. For this system an extra feature could be added as well and let the ghosts ask questions to pupils about the location or site.

The system to practise language skills is based on the Interactive Storytelling Engine [CCM04]. In the Interactive Storytelling Engine autonomous characters live in a virtual world. All of these characters are fully rendered in 3D and live in a 3D world. It is something like the Virtual Storyteller only more focused on graphics instead of creating a text-based story.

The suggested projects to create the educational applications with prototypes are already developed and tested. The suggested applications could be develop in a few years using the techniques and prototypes of these projects.

3.3 College
The idea behind the Holodeck [HOLO01] or the mixed reality system [CMN04] could be used to simulate real life situations. These simulations could be used to train students. One example would be the training of the doctor-patient relationship. Virtual actors driven by a digital storytelling engine could simulate patients, which students have to diagnoses by talking to them. Another example is training students for project work. Often project groups have to work for a client. A virtual actor could also play this client with a storytelling engine.

Another approach is using digital storytelling for simulating certain real-life scenarios so that student can see what happens. This could be for example being applied in sociology, epidemiology [BES05] and business/management. A digital world with autonomous characters could be set up. When the world is started every characters has it owns goals and tries to reach those goals with certain actions. These actions have influence on other characters and the world where the characters live in. When the simulation is stopped at a certain point the system can show how and why everything is evolved in a certain way.

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The two examples for participating in simulated real-life situations are only a small suggestion how virtual actors could be used. The system that could be developed around this idea could offer a whole range of applications where people can train their communication skills in the situation they want like a meeting, presentation or job interview. The virtual actors could be presented on a computer screen or to make it more real using a HMD (Head Mounted Display) or the system of [HOLO01] so that the experience becomes more real. Mixed reality offers a different experience by placing yourself into the virtual world.

The system to simulate real-life scenarios to learn more about what would happen if these scenarios would take place is based on the Interactive Storytelling Engine [CCM02] [CCM04]. Because of the use of autonomous characters and the possibility to give them emotions and goals real-life situations could be fairly good simulated.

Digital storytelling is used in these applications to create scenarios, which are interesting and useful for the student. Also the digital storytelling has to be used to give the virtual actors a compelling way to tell their stories and be able to tell their stories in different ways, because of change in their emotion or situation.

The suggested applications are based on systems that are in development and all have prototypes. The developers[2] of the Interactive Storytelling Engine [CCM02] [CCM04] said that applications for education could be available in a few years.

4. INTERVIEWS
All the suggested applications may sound applicable and good innovations for education, but there is more to a success of digital storytelling in education. For a system to be successful first of all there have to be people who want to create such a system. Secondly it has to be used by the people it is meant for. To get an idea if there is interest in applications of digital storytelling a small number of people involved in education like students and teachers and people developing digital storytelling systems were interviewed about their opinion of the usage of digital storytelling in education. To get a more accurate view on the interest in digital storytelling systems in education real market research should be carried out.

4.1 Developers
Three developers[3] of applications of digital storytelling were interviewed. They all acknowledged that digital storytelling has two big markets. The first one is entertainment and the other one is education, but they gave to understand that it is hard to draw a line between those two. The question is where education stops and entertainment begins. Actually it is so hard a new term 'edutainment' has been introduced to give certain systems a label. Another example of edutainment is games, normally only for pure entertainment can also be used to educate [JKST03] [MR04] [AA03] [JG04]. The numerous research projects [HOLO01] [SEMWC04] [GC97] [CR01] [KSS01] [MR04] [BES05] that are using digital storytelling in applications for edutainment/education and the opinion that education is one of the two big markets shows that developers have believe in a future for the use of digital storytelling in education.

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[3] Cavazza, Prof. M.O. (m.o.cavazza@tees.ac.uk), Theune, dr. M. (m.theune@ewi.utwente.nl) and Swartjes, I. (swartjes@cs.utwente.nl)

4.2 Teachers
The five teachers (one primary school teacher, one secondary school teacher and three college teachers) that were interviewed were curious about the possibilities digital storytelling can offer. Not one of them was afraid that digital systems, including digital storytelling systems, will replace teachers in the future, but most of them see a different role put aside for teachers. They see themselves more in a roll of student-advisors then as an old-fashioned teachers standing before the class in the future. As for the application of digital storytelling they see a new, more varied possibility of offering practise and training to students. They also see the advantage of a more engaging and compelling experience this way if digital storytelling is used. They noted that it is important that the systems are developed with the focus on education and are user friendly and easy to work with to prevent frustrating situations where systems do not work.

4.3 Students
Six out of the eight students (two secondary school students and six college students) that were interviewed reacted enthusiastically about the idea of using digital storytelling in education. The other two were more reserved, but acknowledged the advantages of using digital stoytelling. When confronted with the suggested applications the first reaction was mainly astonishment that it would really be possible to create such applications. After explaining what research is going on and what systems are in development they understand that these kinds of applications can be developed. The advantage students mostly see is a new and more personalised way of practise and training, but the students made clear that it is important that the applications should be realistic in such way that it is really helpful to use them and not only a gimmick. The applications also should be easy to use.

5. ADVANTAGES USING DIGITAL STORYTELLING IN EDUCATION
Digital storytelling will certainly offer new ways of educating people, but an important question that has to be asked is if digital storytelling could also improve the standard of education. In this section advantages of the use of digital storytelling are listed.

5.1 Variation
The first advantage of digital storytelling is an obvious one. In all the examples given digital storytelling can offer more variation then traditional practising methods. Because of the generating power of digital storytelling no story or scenario has to be the same. This gives a big advantage, because once an application is developed it can be used over and over again by pupils or students without becoming repetitious and boring.

5.2 Personalisation
One of the major advantages of the use of digital storytelling is that education can become more personalised. Systems could be developed in such a way that the level of education can be adjusted to the level the person using the systems needs. The suggested system to practise languages on the secondary school could be developed in such a way that a person with certain language skills will be placed in scenarios were their skills will be tested on the right level. With better skills the student will be placed in more complex and difficult scenarios, but also the story creation could be personalised. The suggested system for children to learn the alphabet could be personalised in such a

way that children could choose what kind of characters will play in the story, where the story takes place and so on. The story can be made in the way they think they will like it the most. It is likely then that they will enjoy the story and this will cause more attention, because people tend to have a lot more attention for a story when they enjoy it [GJ04].

5.3 Compelling

A third advantage is that if a story is told in a good way it is compelling. Compare it with good book; when you are reading an interesting and exciting book you are sucked into the book and before you now the story is to an end. The use of digital storytelling in education can be a way to make explanation or practising of certain topics more compelling when supported by an interesting story [GJ04].

5.4 Real life situations

Another advantage is the possibility to create real life situations in an easy way and cheaper way [HOLO01]. If we look at the proposed system for practising the doctor-patient relationship normally a teacher will take the role of a patient and the student has to try to diagnose the patient. If we could replace the teacher with a virtual actor driven by a storytelling engine the student could be placed in a more and different real life situations. The virtual actor has a 'story' to tell and can tell this in many different ways. The system could be developed in such a way that the virtual patient can be given certain characteristics like mood, problem and age. In this way the student can be trained for many different situations. For example people willing to tell their "story" and being friendly to people with vague complaints and being cross.

5.5 Engaging

An advantage as well is the opportunity to arouse the interest and engage students by using applications of digital storytelling. For example the suggested application for history class, the introduction of the subject-matter can be done by first letting student virtually visit the museum or site about the subject-matter. After visiting students can visualise better how things were and could become more engaged by the stories they have heard.

5.6 Active learning

Research has shown that active learning is a really effective way to learn subject-matter [AM92] [MR04] [JG04]. Digital storytelling systems can offer diverse interactive learning systems and improve the involvement of students in the process of learning. In all the suggested applications of digital storytelling interaction is important and makes the student to participate in the system and learn the subject-matter by doing.

6. DISCUSSION

To use digital storytelling in education sounds promising, but it takes more to make applications of digital storytelling successful in the field of education. In this section some notions will be made about things to have to be taken into account if systems are going to be developed.

Probably the biggest risk is that the experience itself takes over the goal of the system namely 'to educate'. It must be insured that the entertainment aspect of the system does not supercede the educational aspect. To find a good balance between education and entertainment systems should be developed in close collaboration with teachers.

It also has to be made sure that systems are developed, because they offer something extra to education and not only because it is possible to create such an application with the technology that is available.

Another risk is that if a system is developed the stories that it produces might not be interesting. Then the same thing will happen what happens to bad books, the system will be put away quickly. That is why the development of such systems should also be developed with people who have knowledge about storytelling and the aspects that are needed to create interesting and good stories. The presentation of a story is also important, but the story self comes first. It is like reading a book, when the story is good you can visualise it yourself. People can have a compelling experience with a good story and basic presentation. A book like 'The Da Vinci Code' [DB03] or an old movie like 'The Seven Samurai' (1954) [IMDBSS] are highly praised, not because the great visual aspects, but because the great story.

7. CONLUSION

Research has shown that people learn better if they see, hear and do simultaneously rather than only hearing or seeing something [AM92]. Digital storytelling, artificial intelligence and graphics technologies can be combined to create systems to take advantage of this. With the ongoing progress in these fields it is becoming more and more interesting to use these technologies for creating systems with educational purposes.

With the help of some examples I have tried to show how digital storytelling could be used in education and which advantages it can give. The use of digital storytelling could make practise and training for students more diverse, personalised, compelling and realistic. It also offers a new way to arouse interest and engage them.

All the groups of people who are needed the make a success of digital storytelling in education are positive about it. Researchers believe in a future for it and students and teachers acknowledge the new possibilities digital storytelling could offer.

An important note is that systems should be developed in close collaboration with teachers to create a good balance between entertainment and education.

It would be great if creating stories with digital aid would be as easy as told in [RD96], but unfortunately things are more complex. So before the conclusion can be drawn that digital storytelling has a future in education it first has to be seen if computers are capable of creating interesting and compelling stories.

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