Children's narrative development through computer game authoring

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ABSTRACT

Recent research into the educational applications of computer games has focused on the skills which children can develop while playing games. Various benefits of computer game playing have been recorded, such as increased motivation; development of problem solving and discussion skills; and improvement in aspects of story writing. While encouraging children to *play* appropriately designed computer games can be used to enhance their learning, enabling children to *create* their own computer games offers a further range of learning opportunities. This paper describes a workshop in which young people learned how to create their own computer role- play games for their friends and family to play. The purpose of the workshop was to give the young people an opportunity to tell stories in the medium of a computer game, and to develop narrative skills such as character creation, plot planning and interactive dialogue writing. Results from this study are used to illustrate the educational benefits of computer games authoring, and to suggest directions for future research in this area.

Keywords

3D virtual reality environments, story creation, computer game design

INTRODUCTION

Playing computer games is an extremely popular leisure activity for children. Young people are willing to devote considerable amounts of their time to playing games. For example, a recent UK survey reported that 53% of eleven to fourteen year olds play games four times a week or more, and that 44% play for more than one hour at a time[8].

Based on the popularity and strong motivational effect of computer games among young people, educators have started to consider how games can be used in educational settings. In a study conducted by the "Teachers Evaluating Educational Multimedia" organisation, parents, teachers and pupils were asked what they thought children could learn from playing computer games [8]. 85% of parents interviewed said that they thought that their children learned something from playing computer games, identifying skill development in areas such as decision making, design, strategy, co-operation, and problem solving. After integrating selected computer games into their normal classroom teaching, teachers were asked to evaluate the learning outcomes from using the games. They reported that the children rarely gained knowledge from the game content which was directly applicable to other areas of the curriculum. However, they did find some games useful as a stimulus to other creative activities, such as writing stories about popular game characters or scenarios. The teachers also valued the skills which the children developed directly from playing the game, or indirectly from working in a group on a game playing task. Problem solving, sequencing and deductive reasoning skills were used while playing the game; peer tutoring, co-operation and collaboration skills were developed as the children interacted with their peers around the computer. The benefits of team work associated with playing computer games were also identified by the pupils who took part in the study.

As well as developing the problem solving, reasoning and team work skills described above, computer games can be integrated more tightly with specific domains within the curriculum, for example, literacy and narrative development, the subject of this paper. Literacy development, particularly the improvement of writing skills, is a high priority within the UK education system As many pupils find writing a difficult chore, an important task in writing instruction is to increase motivation. A related problem is writing apprehension –

some pupils dread writing assignments because they find them so difficult and have had negative feedback during writing experiences in the past [10].

In classroom instruction, the written word is often the only medium in which children have an opportunity to create their own stories. Given the central importance of narrative as a mode of thought [2], it is unfortunate that difficulty with writing often prevents children from expressing their thoughts and feelings in narrative form. We use narrative thinking to make sense of the world, and our place in it. Creating a story is an opportunity to exercise the imagination; to explore thoughts and feelings; to celebrate our memories and see into our futures. Experiences with helping children to create stories to tell orally suggests that they have a wealth of story ideas which they enjoy sharing with other people. It is also clear that written language can act as a barrier for some children, preventing them from developing or enjoying ideas [11]. Enabling children to express their ideas in a non-textual medium gives them the opportunity to exercise their imaginations and produce an artifact which can be enjoyed by an audience. Successfully creating something which can be enjoyed by other people is rewarding, and has a positive effect on self esteem.

This paper goes beyond the state of the art by considering the benefits which can be gained from enabling children to create stories in the medium of interactive 3D virtual reality computer games, with reference to previous research and currently available software packages. We focus on a study in which ten teenagers created their own stories using the computer game authoring tool available in a commercial role-play game, *NeverWinter Nights*. The games creation process, including preparation work away from the computer, is explained with emphasis on the narrative aspects of the games. Findings from interviews in which the workshop participants reflect on their experiences are reported, and implications of these findings are explored. The paper concludes with some suggestions for future research.

INTERACTIVE NARRATIVE IN COMPUTER GAMES

Interactive fiction offers the reader a choice of paths through a story. Children's adventure books which ask the reader to decide what they think the characters should do next, and then to turn to different pages to read the next installment, are examples of textual interactive fiction. Early computer adventure games were also a form of interactive fiction. Players/readers of these games traversed a world described in text by choosing where to go, what to do and who to speak to. Previous research has shown that writing interactive fiction for textual computer games has a positive effect on children's writing skills because children find it extremely motivating [1][13].

More recent computer games are examples of stories in interactive 3D virtual reality narratives. Users choose their own path through the virtual world by deciding how to respond to the situations they encounter. Ghostwriter is an example of such a computer game which was designed specifically to improve children's story writing skills [10][11].

Ghostwriter is a 3D graphical virtual environment implemented using the Unreal Engine, a commercial computer game engine. During a Ghostwriter role-play session, pairs of children engage in computer-mediated role-play, with each child taking on the role of a character in the story. A (human) role-play leader plays the part of the other story characters, and in role, encourages the children to become emotionally involved in the story and discuss difficult decisions with each other. After the role-play session, and a discussion about the experience, the children write stories based on their adventures in the virtual world. Results of field studies with ten- to- twelve-year-old children showed that children are highly motivated by Ghostwriter and form relationships with each other and the game characters [11]. The stories they write afterwards contain more portrayals of characters' relationships, especially through dialogue [12].

Ghostwriter was positively received by the teachers who saw it used. They could see the benefits of the activity on the children's motivation and self esteem, and noted that this motivating experience seemed to have generally improved the behaviour of some of the children [10]. The study reported in this paper builds on the Ghostwriter research by examining the educational benefits of *creating*, rather than experiencing, stories in computer games.

CONSTRUCTIVISM AND COMPUTER GAMES

To date, children have been unable to create interactive narrative in 3D computer games, because of the programming and advanced mathematical skills involved. The technology has only now reached the point where children could create stories in 3D virtual worlds, and we think this is an extremely important landmark from the point of view of research and education.

Firstly, these changes in technology allow children to fully realize their ideas for an interactive audio-visual story and to develop a final product. An endeavour such as the Game On exhibition website (http://www.gameonweb.co.uk/education/) provides a wealth of information to help teachers lead children in the activity of *designing* a game, but the implementation of the game remains out of reach of the children because of the technical sophistication required. We feel however that being able to create a product which is usable by others, and which can be critiqued and revised, is an important part of the game design process from an educational point of view.

From a motivational perspective, children have high expectations as to what constitutes a good computer game based on their experience with commercially developed games, many of which have taken hundreds of person years to develop. If we are to use games in education, and expect them to motivate children, they must be of high quality, otherwise their effect will be lost [3].

Finally, while there is increasing research into the benefits of playing computer games (e.g. [4], the Games to Teach Project (http://cms.mit.edu/games/education/) and the Education Arcade (http://www.educationarcade.org/) many in the educational field are still looking to computer games to provide extrinsic motivation for traditionally unpleasant subjects, and see children as game consumers, therefore adhering to an instructionist view of games in education.

There is much less research from a constructivist/constructionist perspective, where children create their own games, with the notable exception of Kafai [6], [7]. However, in the relatively short time which has elapsed since Kafai's research on children and game design, the technology has evolved considerably. Previously, game design has required substantial amounts of programming. While this is a laudable goal in itself, and likely a very motivating way to learn programming, we are only just now at the point where we can look more fully at the other types of skills involved in computer game design, particularly at the development of narrative skills and literacy. By having environments in which interactive 3D audio-visual narrative can be created through user-friendly interfaces and minimal scripting, rather than having to learn a programming language, children can focus on literary concepts such as creating gripping plots, believable characters and compelling settings.

CREATING INTERACTIVE 3D NARRATIVES

As described above, creating audio-visual computer games has until recently been a task which required programming and 3D modelling expertise – skills the general public do not usually possess. There has been an increasing trend in the games industry towards selling games editing tools along with commercial games to encourage skilled members of their user communities to develop further (free) content for other players to use. Additional development by a user community keeps a game popular even after most players have played the original game content. In 2002, the role-playing game *Neverwinter Nights* released the *Neverwinter Nights toolset*. This toolset can be used by non-experts to create characters, settings, and interactive plots. No knowledge of 3D modelling is required, and basic tasks can be completed without any programming skills. More advanced game features require the creator to learn some commands in a scripting language.

Figure 1 shows the use of the *Neverwinter Nights* toolset. In the middle of the screen, the area in which the story will take place is represented as a view from above, with a grid superimposed on it. The game designer can choose from a range of objects on the right hand side and place them in the area. In this case, a campfire has been placed, and is outlined in light green.

On the left hand side of the screen, the game designer can create conversations and write scripts for more sophisticated behaviour.
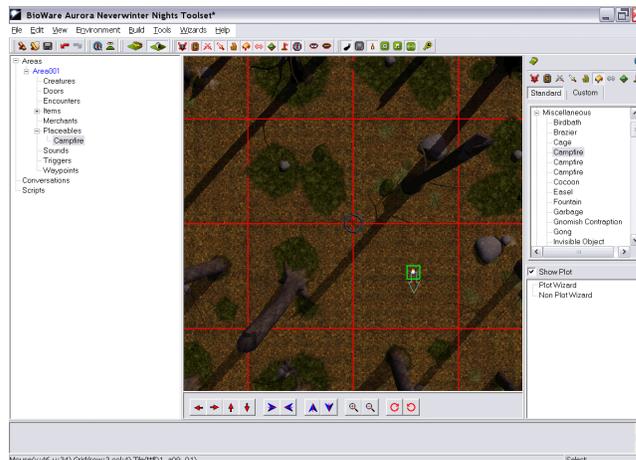

Figure 1: Inserting a campfire on an area using the *Neverwinter Nights* toolset

The *Neverwinter Nights toolset* is a valuable research tool for exploring the educational benefits of computer game authoring. Indeed it represents a very important landmark in the study of computer games in education as it allows researchers to look at the creative aspects of computer game design by young persons, a subject about which very little is known to date.

The following section describes an initial study into computer game design. The work was carried out during a four-day workshop with a group of teenagers and represents, as far as we aware, the first research study which investigates the creation of 3D role-play games by young people. .

THE GAME MAKER WORKSHOP

The Game Maker workshop was part of Edinburgh City Council's Go4it summer holidays programme 2003, and was advertised as being open to all secondary school pupils in communities around Edinburgh. The workshop took place over a period of four days in the computer lab of an Edinburgh secondary school.

The aims of the project were to:

- Give young people an opportunity to tell their own stories in the medium of computer games;

- Explore the possibilities of computer games creation as an approach to developing literacy skills;

- Discover the strengths and weaknesses of the computer games authoring tool *Neverwinter Nights toolset* as an educational software package, with a view to developing a custom made educational games authoring tool as a software research project at Edinburgh University.

The workshop participants were nine boys and one girl aged between twelve and fifteen years old. The workshop leaders were the first author, a visual artist, a professional storyteller, and an experienced amateur games designer with considerable experience using the games authoring software, *Neverwinter Nights toolset*.

Throughout the workshop, face to face story planning activities were interspersed with game creation tasks at

the computer. The workshop culminated with an opportunity for the young people to play each other's games, and participants took home the games and other artwork they created during the workshop. One week after the end of the workshop, the games were showcased at the Museum of Scotland's public games exhibition as part of the Edinburgh International Games Festival. The workshop participants were invited to this event with their friends and family where they demonstrated their games to the general public.

Workshop activities

The workshop was organised around a series of activities as discussed below. The early workshop sessions aimed to assist the young people in developing storylines for their games using techniques which the authors have successfully used in other storytelling media.

Group discussion about games

On the first day of the workshop, the storyteller and researcher led a discussion about the sorts of games that the young people enjoyed playing at home, their favourite game characters and why they liked them. The researcher then explained what the workshop would involve. This discussion was a good ice-breaker, as the young people were keen to share their opinions about gaming.

Initial trial of Neverwinter Nights game

Before planning the storyline or characters for their game, the young people were introduced to the technology they would use. They spent thirty minutes playing the tutorial level of the *Neverwinter Nights* game in order to familiarise themselves with the sort of game which the toolset would allow them to author. This led onto a critique of the tutorial, and a spontaneous discussion of principles for good game design. It was clear that some of the young people, particularly the older boys, had spent some time thinking about these issues on previous occasions.

Character design

The young people were then asked to design characters for their games. They drew pictures of the characters' physical appearance and wrote notes describing their motives, personalities, missions within the game, and other background information. This activity lasted for around thirty minutes.

Character model making

Once the participants had decided on their characters, the artist explained how to make three-dimensional models of them. The artist prepared a selection of wire skeletons for the models based on the creatures available in the *Neverwinter Nights* toolset. The participants each selected a wire frame which was suitable for their character. The models were built up by layering plasticine on top of the wire frame to make heavy, solid bodies.

The artist demonstrated techniques to make the characters more life-like, and then facilitated the creation of three sets for storyboarding: a river, castle and a graveyard. This session with the artist lasted for around four hours.

Plot planning

On the second day, the young people split into two groups. One group planned stories in the morning and created games in the afternoon, while the second group did the opposite. In the plot planning activity, each of the five participants started with their model and a blank sheet of paper. They wrote down the first plot episode in the game which would include the character they had created. Each participant then moved one place to the right, where they read the plot episode and decided what should happen next. They wrote this new episode before moving on again. In this way, the young people helped each other to brainstorm ideas for a plot. This activity took around forty minutes.

Storyboarding with digital cameras

The next stage of story planning was to pose the character models in the stage sets to represent each plot episode. The young people split into pairs to help each other to pose the characters and take digital photos of the scenes. Once photos were taken for every scene in the story, the participant imported the photos into Microsoft Powerpoint. The photos were arranged into a storyboard with captions underneath to explain each scene. The time spent on this task varied from around twenty minutes to an hour.

Game authoring using the Neverwinter Nights toolset

The participants explored the *Neverwinter Nights* toolset at their own pace. The games expert was available to answer individual questions as they arose. Participants tended to start by exploring the facility for creating areas, and for creating characters. Having mastered the basics, they wanted to learn more advanced tools, such as joining two areas together with portals or doors; how to make interactive conversations; how to make merchants sell items to a player; and how to use the plot wizard to make quest storylines. Once participants mastered a technique, they would often volunteer to teach it to others. The group adopted an informal testing strategy of playing each others' games after incremental changes. On the last afternoon of the workshop, the participants decided to play each others' games collaboratively using multiplayer mode, which allows more than one player to participate in each game at the same time. The time spent on game authoring varied between participants from around ten to thirteen hours.

Reflecting and planning

On the third day of the workshop there was a group activity where individuals reported on their progress and planned what to do for the rest of the workshop. The participants filled in a graph to estimate how much time they had spent using toolset features including: making areas; creating characters; using the plot wizard and creating conversations between characters. The most time consuming activity for five of the young people was creating areas, while the other four had chosen to spend their time on different aspects of the game.

In addition to charting their progress with the toolset, the participants were asked to plan how to spend the rest of their time with the toolset. All of the participants indicated that the highest proportion of their total time would be spent creating areas, although some considered creating conversations and characters almost as important. Some of the participants elected to spend more time on the activity which they had previously spent most time, emphasising the value they placed on that activity. Some people additionally decided to even out their efforts by spending more time on previously neglected activities, or beginning activities which they had not yet tackled.

INTERVIEW ANALYSIS

On the last day of the workshop, the participants were interviewed individually. The interviewer asked a series of questions relating to the young people's computing background, their opinions of the workshop activities, and their experiences with the *Neverwinter Nights* toolset. The interviews lasted for 15 minutes on average. These interviews were videotaped, and later transcribed. This data gives insight into the workshop from the point of view of the learner, and is useful both for developing workshop activities for the future, and for evaluating the features of the *Neverwinter Nights* toolset.

Prior Experience

All of the participants reported having a computer at home (with some having up to three). All had played games on the computer, and some participants also reported playing games on games consoles. The nature of the games varied, from the *Sims*, to *Warcraft 3*, *Age of Mythology*, *Harry Potter and the Philosopher's Stone*, *Theme Hospital*, the *Age of Empires*, a WW II flying game and solitaire.

Three of the participants had some experience in using software to design games (for example, making terrain, placing characters on a map, etc.).

Workshop components – plasticine model making

One of the components of the workshop involved the use of wire frame models and plasticine to build characters for the game. Reactions to this activity were varied, although almost all were positive. It was evident that many of the participants enjoyed the experience itself, but not all found it of use in terms of game design.

Three of the participants did find the experience useful for visualizing their characters and getting a better feel for what they would look like. On the other hand, six participants expressed clearly the idea that the *Neverwinter Nights* toolset imposes restrictions on the physical appearance of the characters, whereas the creation of plasticine models allows almost limitless possibilities. A certain number of character models had to be abandoned because corresponding characters could not be found in *Neverwinter Nights*.

One participant noted that although his plasticine model character didn't make it into the game per se, his mind and personality did. This suggests adding a pre-game design activity which focuses on the personality and motivations of a character in addition to physical characteristics.

In terms of the organization of the workshop, this also points to the need to have participants become familiar with toolset options (and restrictions) before going too far in the model making process. In terms of game design software, more flexibility in terms of character creation would be a desirable feature.

Workshop components – game design

When asked about the aspect of game design they enjoyed the most, "creating the characters" was most popular (6 responses). The second favourite design activity was creating the areas (5 responses). This is encouraging from an educational point of view, as it suggests that participants enjoyed those aspects of game design which share characteristics with the design of plays and other types of drama.

Of the things participants enjoyed the least, the plot wizard was mentioned most frequently (4 responses). The plot wizard is a feature of the *Neverwinter Nights* toolset which guides users through the process of creating a story within the game. The type of plot is very limited – most participants used a plot type where the player must collect an item for a character in order to earn a reward. Following the steps within the wizard requires the user to specify dialogue between the character and player. Most participants stated that it was not difficult per se, but that planning out the conversations was tedious, as was having to click through all the different screens in the wizard.

Story Planning

An important issue which arose from the interviews involved the pros and cons of planning out a story in advance before using the game design toolset, or simply letting the story evolve while using the toolset. In traditional pen and paper based story writing, students are encouraged to plan out stories in advance, using text-based techniques such as outlines, or graphical methods, such as mind maps. On the other hand, game design imposes different constraints, and a number of challenges. It is more akin to planning a play or a film, and requires thought about the visual aspects of characters and settings in addition to the narrative structure of the plot. Furthermore, interactive non-deterministic dialogue based games of the type which can be created in *Neverwinter Nights* compound the planning process, as game designers must think of a number of possible ways in which the plot could evolve, depending on the answers chosen in multiple choice conversations.

In considering the question of whether to plan out a story in advance, or let it evolve, opinion seemed to be more or less evenly divided.

Reasons given for planning out the plot in advance included:

- If the plot is already planned out, it frees the game designer up to spend time adding extras and improving the look of the game;

- It's better to plan in advance so that the game designer can concentrate on the toolset, rather than making lots of mistakes and having to delete things.

- Planning is helpful, otherwise the game design process takes longer.

- If the story has been planned in advance, "people get a sense that you know what you're talking about".

- Planning gives a clear structure to the game, with an obvious start and finish, rather than a series of multiple quests.

Reasons stated for letting the game evolve during the game design included:

- If the game is completely planned out, it may be overly rigid.

- Even if the plot were completely planned in advance, it probably would change during the game design anyway;

- Although there's more scope for "doing just anything", if you stick to a plan too rigidly, you may limit your creativity by not including good ideas as they occur.

- Letting the game evolve as you go along is easier if you are getting used to the interface (note that this is diametrically opposed to a comment made above on the benefits of planning).

- It's interesting to "go for it" and see what happens.

Use of the Toolset

Overall, feelings about the toolset were positive. As one participant pointed out, the toolset was a "good idea. You wouldn't get to make a decent game otherwise".

All of the participants found the toolset easy to use once they became familiar with it. Nonetheless, one participant was aware that there were obviously much more difficult things that could be accomplished with the toolset that he hadn't yet tried. Another participant stated that lateral thinking was required in order to use the toolset, as it was necessary to think several steps ahead, and to anticipate consequences of actions.

The most difficult part of the toolset seemed to be the portals (5 responses). Portals can be placed within an area, and allow separate areas to be linked together. The difficulty with defining portals appears to stem from the requirement to have a unique identifier for each portal in order to specify which location should be reachable from which portal. Furthermore, this particular task requires scripting, and many participants needed help with this.

When asked if there was anything too hard to do in the toolset, the subject of portals arose again (2 responses), suggesting that these participants had not been able to master portals during the workshop. Finally, one participant wanted to have several characters follow the player around, but *Neverwinter Nights* only allows one character to do so. These comments reflect different issues: in the case of portals, the option to create them is available in the toolset, but it is difficult to do, whereas it is simply not possible to specify that multiple characters should follow the player using the *Neverwinter Nights* toolset.

Similarly, the plot wizard was seen as difficult and/or tedious to use. One participant commented that the plot wizard "gets confusing. If you click the wrong box it totally changes everything".

One of the biggest issues targeted for improvement concerned the characters. One participant pointed out that the appearance of characters could only be minimally changed. Many expressed a desire to be able to include the digital pictures of their plasticine models as portraits of the characters in the game (i.e. include a digitized still picture in their character's description). Many other comments focused around character design, and included

- Ability to do full character design, e.g. to include oneself in the game;

- Increased ability to modify features of existing characters;

- Ability to choose different faces for characters, as well as more choices of clothing;

The creation of portals was also targeted for potential improvement, for example, by having *Neverwinter Nights* automatically generate unique identifiers, or by having a drag and drop interface for portal creation rather than a wizard.

Finally, other suggestions for improving the toolset were:

- Be able to include sound recordings, e.g. include key phrases for characters;

- Increase choice of objects;

- Provide more options for present day scenarios (as opposed to "medieval" ones);

- Include the toolset as part of the game itself (currently, it is necessary to quit out of the toolset and launch *Neverwinter Nights* in order to view one's game);

- Allow the use of icons within the plot structure, e.g. to represent a quest, or a conversation;

- Include instructions on getting started.

DISCUSSION

The Game Maker workshop was the first step towards understanding the educational benefits which can be gained from enabling young people to create stories in the computer game medium. The results reported in the previous section suggest that there is valuable educational potential in this approach.

The most important benefit was, as anticipated, the strong motivational effect this workshop had on the young people who took part. During the interviews, all the young people reported that they enjoyed the experience and would continue to use the *Neverwinter Nights* toolset if they had access to it. They became engrossed in the games design task, particularly when

using the computers, and it was very difficult to persuade them to stop what they were doing to take lunch breaks. Some pupils were so keen to finish their games that they arrived early for the morning sessions, and stayed late after the afternoon sessions. This behaviour is particularly striking because this was a voluntary activity during the summer holidays when they could have been doing any activity of their choice.

A related benefit of the workshop was bolstering of the young people's self esteem. The participants were keen to have the other workshop participants play the games they had created because they valued the opinions of their friends. They were proud to show their games at the Edinburgh International Games festival to which they invited friends from school and members of their family. The younger participants seemed to particularly enjoy showing their parents their games in great detail, while the older participants spent some time helping general members of the public play their games. Some of the young people's parents took the opportunity to discuss their children's experiences of the workshop with the researcher. One mother was particularly pleased about her son's progress during the workshop because she said that he didn't like writing stories at school, yet he spoke with great pleasure about the game he was creating in *Neverwinter Nights*. She was keen for him to develop his interest in computer games design, perhaps with a view to studying it in further education.

The Game Maker study also answered some open questions about the feasibility of the computer game authoring task for young people. Creating computer games is a complex task. Until the release of simplified toolsets such as the *Neverwinter Nights* toolset, it was not possible for non-experts to make their own games because of the programming skills required. The Neverwinter Nights toolset was the first authoring environment which did not require specific technical skills. Nevertheless, there are some difficult concepts and complicated procedures involved in creating an interactive narrative, such as: planning an interactive plot; understanding how interactive dialogue is represented in the interface; and ensuring that objects such as portals have unique tags. In spite of the complexity of the games creation task, all the young people managed to create a game to their satisfaction. The games varied in sophistication, as would be expected when the authors have varied computing backgrounds and represent different age groups. All the participants but one were able to teach themselves how to use the basic features of the interface. The only girl in the group had more difficulty than her peers but she received extra help from a friend. Some participants mastered the more difficult features of the software, such as portals, after some tuition from the games expert.

Although the young people were able to use the *Neverwinter Nights* toolset to express their story ideas in game form, the software was not ideal for this purpose. The participants in the Game Maker workshop had difficulty using the plot wizard feature in the *Neverwinter*

Nights toolset. The software has no facility for showing a representation of the multiple plot threads. The conversations created using the *Neverwinter Nights* toolset did not fully take advantage of the possibilities offered by interactive dialogue. This probably results from a combination of the inadequacy of the software's user interface in supporting this task and lack of instruction on the skills required.

In addition, *Neverwinter Nights* contains a number of features which make sense in the context in which they were designed, but may not be desirable in the context of game design for educational purposes. For example, characters and settings are confined to the *Dungeons and Dragons* genre, and have a pseudo-medieval appearance. Allowing for a wider range of settings and characters would similarly expand the types of stories which young people could create. Similarly, the characters in the story possess a number of inherent features, such as skill and ability in different types of combat. Ideally, a game author should be able to create a character as a blank slate, and add personality features which go beyond the typical combat oriented scenario, for example, compassion or trustworthiness.

We are currently working on a prototype of a purpose built tool (AdventureAuthor) for creating stories in the games medium which has features to directly support story construction. The AdventureAuthor prototype will address these limitations of Neverwinter Nights by providing a visual representation to support plot planning and interactive dialogue as well as support features to guide the user through the game creation process [5]. It will also allow for a broader range of settings, and characters with more fully developed personalities. More research is required to identify how the game making process could be integrated with the curriculum in a classroom context. Obviously the community education setting of the Game Maker workshop is very different from the formal educational setting of a classroom. In spite of this, there is some common ground. The approach of combining the non-computer story planning activities with the computer game creation task could be successfully adapted for a classroom, taking into account the participants' reservations about the extent to which their character plans could be used in the final game. Teachers might prefer to use more traditional story planning exercises as a preparation for making the game, such as class discussions, mind maps or short written descriptions of the characters.

A particularly interesting area for further research is the extent to which skills developed during story making in the games medium are relevant to textual story writing. For example, experiences from the Game Maker workshop suggest that games authoring might be a particularly motivating way to teach general dialogue writing. Classroom studies are required to explore whether computer games authoring can be used as a method of motivating reluctant writers.

In addition to the general storytelling skills which are common to all storytelling media, such as developing

coherent plots, well motivated characters and convincing dialogue, game authors are likely to develop medium-specific storytelling skills. Learning how to express the emotional content of stories using sounds, music and lighting effects is a valuable part of becoming literate in the medium of computer games.

CONCLUSIONS

The strong motivational influence of computer games on children can be used positively within education. This paper looks beyond the educational benefits which children can gain as *consumers* of computer games to explore the additional benefits which could be gleaned from enabling children to *produce* their own computer games. In the domain of literacy and narrative development, creating an interactive audio-visual computer game to tell a story has many potential benefits. The Game Maker workshop described in the paper confirms that creating stories within computer games is a task which young people find highly enjoyable, engaging and rewarding. Additionally, the workshop experience suggests that sophisticated game design is well within reach of 12-15 year olds. These motivational advantages indicate that it is well worth exploring how computer game authoring can be used in the classroom to raise both literacy standards and children's enjoyment of story making activities.

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