Two Computer-Based Learning Environments for Reading and Writing Narratives

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Abstract: In this brief paper, two computer-based educational tools are described. They are designed to support children learning the literacy skills of narrative comprehension and creation. We give an overview of these tools, and then discuss the educational hypotheses that we are planning to use them to test.

Introduction

Can interactive learning environments be built that effectively support children engaged in the process of learning about narratives? A great deal of educational technology research related to literacy has focussed on language learning, but much less work has been done with regard to other aspects of literacy such as the ability to read and comprehend, and construct, narratives.

We present two computer-based learning environments for children. Both learning tools are inspired by Papert's theory of constructionism (Kafai & Resnick, 1996): the idea that the most conducive environment for learning (particularly for children) is one that is centred around the construction of concrete objects. Concrete objects are items, either virtual or physical, that can made, manipulated and tested by a learner, and then shared with his or her peers. A simple example would be an electronic interactive Christmas card delivered over the Internet.

The first package, STORYWORLD BUILDER, is a networked environment that enables children to collaboratively build virtual settings for a story, and then role-play that story. Transcripts of the children's role-playing sessions can be saved and used as the starting point by the children for writing their own stories. The hypothesis we plan to test is that children using STORYWORLD BUILDER are able to produce narratives that are more complex than they would have been otherwise able to produce. In other words, they can write better stories as a consequence.

The second package, E-BOOK MAKER, is a tool that enables children to take the text of a story from a digital library and format it into an electronic storybook. The formatting involves placing the text onto pages, choosing fonts and font sizes, adding images and colours, and so on. Once the storybook in constructed, it can be saved in PDF format, thus enabling it to be stored back to the digital library, emailed, or printed out. The basic hypothesis underlying this tool is the idea that children engaged in the active creation of an electronic storybook are more likely to comprehend the story's narrative than those who simply passively read the story.

Both software packages have been developed to the working prototype stage. We are about to commence formative evaluations of both packages in classrooms, which will lead in the very near future to summative evaluations aimed at verifying or disproving the hypotheses. The remainder of the paper describes the two working prototypes and research programs in more detail, and places this research in context.

STORYWORLD BUILDER

STORYWORLD BUILDER is a collaborative, networked environment for virtual world building and role-playing. In this section, some of the issues underlying the design of STORYWORLD BUILDER are discussed and the system is overviewed. Our plans for evaluation are then expanded.

Overview

STORYWORLD BUILDER lets participants co-inhabit a virtual story world that they themselves either collaboratively or individually design and build. A significant design decision made when STORYWORLD BUILDER was in the conceptual stages concerned the type of virtual world the participants would be allowed to construct. Typically, contemporary non-educational computer games of this type utilise realistic 3D graphics when depicting a virtual world.

This present the following conundrum when participants are expected to design the virtual world: how much effort should a player spend designing? If the world is rendered in 3D, then the player will be expected to construct 3D models, place them in the environment, view the environment from different angles in order to evaluate it, and so on. In effect, the player becomes a 3D designer. This is acceptable if 3D modelling is the primary goal of the learning environment.

However, if the virtual world building is only a part of the system's purpose, then there needs to be a compromise in order to reduce the risk that the other objectives (e.g. the educational side of the software) are not ignored or become peripheral. And clearly, sophisticated design may well be beyond some users (e.g. only the brightest 10 year old could be expected to produce a realistic 3D model of a castle).

Therefore, the decision taken was to make the graphics of STORYWORLD BUILDER as simple and underdetermined as possible. A basic 2D tile-based graphics approach is used. Participants build virtual places by laying out tiles on a virtual world that is a scrollable, shared 2D map. It takes a matter of minutes, for example, for a child to draw a house, cave, lake, or whatever is appropriate for the story that will be role-played. In order to keep the design as simple as possible, the actual types of tiles available are fixed and cannot be edited. Consequently, players have more time to spend on the other primary activity of role-playing stories.

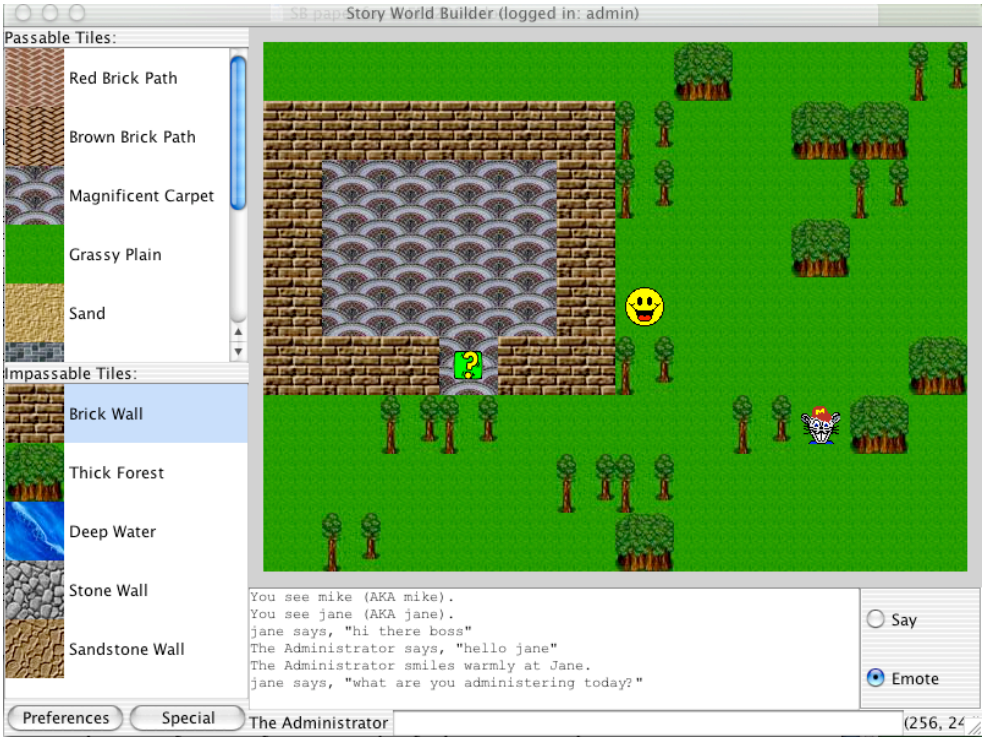

Fig. 1: STORYWORLD BUILDER main interface.

With this in mind, the main interface of STORYWORLD BUILDER is depicted in (Fig. 1). The main view, occupying most of the screen space, depicts the virtual world in 2D tiled graphics. The player, who is represented by an avatar, appears in the centre of the screen. Other players' avatars (for example, the gopher to the south-east of the player) may also appear on the map if there are other players nearby.

Communication between players follows the standard methods of communication employed in a MOO or MUD: players can speak and they can perform virtual gestures (emoting). The mode of communication is selected in the bottom right hand corner of the screen. Again, in order not to limit the flexibility of the system, speech and actions are specified using a text string, so in effect anything that can be described in words is possible. For example, if a user named `john` clicks on *emote* button and then types `jumps up and down with his hands on his head`, then all players whose avatars are nearby will see `john jumps up and down with his hands on his head`. Similarly with the say button, except that the typed text is preceded by `john says` and is enclosed in speech marks. This gives children practice at writing and reading in two contrasting modes: direct speech (via the *say* button) and descriptive (via *emote*).

The panels on the left hand side of the main interface are used for the virtual world building. There are two basic types of tiles: passable tiles, such as sand and wooden flooring, which an avatar can move over, and impassable tiles, such as brick walls and ocean, which an avatar cannot pass over.

In addition, any normal passable tile can be made into a "special" tile that contains textual descriptions that appear whenever an avatar moves onto it. Special tiles can be used to add descriptive richness to a virtual place by augmenting the graphics with text. For example, in (Fig. 1), there is a place that looks like a house. A special tile is located in the entrance-way to the house (denoted by the question mark) and therefore, whenever an avatar enters the place, the player controlling the avatar sees a textual description of what lies inside to accompany the graphical representation. Like the two modes of communication, special tiles give the participants an opportunity to practice a particular type of writing and reading skill: in this case, descriptive prose.

The preferences button at the bottom right-hand corner of the window allows a player to change his or her screen name, avatar icon and the textual description of the player that appears when another player clicks on (or "looks at") one's own avatar.

The current version of STORYWORLD BUILDER is implemented in Java 2 so that the system is operating system independent. Network communication is achieved using the Elvin content-based messaging system (Segull et al., 2000) to ensure scalability to larger numbers of users in future iterations of the software.

Evaluation Plans

An initial formative evaluation of STORYWORLD BUILDER has already begun with a small number of children from a local primary school. We hope that the formative evaluation results will enable us to iron out any usability problems and tweak the system according to feedback from teachers and students. We also hope to garner ideas for future hypotheses that STORYWORLD BUILDER could be used to test.

A summative evaluation will be carried out after the formative evaluation. We plan to test the hypothesis suggested by Robertson & Good (2003) that children writing stories as a consequence of using a collaborative role-playing system actually write better stories in terms of narrative complexity than those involved in a traditional creative writing lesson. Robertson came to this conclusion after running an experiment that compared a group of children using her collaborative software called Ghostwriter to write stories, with another group of children who had a traditional creative writing lesson. She applied a metric for the narrative complexity of stories to the results, and was able to show an improvement in the experimental group.

Her Ghostwriter system (Robertson & Good, 2003; Robertson & Oberlander, 2002) is an immersive 3D environment in which children take on the roles of characters and role-play a story. Considerable effort was expended on obtaining the 3D graphics for the system. For example, actors were hired to generate the 3D character models. This is clearly an expensive undertaking and is not likely to be feasible for the average school. It also explains why Ghostwriter implements only a single story scenario that participants are unable to alter.

We are therefore interested in investigating the question firstly of whether the sophistication of the graphics correlates to the complexity of the resulting stories. In other words, is it possible to obtain the same measurable improvements that Ghostwriter obtains using a system with much simpler and underdetermined graphics such as STORYWORLD BUILDER?

The second question we plan to explore concerns the effect of collaboration. In both Ghostwriter and STORYWORLD BUILDER, children collaborate across a computer network. However, in the control group of Robertson's experiment, children were presumably not collaborating at all when they participated in the traditional creative writing lesson. Therefore, a more telling experiment would involve children in the control group writing stories collaboratively using pen-and-paper, and comparing those results to the computer-mediated experimental groups.

Finally, a third interesting question is how learners with different preferred learning styles will use the system. For example, would players with a visual learning style prefer the graphical tiles over the special tiles? And is the converse true for players with a non-visual learning style? We plan to investigate these questions in the future.

E-BOOK MAKER

The second tool currently under development is a specialised digital library client for children called the E-BOOK MAKER. The tool enables children to format stories from a digital library into colourful electronics books that can then be saved back to the digital library and shared with other children.

Overview

Although digital libraries (Witten & Bainbridge, 2003) appear to be a promising form of educational technology, research into educational applications of this technology for young children is limited. The International Children's Digital Library (Hourcade et al., 2003) is perhaps the only well-known example in this area: it is a digital library comprising hundreds of scanned story books, with an iconic, hierarchical browsing interface designed specifically for pre-literate children. However, the library is static in that children can only browse and read the stories, and they are unable to alter them or build any constructions based upon them.

Some research into dynamic digital libraries for children is described by Theng and co-workers (Theng et al., 2001). The basic idea is that children upload their own stories and peoms to a digital library in order to share them with other children. This solves the problem of finding content for a children's digital library. However, its value can be questioned from the perspective of children learning how to read and write. Is it more efficient and effective for children to read stories written by accomplished writers rather than their peers? Another drawback of this approach was that the teachers participating in the research were adamant that submissions had to be moderated in order to prevent the propagation of grammatical and spelling errors. On a larger scale, this could be quite an inefficient approach towards digital libraries for children.

E-BOOK MAKER takes the middle ground between these two approaches. The basic idea is that story text is fixed and stored in the digital library. Children can read or download the story, but the copy in the digital library cannot be changed. They also cannot upload their own stories. However, the library is dynamic in that the children can construct their own "interpretations" of the stories by formatting the text of any story into an electronic storybook. The formatting involves making various design decisions such as defining how many pages the storybook will comprise; placing the text onto the pages and selecting fonts, sizes and colours for the text; adding images and background colours to the page; and so on.

There are basic constraints built into the system that prevent the order of the words in the story from becoming jumbled: the story text always reads from left to right and top to bottom. However, the child has complete control over all the other formatting options.

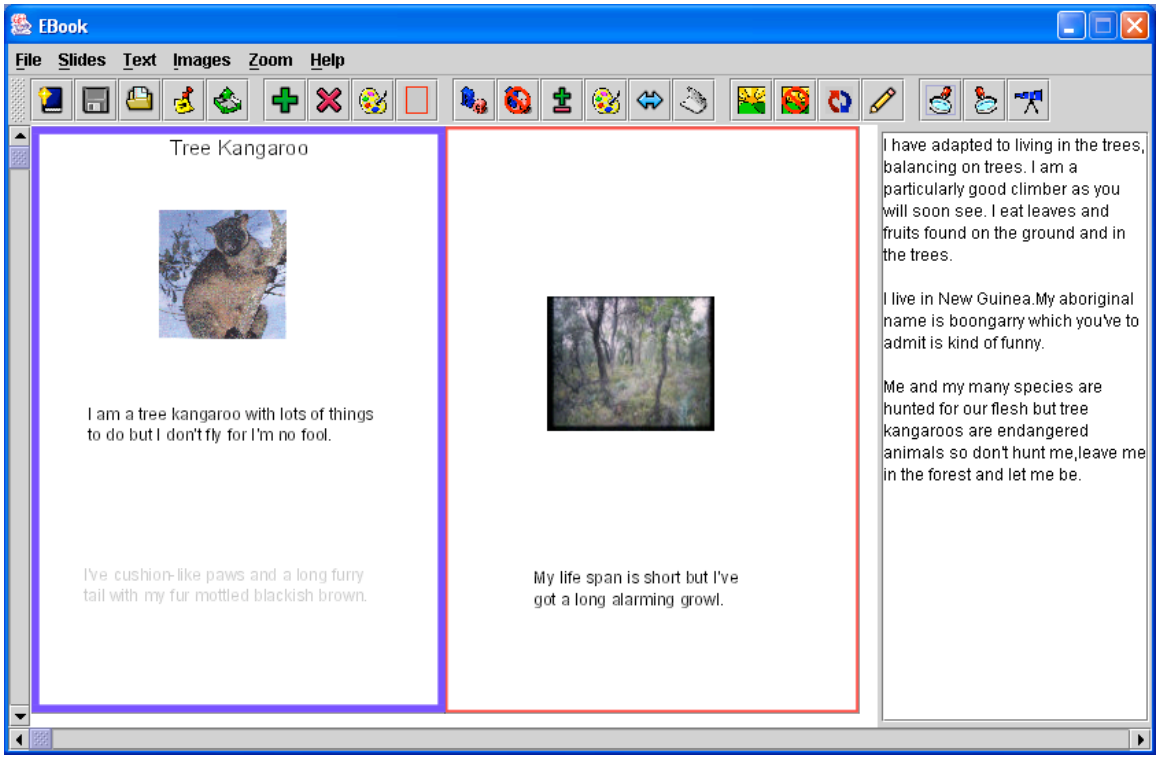

Figure 2: E-BOOK MAKER main interface.

Once an e-book is constructed, the child then has the option of saving it back to the digital library in order to share it with other children using the same library. They can also convert it to PDF format in order to print, email, or view the storybook.

(Fig. 2) depicts the main interface to E-BOOK MAKER. The current prototype makes use of the Piccolo zoomable canvas (Bederson et al., 2003) so that the user can see all of their pages laid out on the screen, and then quickly zoom in to a single page with a single mouse click.

Evaluation Plans

The main question we want to investigate using E-BOOK MAKER is whether the process of constructing an electronic book from the text of a story improves a child's comprehension and understanding of that story. Constructionist theory suggests that there should be a learning gain because an electronic book is effectively a concrete object that can be manipulated and shared. The question is whether this active type of story interpretation is more effective at producing comprehension than simply passively reading the story.

Conclusion

To summarise, we have introduced two new learning environments for children. The first, STORYWORLD BUILDER, aims to support narrative creation by having children role-play in a custom virtual world. The second, E-BOOK MAKER, is a design environment for children enabling them to transform story texts into colourful, interactive electronic storybooks. We are currently in the process of evaluating these two tools.

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