Educational Interactive Storytelling for Narrative Comprehension and Recall in Dyslexic Children: Employing a Mythic Narrative Structure

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ABSTRACT

Dyslexia has a significant impact in the development of literacy skills, which represent a crucial factor in success at school. Analyzing oral traditions in their function to preserve cultural capital, we come upon interesting similarities with study patterns used for and by dyslexic children, in their effort to understand and use written material. In this paper we outline a framework for the design of interactive systems, related to educational interactive storytelling, which aim in the development of literacy skills through narrative comprehension and recall in dyslexic children. We will examine a cognitive model of narrative comprehension, review a set of study skills for dyslexic children and propose a narrative framework based on the structure of the monomyth together with a teaching and assessment method. Finally, we will present the basic structural components for the construction of a prototype interactive storytelling system.

Categories and Subject Descriptors

K.3.1. [Computers and Education]: Computer Uses in Education, D.2.10 [Design]: Methodologies, K.8.0 [Personal Computing]: General - Games

General Terms

Design, Human Factors

Keywords

Dyslexia, interactive storytelling, narrative comprehension, narrative recall, oral tradition, myth

INTRODUCTION

Dyslexia has a significant impact in the development of literacy skills, which represent a crucial factor in success at school [1]. The demand to develop literacy skills dominates the school curricula, which are usually either content-centered or instructor-centered.

In this paper we focus on a framework that employs a user-centered approach that potentially combines the importance of content, an interactive system and the involvement of instructors and students.

The deciphering aspect of reading presents a special difficulty in the dyslexic students and has been approached by a number of studies and educational software and games [2]. Moreover, even when the decoding process and the working memory are controlled properly by the students, deficits in reading comprehension still remain [3]. For this reason the following proposed design framework for educational interactive storytelling leverages higher-order cognitive processes concerning narrative comprehension and recall. This paper is concerned with narrative rather than expository text because it is the primary genre of oral discourse and also considered the easiest to recall [4].

A COGNITIVE MODEL FOR NARRATIVE COMPREHENSION

Narrative comprehension mechanisms which readers employ are quite stable among individuals within and between cultures [5]. These cognitive processes contain six levels of discourse structure: *the surface code* (the exact wording and syntax of the explicit text or the intonation patterns in the case of oral narrative), *the textbase* (the meaning of the explicit propositions in the narrative), *the situation model* (the mental micro-world describing the narrative), *the thematic point* (the moral or premise of the story), *the agent perspective* (the narrators point of view) and *the genre* (the specific category of narrative under consideration). These levels need to interact gracefully with each other and for none to dominate. In order to facilitate synchronous interaction among the constraints, placed by these six representational levels, the conversions of a genre can be used [5].

The cognitively represented actual wording, syntax and propositions used in storytelling do not remain long in memory. The surface code lasts in memory less than a minute and the textbase for approximately an hour [6], [7].

The situation model consists of a deeper level of representation than the surface code and the textbase; it directly influences the processes of inference and recall and it is close to our current computational models of narrative generation [8]. Although the process of acquiring the thematic point can have a significant influence in narrative comprehension and recall, it is generally very difficult for many children to construct a theme during and after reading. The agent perspective is not often salient in the mind of the reader; children potentially construct multiple agents in their cognitive representations. The conventions of a narrative genre can guide both the creation and the comprehension of narrative material. The notion of genre is thoroughly analyzed in a following section.

Although every level of the cognitive model should be accounted for when developing a narrative framework, for the reasons stated above focus on the situation model is given.

Situation model

The situation model is a mental representation of the state of the narrative world, containing background world knowledge, relevant to the explicit text. It is coherently organized by formulating themes and messages that transfer information to the readers [5].

The situation model consists of five dimensions [8]: *space* (the physical layout of the narrative world), *time* (the timeline of the story and the sequence of events), *causation* (the causes and effects of the events in the narrative), *intentionality* (the goals and motives of the characters) and *protagonists and objects* (the characters of the story and the objects they encounter). For a student the reading time may increase whenever a narrative faces a break in coherence or in the continuity of these dimensions [9] and each dimension influences directly the processes of comprehension and recall of the narrative [8].

STUDY SKILLS FOR NARRATIVE COMPREHENSION AND RECALL

Among the study skills proposed by Reid [1] for school based learning, it appears that the following set can aid the dyslexic child build effective strategies for better comprehension and recall in narrative material. They can also facilitate children to acquire and develop a situation model that corresponds to the narrative under consideration.

The following study skills are important:

- **Sequencing information:** children should be able to know the sequence of the events in the story. Through this particular skill the dyslexic children understand the temporal dimension of the situation model.

- **Use of context:** children should rely on semantic context, which serves as a comprehension and memory aid.

- **Developing schemata:** the developing of story schemata can be accomplished through a story framework (i.e. story scripts and story grammars). Story schemata can form the building blocks for the construction of situation models.

- **Developing imaginative and visual skills:** these skills through the formation of inferences help the dyslexic children imagine and visualize details that are omitted in the story.

- **Repetition and over-learning:** these skills can help the child overcome difficulties in short-term memory.

- **Developing mnemonics:** mnemonics provide visual (e.g. a familiar scene) and auditory (e.g. rhyme, alliteration) cues for the recall of a narrative material.

FORMULATING THE NARRATIVE FRAMEWORK

We propose a narrative framework based on the narratives of oral traditions. Oral traditions are systems that are characterized by multiple constraints. These constraints are related to: the organization of meaning, the imagery of the narrative events and the patterns of sound found in narration (i.e. rhyme alliteration, rhythm, music). Through these constraints organized and coherent stories can be created. We will compare some of the characteristics of oral traditions, as examined by Rubin [4], with the study skills presented in the previous section. Oral traditions are sequential; the narrative recall in these traditions is following a serial pattern and is guided by multiple constraints such as theme, rhyme and rhythm (**sequencing information**). They have a context-rich organization and thus semantic contexts and cues select particular aspects of the meaning of a word and reduce or eliminate ambiguity (**use of context**). Their use of theme is equivalent with the use of a schema. The stories of oral traditions can be parsed to scripts and story grammars (**developing schemata**). Oral traditions contain agents and actions that are easy to visualize (**developing imaginative and visual skills**). They use repeated material, such as formulaic phrases, trembling (the rule of 3's in fairy tales) and narrative patterns (**repetition and over-learning**). They use mostly spatial imagery; the heroes of epic are always on the move and thus invoking a highly developed spatial-memory system (**developing mnemonics**, acquiring the **spatial dimension** of the situation model). Oral traditions employ the repetition of sounds as a poetic device (through rhyme, alliteration and assonance) and as a memory aid (**developing mnemonics**).

The concept of the monomyth, as described by Joseph Campbell [10], is found in many oral traditions and in many myths around the world (i.e. the theme of the novice hero in epic poetry [4]). The monomyth describes the stages of the journey of the mythological hero form the world of everyday life to the special world of the adventure and back. This concept has been chosen as the basis of the proposed narrative framework. In order to make the framework more elaborate and specific, a subset of Propp's [11] functions is mapped to the stages of the monomyth. In

his morphological analysis of the Russian fairy tale Propp identifies the functions that are performed by the characters (dramatis personae) of Russian fairy tales. The proposed model comprises of 27 stages with each stage representing a narrative event. Each stage has a number of variants that can be employed, a prerequisite (for the selection of the appropriate variant) and an indication, showing whether a particular stage is mandatory (it cannot be omitted) or can be thrice repeated (use of trembling). This model is used to generate random stories for the proposed interactive storytelling application. The story stages of the narrative model are presented in Table 1.

Table 1 - The story stages of the narrative model

Story stage	Depends on Story Stage	Mandatory	Trembling
1. Initial situation		YES	NO
2. The villain causes harm or injury	1	YES	YES
3. Misfortune is made known; the hero is approached with a request or command	2	YES	NO
4. Refusal of the call		NO	NO
5. Supernatural aid	4	NO	NO
6. The seeker agrees to or decides upon counteraction	2	YES	NO
7. The hero leaves home		YES	NO
8. The hero is tested, interrogated, attacked, etc.		YES	YES
9. The hero reacts to the actions of the threshold guardian	8	YES	YES
10. The hero acquires the use of a magical agent	9	NO	NO
11. The road of trials		YES	YES
12. Approach to the inmost cave		NO	NO
13. The hero and the villain join in direct combat	2	YES	NO
14. The hero is branded		NO	NO
15. The villain is defeated		YES	NO
16. The initial misfortune is liquidated	2	YES	NO
17. Refusal of the return		NO	NO
18. The hero returns		YES	NO
19. The hero is pursued		YES	YES
20. Rescue of the hero from pursuit	19	YES	YES
21. The hero, unrecognized, arrives home or in another country	1	YES	NO
22. A false hero presents unfounded claims		NO	NO
23. The hero is recognized	21	YES	NO
24. The false hero or villain is exposed	2 and/or 22	NO	NO
25. The hero is given a new appearance		YES	NO
26. The villain is punished	2	NO	NO
27. Freedom to live		YES	NO

Apart from the hero character, the system will use a group of virtual characters that will be recycled through the generated stories. Each character will be able to perform certain sets of actions. The actions are grouped via the archetypes that are found in the monomyth, as proposed by Vogler [12]. These archetypes are the following: the mentor, the threshold guardian, the herald, the shape-shifter, the shadow, the ally and the trickster (the hero archetype corresponds to the user's avatar).

We will also use a set of formulaic phrases that will present specific actions in the narrative. The actions that are constant in our framework include the call to adventure, an act of villainy, the departure from a homeland, etc. For each recurring action a phrase containing rhyme or alliteration will be used at specific points of the story. Through these formulaic phrases and through the continuous experimentation with the application, we argue that the children will build a coherent sequence of the events that take place.

TEACHING AND ASSESSMENT METHOD
The teaching and assessment method that is proposed (based on [13], [14]) develops in the following steps. Firstly the child is introduced to the storytelling activity. The student then experiences the interactive story through the control of a character avatar. At the completion of a story episode (each one consists of a setting, a set of characters, a specific problem, the actions performed and the resolution of the problem) a set of schema-based questions will appear to the user in the form of an embedded narrative (how did the story start, where did it take place, who were the main characters, etc.). The user may respond through selecting from multiple-choice answers. At the completion of the story the user is asked to solve an interactive narrative puzzle. The goal of the puzzle will be to place the story events in the correct form and order.

THE INTERACTIVE STORYTELLING SYSTEM
The basic structural components for the construction of the proposed prototype interactive storytelling system are: *the narrative model*, *the story generator*, *the schema-question generator*, *the user interaction* and *the post-story assessment application*. For the representation of the narratives the video format (found in film and video games) has been chosen due to its facilitating role: in narrative comprehension, in the construction of complex inferences, and in the minimization of processing resources. In the next paragraphs follows a brief examination of the components of the proposed architecture.

The narrative model

The narrative model contains a pattern for generating random stories together with a set of pre-authored characters. Each stage will be represented as an animated sequence, or as an interactive scene of the narrative world. For every recurrent action in the model a set of audio phrases will be employed. These formulaic audio phrases will represent specific events. For example, when the hero of a story accepts the call to his adventure *the acceptance of the call* phrase can be fired, e.g. - "And so our hero sallied forth into the unknown and mysterious world". The authoring of the scenes, the characters and the audio material will be done by the application designer, though the instructor that will employ the software must be aware of the general structure of the narrative model.

Story generator

The story generator will pick randomly stages of the narrative model, cast a set from the repertoire of characters and build a story depending on certain prerequisites and variations. The final product of the story generator will be a series of interactive scenes, animation sequences and formulaic audio phrases; all combined form a narrative world.

Schema-question generator

At the conclusion of every episode in the story, a set of schema-based questions will be presented to the user in the form of an embedded narrative. The questions will be constructed automatically depending on the generated story.

User interaction

The user will explore the narrative world in an almost linear way. S/he will control an avatar's movement and will interact with certain objects and characters in the virtual world. The actions performed will not change the route of the story but will enable the player to engage in the virtual world and get information from the story's characters. The progression from one stage to the other will be performed either immediately or when the player's avatar reaches certain locations.

Post-story assessment application

After the completion of each story, the user is asked to complete an interactive narrative puzzle, in order to express and summarize his/her understanding of the generated story. In the puzzle the user is called to indicate the characters, the objects, the settings and some key actions of the most important parts of the story. The puzzle will provide interactive feedback in order to let the children experiment and understand the causal chains of the narrative events that arose during the course of the story.

CONCLUSION

We argue that interactive storytelling appears to be a promising tool for strengthening literacy skills in dyslexic children. Analyzing oral traditions in their function to preserve cultural capital, we come upon useful similarities with study patterns and methodology used for and by dyslexic individuals, in their effort to understand and use written material.

Every parameter of the narrative model that is used to build the stories offers a ground pillar to the dyslexic children. The coherent and constrained structure of the generated stories allows the dyslexic children to understand the sequence of narrative events, rely on semantic context and develop imaginative and visual skills. The generated schema-questions and the post-story assessment facilitate the development of story schemata, which are critical in acquiring a situation model that corresponds to the generated narrative. Also the use of rhyme and the spatial dimension of the stories can aid the developing of mnemonics. Finally we argue that the overall repetitive nature of the narrative patterns can aid over-learning in a non-tedious way. An example of an interaction scenario and its design will be presented in detail during the workshop.

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