Towards Narrative-Centered Learning Environments

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Abstract

Because narrative plays such a central role in cognition and culture, narrative-centered curricula have been the subject of increasing attention. By taking advantage of the inherent structure of narrative, narrative-centered learning environments could provide engaging worlds in which students are actively involved in motivating story-building activities. The fundamental hypothesis of this research program is that by enabling learners to be co-constructors of narratives, narrative-centered learning environments can promote the deep, connection-building meaning-making activities that define constructivist learning. We outline the features of narrative that support constructivist learning, explore the key issues in introducing narrative into learning environments, consider how these environments can support one particular subject matter, literacy education, and sketch the research agenda required to make narrative-centered learning environments a reality.

Epigraph

"The universe is made up of stories, not atoms."

—Muriel Rukeyser

Introduction

Recent years have witnessed a growing interest in narrative. Originally confined to frameworks developed by literary critics, narrative analysis is now being adopted by those seeking to extend the foundations of psychology (Bruner 1990; 1991), cognitive models of reading comprehension (Gerrig 1993), and film theory (Branigan 1992). It is becoming apparent that narrative can be used as an effective tool for exploring the structure and process of meaning making – whether the object of analysis be everyday life, the novel, or film. In a parallel development, the AI community has gradually become aware of the possibility that narrative may well have something to offer them as well. By creating computational models of narrative processes, it becomes possible to create intelligent drama and entertainment systems that combine the benefits of narrative and interactivity (Laurel 1986; Loyall & Bates 1997; Weyhrauch 1997).

One of the most intriguing possibilities raised by the emergence of narrative intelligence is the potential to create narrative-centered learning environments. By taking advantage of the inherent structure of narrative, narrative-centered learning environments could provide engaging worlds in which students are actively involved in "story-centric" problem-solving activities. Classically, intelligent tutoring systems (Carbonell 1970) were envisioned as essentially dialogue systems that would emulate the conversational give-and-take of tutorial discourse. In contrast, narrative-centered learning environments could revolve around compelling virtual worlds, believable characters, thought provoking themes, and rich stories.

We believe that computational models of narrative can serve as the basis for a new generation of learning environments. We are particularly optimistic about the prospects of narrative-centered learning for children. Below, we outline the features of narrative that make it attractive from a pedagogical perspective. We then briefly explore some of the challenges of introducing narrative into learning environments. These include rethinking key issues in tutoring systems such as developing narrative-centered analogues of pedagogical planners, student modelers, and explanation generators. Finally, we consider the design of a narrative-centered learning environment for a domain that is particularly conducive to investigating a story-based pedagogy, namely, literacy education. We conclude by sketching the research agenda required to make narrative-centered learning environments a reality.

Narrative-Centered Learning

Narrative experiences are powerful. In his recent work on cognitive processes in narrative comprehension, Gerrig (Gerrig 1993) identifies two properties that readers of narrative experience. First, they are transported, i.e., they are somehow taken to another place and time in a manner that is so compelling it seems real. Second, they perform the narrative. Like actors in a play,

they are active in drawing inferences and experiencing emotions as if these were somehow real. By adopting a narrative-centered approach to learning, we believe these two characteristics, being transported and performance, can be exploited to great advantage by learning environments.

Narrative could well form the basis for entire curricula. Because narrative seems to play such a central role in memory by providing an organizing structure for new experiences and knowledge (Mandler 1984), one can envision a narrative-centered curriculum that leverages the organizational features of our innate metacognitive apparatus for understanding and crafting stories. This insight has recently led educators to recognize the potential of contextualizing *all* learning within narrative (Wells 1986):

> Constructing stories in the mind—or storying, as it has been called—is one of the most fundamental means of making meaning; as such it is an activity that pervades all aspects of learning .... Through the exchange of stories, teachers and students can share their understandings of a topic and bring their mental models of the world into closer alignment. In this sense, stories, and storytelling are relevant in all areas of the curriculum. (p. 194)

Perhaps the most natural fit for narrative is language arts, where the focus on literature has become the time-honored approach to literacy, but narrative may turn out to be equally effective in other disciplines (Lauritzen & Jaeger 1997). In mathematics, narrative could shift the focus from mechanical, algorithmic problem solving, e.g., arithmetic, to a more analytical approach to real-world problems that emphasizes analyses. In the sciences, an inquiry-based curriculum featuring dynamic narratives of the highly nonlinear process of scientific discovery could foster an in-depth understanding of how real-world science plays out. In social studies, biographies could shift the focus from rote memorization of facts and dates to an analysis of compelling historical figures, their motivations, and the geographical contexts in which they lived.

Engaging narrative-centered learning environments could play a central role in such a curriculum. They offer much promise for addressing the twin pedagogical goals of learning effectiveness and motivation. The notion of learning effectiveness has evolved considerably in recent years as many educators have embraced constructivist learning, which emphasizes knowledge construction instead of rote learning (Mayer 1987). Constructivist learning, with its emphasis on the active role played by the learner as she acquires new concepts and procedures (Piaget 1954), has made substantial gains over more didactic approaches. Because of the active nature of narrative, by immersing learners in a captivating world populated by intriguing characters, narrative-centered learning environments can enable learners to participate in the following families of activities:

1. *Co-Construction:* Participate in the construction of the narrative.
2. *Exploration:* Engage in active exploration of the narrative, e.g., by considering how characters' intentions affect their actions in the evolving narrative.
3. *Reflection:* Engage in post-hoc analysis activities by reflecting on narrative experiences and their underlying subject matter.

Historically, learning effectiveness has functioned as the sole metric by which learning environments are gauged. However, from a practical perspective, it has become clear that educational software that fails to engage students will go unused. In his classic work on motivation in computer games and educational software, Malone distinguished between game playing experiences (and educational experiences) that are extrinsically motivating and those that are intrinsically motivating (Malone 1981a). In contrast to extrinsic motivation, intrinsic motivation stems from the desire to undertake activities sheerly for the immediate pleasure to be derived from them.

By emphasizing qualities such as challenge, curiosity, and fantasy, Malone argues that learning environments can create intrinsically motivating experiences (Malone 1981b). Narrative-centered learning environments, if successful, should be able to provide precisely these properties. By creating compelling narrative experiences, narrative-centered learning environments should be able to achieve significant gains in motivation over current-generation educational software. This in turn has the potential to dramatically increase the time that children seek to spend with educational software. As a result, narrative-centered learning environments could produce follow-on gains in learning effectiveness from time-on-task effects.

In short, the "being transported" property of narrative experiences can contribute to the suspension of disbelief that plays an important role in motivation, and the "performance" property can contribute to the active problem-solving inherent in constructivist learning.

Issues In Narrative-Centered Learning Environments

All interactions in narrative-centered learning environments should exploit the power of story. This raises the central question of how we can devise computational models of narrative that are pedagogically effective. To answer this question, we need to develop a theoretical foundation for narrative that is informed by the communicative requirements of constructivist learning. In our work on narrative-centered learning environments, we take Bruner's notion of the centrality of culture to cognition (Bruner 1990) as a bridge from story to pedagogy. He defines narrative as

> a unique sequence of events, mental states, happenings involving human beings as characters or

> actors. These are its constituents. But these constituents do not, as it were, have a life or meaning of their own. Their meaning is given by their place in the overall configuration of the sequence as a whole—its plot or fabula. (p. 43)

Our fundamental hypothesis is that *by enabling learners to be co-constructors of narratives, narrative-centered learning environments can promote the deep, connection-building meaning-making activities that define constructivist learning.* The corollary of this hypothesis is that if we can (somehow) build narrative-centered learning environments that enable learners to actively explore narratives, we can accrue the motivational benefits associated with immersing them in their own stories. Perhaps most central among the tenets of constructivism is that learners should be engaged in active exploration and develop an understanding of a domain through challenging and enjoyable problem-solving activities. Narrative-centered learning environments should be able to address this directly by exploiting the intimately familiar structure of story.

It is perhaps useful to contrast the narrative-centered learning environments advocated here with (1) adventure-based edutainment that involves a story in which the narrative and pedagogical activities are not intimately linked, e.g., (Waraich & Brna 1998), and (2) entertainment software that centers around narrative but is not specifically pedagogically oriented in a traditional sense, e.g., (Machado & Paiva 1999). In the first case, the aim is pedagogical, but the narrative is not tightly coupled with learning in any strong sense. While much of the "adventure-based" edutainment that currently exists has elements of narrative, these are typically tangential to the learning process itself. In the second case, the aim is to teach children about narrative *per se* and, to some degree, socialization, rather than to assist them in mastering a traditional academic subject. Machado and Paiva propose what is perhaps the most advanced use of story generation systems for children to date (Machado & Paiva 1999), and similar efforts are currently underway at DFKI and Sussex University (André & Scaife 1999).

What is needed for traditional academic subjects (e.g., mathematics, language arts, social studies, and the sciences), we believe, is a tight coupling of narrative to pedagogy via interactive computational models that can simultaneously reason about both the pedagogical and the narrative contexts in a unified manner. As a result, it should be possible to craft dynamic narrative worlds in which every element—these span setting, characters, plot, and theme—contribute to the operative pedagogical goals in a discovery-based setting.

Achieving these kinds of interactions requires rethinking traditional approaches to intelligent tutoring systems. This entails recasting the classical approaches to key ITS architectural components (e.g., pedagogical planners, student modelers, and explanation generators) to take into account the demands of narrative-centered learning:

- *Pedagogical Planning:* Typically, pedagogical planners (Murray 1990) have been responsible for selecting the next action to take in a tutorial discourse. They determine what type of problem to pose, when and how to assess the learner's understanding, and what type of remediation is most appropriate. In narrative-centered learning environments, pedagogical planners must serve in the dual capacity of drama managers (Weyhrauch 1997) and tutorial action managers.
- *Student Modeling:* Historically, student modelers (Brown & Burton 1978) have been responsible for detecting learners' errors, determining what the nature of their misconceptions are, and then providing appropriate remediation. In narrative-centered learning environments, student modelers must observe learners' responses to questions about the narrative they have constructed to ascertain whether they are experiencing conceptual difficulties and, if so, determine the nature of these "narrative bugs."
- *Explanation Generation:* In the past, explanation generation has been employed to explain domain phenomena and provide students with problem-solving advice (Moore 1995). In narrative-centered learning environments, explanation generation must be broadened from discourse planning to story planning, including the planning of setting, narration, and perhaps even dialogue. Critically, this new form of "explanation generator" must exploit advances in believable agent architectures (Loyall & Bates 1997; Sengers 1998) to craft characters—these may or may not have a visual presence—that effectively promote the suspension of disbelief.

Analogous kinds of developments are important for devising techniques for narrative-centered curriculum management, direct manipulation problem solving, plan recognition, and tutorial dialogue management.

Narrative-Centered Literacy Learning Environments

Given the importance of literacy skills and the close relationship between narrative and the language arts, creating a narrative-centered learning environment for literacy education holds much appeal. Acquiring sustainable literacy skills is perhaps the single most important goal of elementary education. We face a critical need for early elementary school students to acquire reading and writing habits in order to develop fluency as they progress into more demanding academic contexts and ultimately the workforce.

The demands for higher literacy are steadily increasing, creating dire consequences for those who fall short and contributing to the widening economic disparities in our society (Bronfenbrenner 1996). We find in our schools increasing numbers of students without functional reading and writing skills who are likely to disengage from school prior to graduation or to drop out

altogether. Current difficulties in reading originate not only from declining absolute levels of literacy but also from rising demands for literacy (Stedman & Kaestle 1987). While the gap in reading performance between educational haves and have-nots has shrunk over the last fifty years, it remains unacceptably large (National Academy of Education 1996) .

If somehow we could leverage the potential communicative power of narrative-centered learning, we could create literacy learning environments that are intrinsically motivating. Some children—these include children from non-English speaking families, as well as children who have innate predispositions for reading difficulties—could benefit considerably from the support of narrative-centered learning environments that would foster literacy acquisition and reading success. Narrative-centered learning environments could capitalize on students' motivation to create their own story worlds, while at the same time taking advantage of the growing research base on multimedia learning that exploits the inherent benefits of both verbal and visual modes of communication (Mayer & Anderson 1991; Mayer & Moreno 1998).

Although creating literacy learning environments present serious challenges, recent years have witnessed a growing consensus about basic literacy processes and the types of instruction that best support literacy acquisition (Adams 1990; The National Research Council, 1998) . We now know that by the end of third grade, students need to have had positive experiences with word recognition, vocabulary building, comprehension, fluency, and independent reading to ensure continued reading success in later grades (Anderson & Pearson 1984; Dole *et al.* 1991). It is precisely these kinds of experiences which we hope to provide with narrative-centered literacy learning environments.

With this end in mind, we are undertaking the design and construction of the StoryTeller, a narrative-centered learning environment that generates customized stories and coordinates a broad array of characters and story lines in real-time. Students will proceed through an iterative writing and review cycle of story development toward their final goal of making their story come to life. Embedded within the script-to-storybook storyboarding process will be pedagogical strategies supporting student literacy development that are customized to the particular needs of the student. These will focus on reading level and past performance as well as on expressed interests. Targeted literacy skills include higher order discourse processing such as summarizing, predicting events, and drawing inferences. It is our hope that this approach will serve the dual functions of creating positive story-building and reading experiences and providing customized pedagogical support for literacy skill development.

Conclusion

Because narrative has such a captivating influence on those who participate in it, designing learning experiences that revolve around narrative holds much appeal. Learning effectiveness may benefit from the active role that learners can play as co-constructors of narrative, while motivation may be significantly enhanced by narrative's almost unique ability to transport us to other worlds. We believe that the most promising means of pursuing the dream of narrative-centered learning environments is to adopt a strongly empirical approach. By employing an iterative process of designing learning environments, implementing prototypes, and conducting empirical studies, we can begin to explore the parameters of narrative-centered learning and identify their ramifications for a refined pedagogy.

To date, we have focused our efforts on lifelike pedagogical agents. We are now beginning to investigate techniques for creating models of pedagogical planning, student modeling, and explanation generation that are informed by the goals of narrative-centered learning, all in the context of literacy education. By exploiting foundational results on lifelike pedagogical agents and three decades of work on intelligent tutoring systems, we are cautiously optimistic about the prospects of seeing children playing with narrative-centered learning environments in the not-too-distant future.

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