Fostering cartoon-style creativity with sensitive agent support in tomorrow's classroom

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Abstract
The Networked Interactive Media in Schools (NIMIS) project is an EU funded project based in three countries, which has designed and evaluated a classroom of the future for infants. The Computer Based Learning Unit at Leeds University, in conjunction with teachers and children has developed an application, ‘Trrific Tales’, which allows children of age 5-6 years to co-construct a multi-frame cartoon to help story-writing with the help of an empathic agent. In this paper we discuss the factors that promote creativity and how the design of Trrific Tales, used in the NIMIS classroom, is intended to help children be creative and includes the positive early results of our analysis of the stories told by the children.

Key words
Creativity, Literacy, Empathic agents, Classroom relationships

Context
This paper considers issues involved in the software development in one area of a European project, which is developing a “classroom of the future” for primary children situated in three European schools one each in Portugal and Germany and England. The NIMIS project, (Networked Interactive Media in Schools) has several interwoven aims, technological, cognitive, and social, embedded in its conception. Central to the project’s aims is the smooth interaction between human and electronic communication, the digital complementing and facilitating the human. The project team envisages the marrying of co-operative technologies with intelligent ones such as “anthropomorphic” agents and uses high technology interfaces (a large 50 inch touch screen and Wacom PL-300 tablets) in a real classrooms, with three different applications designed to encourage literacy and creative writing. Children are able to share and jointly create multimedia stories, exchange ideas, text pictures and sound. This paper looks at software being developed in the English school with which children can create cartoon-style stories using pictures, sound and text with the help of an agent. The paper is an extended version of one published on CD ROM as the proceedings of ISSEI 2000, Bergen, Norway (Brna & Cooper, 2000).

Theoretical Framework
The educational goals of the project are complex and they are all inter-related. In a sense, separating the cognitive from the social and emotional, for example, is a false division (Damasio, 1994; Goleman, 1995). Recent understanding of how the brain works, coupled with detailed understanding about the teaching and learning process (Cooper & Brna, 1999) leads us to believe that creative writing can be supported and encouraged in this software. Firstly by the structure and content of the software and also by the support of an explicit empathic agent, which can encourage and support children in their tasks either individually or collaboratively.

Implicit in the nature of creativity is an ability to be open to new ideas, to make connections between differing ideas and to try new and exciting forms of self-expression (Bryson, 1999). The challenge for teachers and educational software is to engender enough feelings of security in children that they feel confident enough to make the leaps into creativity which are involved in story writing and indeed in any form of learning. The teacher and software must offer just enough structure and intervention to allow the child to progress securely and successfully and offer enough stimulation and variety of approach so that they can establish creative links.

Stories are embedded in every aspect of our lives (Berger, 1997), from the tales we tell of our day at work or school to the stories we tell of our worst and greatest moments, embroidering the almost mundane with
excitement and charging the nearly routine with emotion. Narrative is a fundamental aspect of the human experience.

The human connections made in stories through emotional cues echo those leaps in the brain which are also closely triggered by emotional responses. Some of our most creative moments and our most lateral thinking happen when our rational brain is resting and the unconscious, intuitive aspects are allowed to mull freely (Hesten, 1995; Claxton, 1997) when we open ourselves up in a highly receptive way to deep and diverse thinking. According to Greenfield (2000) our human creativity may well be nurtured by the leaps made between the complementary but very different halves of the brain.

Damasio (1994) and Goleman (1996) emphasise the emotional nature of decision-making and Noddings (1984) highlights the receptiveness and openness needed for caring behaviour. It seems that the empathic approach needed for stimulating personal growth and development may be similar to that needed to enable creativity. The combination of security plus stimulation and receptivity to different ideas creates a fertile ground for the creative imagination.

**Design and evaluation process**

The evaluation methodology we used was first developed by Carroll and Rosson (1992; 1997). This methodology is organised around the identification and exploitation of key scenarios and uses a design rationale we refer to as pedagogic claims analysis, which involves the teachers and children from the outset. After observing creative writing sessions, discussions were held where teachers envisaged how the new technology might support creative writing in the classroom. With the help of interviews and low tech design sessions (Scaife & Rogers, 1997) children were also able to contribute to the detailed provision within the software.

Observations of existing classrooms showed children and teachers making links between the known and the unknown, between reality and fantasy, between their worlds and the worlds of others. This was accomplished by reading, retelling and discussing traditional fairy stories, with use of role-play to explore the feelings and interactions of characters within the stories. This took place within the familiar security of well-formed and affirming teacher/pupil relationships before children made their own initial attempts at story creation.

The open, non-judgmental and affirming role of the teacher is central to setting the tone for security and openness which nurtures children's self-esteem and their ability to move in and out from their own world to the worlds of others. The teacher models the attributes and creates the climate in which children are accepted and able to grow, be open and creative (Fryer, 1996).

Humour is often linked with creativity and openness and is a creative connection in itself, frequently caused by the juxtaposition of diverse elements, Laurel and Hardy, for example, or Basil Fawlty and Sybil. At the heart of humour is the contrast between image and reality, between the voiced and the unvoiced. The effect of humour on the brain is to relax it and make it more receptive, to dissipate tension and relieve anxiety. Relaxation opens up the brain to receptivity. Anger and anxiety make it hard to think freely or creatively (Broadfoot, 2000). In this sense humour is both creative and fosters a climate for creativity, in the same way that acceptance and personal interest in others creates a climate for others to accept and take interest, enabling self-esteem to grow and supporting the development of empathy.

Though young children may articulate stories verbally (Fox, 1993) they do not possess the literacy skills to translate these elaborate ideas into textual format. They need support from teachers throughout the process with words, ideas and structure and also with visual representations. This scaffolding of learning (Wood, 1988) involves careful step by step support in content, form, structure but also in emotional affirmation. The degree of cognitive and emotional support will differ for every child. However the lessons we observed where children wrote simultaneously revealed long waits for help and very gradual creation of text. Teacher support was delayed due to the high teacher/pupil ratio and high dependency of early writing. Supportive software may well buy time for the teacher and enhance this early writing process. Lessons were observed in which we modelled the software in paper and pencil form. These observations indicated that children appreciate and need considerable one to one support with their writing but at just the appropriate moment; we believe a combination of peer and agent support with speech synthesis can meet some of this need.
The NIMIS creative learning environment

The creation of T’rrific Tales attempted to embed some of these theoretical concepts and desired enhancements within the software design and to offer more support to children at this very early stage of literacy.

The software required a system that could work on both the small Wacom tablets and the large touchscreen, would support children who could not spell and could not always think what to do next, and would support collaborative work over a network. A text to speech synthesis package was chosen to help children for those who can not easily read, structured word banks were built for those who have difficulty imagining what to write or want help with spelling, and a software agent designed to take a more proactive help role.

T’rrific Tales was developed primarily in Java with some use of XML to store and structure data and utilising ETI-Eloquence, a commercial text to speech synthesis package. The user interface was built using the Java Swing set of visual components and is reasonably well adapted to both the Wacoms and the touchscreen. The children have no major difficulties with the interface but do need help available from time to time. Fortunately the arrangement of machines and equipment makes it easy for children to share their technical knowledge. The text to speech synthesiser, despite some predictable inadequacies, proved fascinating to the children and has helped them to associate sounds with unfamiliar text. The implementation of the agent is too premature to comment extensively, but the word banks are well developed and have proved very useful to the children, though time consuming to build. An application was constructed to make this task much easier.

T’rrific Tales is different from many previous writing environments because of the combination of distributed story construction, multimedia stories, text to speech, word banks and agent support designed to support children aged 5-6 years old. Few distributed applications exist for the classroom, and while the notion of a ‘writing partner’ (Zellermayer, Salomon, Globerson & Givon, 1991) is relatively familiar, we were faced with a markedly different set of problems when seeking to help 5-6 year olds. For example, affirmation is essential if we are to succeed. While children are beginning to be taught the language of stories (they must have a beginning, middle and end) they are scarcely very proficient in talking about stories in this way. Nevertheless, we have considered that developing a set of pictures may well be usable as a form of plan. However, initially, children can scarcely write more than a few words so our first priority was to encourage them in their first steps. In itself, text to speech may not be novel but research does suggest that text to speech help children to write longer stories, revise more, and enjoy writing more (Borgh, 1992).

The software allows children to select pictures from both familiar and fantastic scenes to encourage the links between the secure and the more imaginative. Children can choose props, scenes and characters from home and school or from fairy tale or space scenes. They may stay with the familiar, but may equally mix and match the objects and characters so that for example, the witch can cast spells in the school. Equally a baby in a cradle can wave a magic wand or the head teacher can forget how to spell. They can create a picture with text beneath and can use from 1 to 6 frames to create the sequence of their story. They can also add speech and thought bubbles, which allow for creative contrasts between thought and action and between covert and overt communication. In addition to the pre-drawn pictures they also have a paint palette which enables them to add their own.

This ability to mix the familiar and the novel, the past, present and future enables children to use their imagination and to challenge and confront existing norms and stereotypes, to change power relations and also to have fun and enjoy their writing. These challenges are also built into the textual ideas and suggested by word banks which can be heard using speech synthesis. The prince, for example, may be a traditional hero, sporting swords and fighting evil or he may still take his teddy bear to bed with him and wear smelly socks. The word banks suggest that he wishes that he worked in a supermarket rather than being prince. The princess may be rescued traditionally by the prince or take the role of rescuer herself. Alternatively she can dream of riding off on her motorbike, mixing old and modern themes and traversing traditional gender boundaries. The knight may fight a battle or protect the king but secretly he longs to be a dancer.

In the word banks children can find story titles and story starters to set the tone or scene, and also story stirrers which link ideas with an emotional element, for example, ‘suddenly...’ or ‘as if by magic...’ as well as exciting events and examples of endings. They can also access a word bank of feelings to add excitement and emotion to their characters.

The software is designed to utilise normal human interaction and discussion. Collaboration and perspective taking are encouraged in various ways in the classroom by the equalisation of relationships and by encouraging a more empathic climate where children have higher status, increased autonomy and are involved more actively in
learning, supporting each other in their tasks. The teacher can move into a facilitator role and children can also move into this role in relation to peers. The NIMIS classroom was especially designed to support this equalisation of relationships though the provision of child-centred hardware and software. For example, the giant touch screen in the classroom has been lowered so that children can interact with it and the octagonal table, with the non-intrusive Wacom tablets, is designed to support helping behaviours and communication.

The children can gather around the large interactive touch screen to create, present and discuss their writing. They can write stories together in pairs or larger groups around the octagonal table. The software is designed to facilitate creativity and perspective-taking through cross-fertilisation of ideas. Children can also write stories together by coupling machines together and passing pictures and words to each other, even drawing and writing on the same screen.

To complement the structured content we have designed an intelligent agent in the form of a helpful character who also provides security and stimulation. Though we hope eventually to have a choice of several characters, they will present similar features. Rather than a highly believable character, intrinsically interesting in themselves, our agents will be modelled on the empathic behaviours of teachers, seen in a one-to-one situation (Cooper & Brna, 1999). The agent is intended to show a friendly interest in what the child is doing, affirm them and then suggest a further step in the story-writing process. The suggestion will be based on knowledge about the child, the specific context and some simple rules. It will reflect the child's attainment level and may retain knowledge from the previous use of the software. It will recognise the features the child has chosen, utilising knowledge about story creation as embedded in the pictures and the structure of the word banks and implicit in the cartoon structure of time and sequence.

The character is simple, but its support is based on a valuing of the child working on a specific task, in a given context. The support will be positive and based on understanding of the child's needs in relation to the story it is writing. There will be no criticism, correction or critical analysis. The character aims to build self-esteem and to encourage the child in her task from a position of limited knowing.

![Figure 1. The agent Louisa](image)

The current character is represented by a child, slightly older than those in the class which research suggests is helpful to learning in school (Kyriacou, 1986). ‘Louisa’ (Fig.1) is occupied with her own work but on cue, looks up at the child's work, smiles and offers positive affirmation, turns to the child and offers a suggestion for the next step. These are broad suggestions initially, followed by more specific suggestions if the child does not progress. For example she might say, “Oh great - you chose the witch ... what is she going to do?” If nothing happens she might continue, “You can listen to the descriptive words for some ideas”. The agent will also be able to suggest that a child also elicits support from their peers to support the creation and evaluation of their story.

Security, structure and stimulation will also be provided eventually by different levels of task. Children will be able to read old stories, sequence jumbled stories, finish part written stories, change stories, help the agent write a story or write their own. A recently created facility allows teachers and children to extend the range of words
and pictures quite easily. This will also enable children to add photographs from home to stimulate their creative writing, again developing the creative from the known and the personal.

**Interim Results of the Use of the Story Software**

These results are based on interim analysis only and should be substantiated in much more detail by the end of the project when the computer logs and all the stories will have been analysed in detail. They do not include any evaluation as yet of the agent.

Children have used the prototype of T’rrific Tales in the NIMIS classroom over a several months. On average a child had twelve sessions on the software. Each session lasted from thirty to ninety minutes. Video-recordings were made, children and teachers were interviewed and the finished stories are now being evaluated. Computer logs have also been compiled and reading ages and National Curriculum levels tracked.

Over the academic year the children's story-writing capacity has increased dramatically, a normal event during year one at primary school. The children have really enjoyed using the software and have produced many stories both individually, in pairs and also a few using electronic coupling. The children's enthusiasm has not waned over time and in recent interviews typical comments were, 'T’rrific tales is my favourite program', ‘It’s really nice -I'd like to play it all day’. Children mentioned the fun element and the enjoyment they gained from mixing up scenes and characters and being able to play with the pictures and the text.

The children write stories which are very different to the ones which they create using paper and pencil. Pen and paper stories, by the end of the school year are mainly continuous, lengthy, usually low quality spellings, and are frequently short of stimulating and different ideas but typified by ‘and then… and then.., and then’.

The cartoon stories are shorter, with multiple scenes and more elaborate pictures and they contain creative mixes of characters from school and fairy tale scenarios, where, for example, the queen comes to school or the teacher gets involved with a witch. Also creativity and conflict appear in the thought and speech bubbles. For example, a baby thinks it is bored because it has to watch a love scene between the prince and princess.

The children have enjoyed the contrasts, which empower them and allow them to laugh a little at the authority figures- e.g. ‘Lucy gets special powers’ and ‘the day the head teacher forgot how to spell’. Early stories put teachers on the ceiling whilst children and babies waved magic wands. Just like the classroom, the software is designed to allow the envisaging of more equal relationships.

The NIMIS stories, unlike normal ones tend to be frequently redrafted. They take longer to be created but there is much thinking, discussion, reading, listening, vocabulary learning and story building occurring. The children are able to play with ideas, listen to words and phrases and redraft them as they work. Typing is fairly slow for these 5 & 6 year olds, although evidence suggests they are quicker than children of a comparable age. However, because of the word banks and the higher legibility of type written words stories are easier to read. The fun element helps to trigger their emotions and also seems to improve memory. The story ideas section gets children started and supports them when they lose their way in the story process. An example of a real story is shown in Figs.2-5 below.
this, a witch was watching them. ‘MMM’ she said. ‘what a feast’

*Figure 2. A real story, Frame 1*

*Figure 3. A real story, Frame 2*
never saw his friends again. The end

Computer Logs

A recent examination of the computer logs gathered over a period of for approximately two months shows more information about the processes at work. The data is collected from stories constructed with word bank support. This allows us to examine some of the trade offs between how children use T’rrific Tales to generate pictures.
featuring backgrounds, props and characters and how children use T’rrific Tales to copy, manipulate and delete text and generate ideas.

An example taken from 13th June features K, and tidied for presentation purposes follows:

14:51.59 moved to 2nd frame
14:52.12 select text
‘and the wizard was gone the witch was very happy.’
14:52.41 choose throne room image

K moves to a frame, then after a while selects some of the text she has written (‘and the wizard was gone ... the witch was very happy.’), and then selects the throne room as a background. Note that the logs do not give a full account – i.e. the full text written, so we are unable to derive a full process based account of the activity from the cartoon logs alone. The current data that we can obtain from the logs is useful but not as complete as we would now wish.

Of around thirteen features of the interaction monitored, we have examined adding a background, character or prop or removing one, adding some text by drag and drop from the word banks or the text written by the child, listening to a piece of text selected by the child and removing a piece of text by drag and drop. The total number of stories for which we have logs is 160 for 23 children. We have taken the group of children, and extracted five with the highest reading age in July 2000 (mean 9 years 5 months) who produced 27 stories and five with the lowest reading ages (mean 6 years 8 months) who produced 36 stories.

This allows us to comment, for example, on the value of the text to speech synthesis for the writing process. For example, one hypothesis might be that as the children’s reading age improves so the need for the text to speech synthesis declines and hence the usage declines. The ongoing statistical analysis so far suggests no statistical difference for the data shown. However, it is clear that both high and low attainers listen to lots of the words and phrases and use many of them. This suggests that the software contains enough of a range of vocabulary to engage and support children at all the levels within the class – confirmed by the comments children make about the software in the interviews.

Conclusions

We now have a much fuller analysis available than can be presented here. Detailed comparisons have been made between the evaluations of normal and NIMIS stories. We also have a comparison between ten children in the NIMIS classroom and ten matched children in another class who have not used the software at all. There are also detailed analysis of the interviews and data from informal discussions and considerable video analysis which we also believe provides interesting results. The impressions from this research are that the software used in the NIMIS environment is fun, can stimulate creative writing and allows children to write humorous, thought-provoking stories in a safe environment. Children have been able to use thought and speech bubbles to add dialogue and give different perspectives to their characters. Children are keen to support each other with ideas around the table and although they are only very young they have managed to write collaborative stories and exchange ideas electronically. The large interactive board has given many children the chance to take the role of expert in the classroom, demonstrating ideas and understanding to others. We would hope that the polishing of the software and the additional support of an empathic agent will further enhance the scaffolding and affirmation, which supports creativity, perspective taking and learning.

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References


