

Leveraging Narrative Interactivity to Foster Computer Science Identities

Philip Sheridan Buffum
North Carolina State University
Department of Computer Science
Raleigh, NC, 27606, USA
psbuffum@ncsu.edu

ABSTRACT

There is growing recognition in the computer science education research community that supporting students in identity formation for computer science is an essential step toward broadening participation in computing. Because students begin establishing their career aspiration identity at an early age, research into computing identity formation in K-8 education is particularly important. Research suggests that narrative-centered learning environments hold great promise for fostering identity formation. My proposed dissertation research focuses on bringing narrative-centered learning environment technology to bear on supporting computer science learners in middle school. I am particularly interested in how we can make these learning environments more equitable for all learners, especially for underrepresented students.

Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer and Information Science Education – *computer science education*.

Keywords

Identity Formation, Middle School, Narrative, Equity.

1. PROGRAM CONTEXT

I have recently completed the third year of PhD studies in computer science at North Carolina State University. This past semester I completed the Written Preliminary Exam, presenting work that I conducted on using a virtual learning companion to bring gender equity to an educational game for computer science. I have already begun building on this work by further developing the system and conducting a series of small user studies. This fall, I plan on conducting a full classroom study that will yield the data for my dissertation. I then hope to complete the Oral Preliminary Exam (the dissertation proposal) the following semester, and graduate in December 2016. As my proposed research questions are not finalized yet, this ICER Doctoral Consortium comes at an excellent time to help shape my dissertation research.

2. CONTEXT AND MOTIVATION

The importance of developing effective interventions for middle school learners has been well established. At this age students first

start developing subject-specific skills in the pursuit of career aspirations [8]. Indeed, researchers have specifically traced the underproduction and underrepresentation issues in undergraduate computer science departments back to lack of exposure as early as middle school [10]. With effective computer science learning experiences during students' formative years, there is the potential to leave a lasting positive impact on the student.

Motivated by this great promise, my colleagues at NCSU and I have created a narrative-centered learning environment, ENGAGE, that aims to help middle school students learn computational thinking. In ENGAGE, students play the role of computer scientists solving a socially relevant mystery. The game's narrative provides a form of scaffolding, with students developing computational thinking skills as they progress through the multi-week intervention. Building off of a rich theoretical background on narrative-centered learning, ENGAGE also hopes to leverage the narrative element's potential for facilitating *identity formation*. Little research has been done, however, on the specifics of how such narrative-centered learning environments can most effectively foster identity formation. My dissertation work addresses this open research question, with particular attention on identity formation among students traditionally underrepresented in computer science.

3. BACKGROUND & RELATED WORK

Narratives – both those we tell and those we consume, both about ourselves and about others – shape our identities in powerful, long-lasting ways. Some have suggested that we can fully equate the identity of an individual with the narratives about that individual [9]. The importance of narrative appears in most, if not all, theories in the learning sciences. In the cultural-historical perspective, for example, we can see adults interpreting their past experiences to project probable futures for their children [5]. The situative perspective on learning, meanwhile, emphasizes the importance of contextualizing knowledge, which can be accomplished through narrative [7].

Narrative-centered learning environments aim to take advantage of the transformative power of narrative. These immersive environments afford multiple perspectives, situate learning, and facilitate transfer [6]. Indeed, the theory of *transformational play* takes us beyond any broad claims about the potential of games to make learning “fun”, and provides more concrete guidance on how to design game-based learning environments that can positively impact students in ways unique to games [1]. In this model, the student takes on the role of a protagonist and, using newly acquired domain knowledge, transforms (a) the fictional context of the game environment, (b) her understanding of the domain knowledge, and (c) herself as someone who uses that domain knowledge to solve socially relevant problems.

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Much of the research on narrative-centered learning has been done in the context of middle school science [1, 6], although narrative-centered learning environments have also been used in other subjects, such as language arts [1]. This technology may especially benefit fields such as computer science that struggle to attract diverse students due to pervasive negative stereotypes. My research aims to explore this hypothesis.

4. STATEMENT OF THESIS/PROBLEM

I seek to understand how narrative interactivity in an educational game can improve a student's ability to identify as a computer scientist. I will investigate how students' computer science attitudes evolve while interacting in the narrative-centered learning environment, paying attention to demographic differences. I am particularly interested in how students traditionally underrepresented in computer science respond to varying degrees of narrative interactivity.

5. RESEARCH GOALS & METHODS

My dissertation research includes the following goals:

- i. Establish how player actions within the existing educational game map to prior (and evolving) computer science attitudes.
- ii. Determine how varying degrees of narrative interactivity affect a student's computer science attitudes.
- iii. Discover if this has a measurable impact on a student's ability to identify as a computer scientist or, if it does not, how we could improve its impact.

Toward the first goal, we conducted a full classroom study of ENGAGE during the 2014-15 academic year, with approximately 200 middle school students. We administered a computer science attitudes survey (pre- and post-intervention), engagement survey (post-intervention) and a knowledge assessment (pre- and post-intervention). We also collected game trace data. I plan on using computational methods to analyze the game trace data, with the goal of identifying how player actions differ between students who scored highly on the computer science attitudes survey versus those who scored less highly. I will also look for differences based on engagement and knowledge gains.

We also plan to conduct a new study with modifications to the narrative-centered learning environment. I have already developed a prototype of a virtual learning companion that can add varying degrees of narrative interactivity to ENGAGE. I will fully integrate this pedagogical agent with the existing game, and then conduct a study with at least 100 middle school students. For this new study, I will follow a similar method as previous ones to ensure as representative a participant pool as possible. This will help me achieve my second goal. To achieve the third goal, meanwhile, we will need to supplement the study with focus groups and qualitative analysis. I believe a mixed methods approach is the only way to fully study the complex topic of "identity" in middle school computer science education.

6. DISSERTATION STATUS

The research goals articulated above build on my completed work investigating how the narrative interactivity of a prototype virtual learning companion can improve the gender equity of a game for middle school computer science education [4]. I have also worked on using narrative to teach new concepts such as "big data" to middle school students [3], developing and validating a

knowledge assessment for a narrative-centered learning environment [2], and using collaboration in a narrative-centered learning environment to improve its gender equity (under review).

With regard to my upcoming research goals, I have already conducted some analyses of the survey data. Specifically I have looked at gender differences in the engagement post-survey and in the knowledge assessment. Analyzing the game trace data is the next step for understanding how learning unfolds in this narrative-centered learning environment. As for preparing for the next study, our team has completed development of the game environment and I have completed building the next iteration of the virtual learning companion. We will conduct the next study during the 2015-16 academic year. My participation in the Doctoral Consortium at ICER would be perfectly timed to help clarify the design of that study and to help shape my upcoming dissertation proposal.

7. EXPECTED CONTRIBUTIONS

My dissertation research will lead to better understanding how we can leverage narrative interactivity to foster computer science identity formation. Enabling young students to identify as computer scientists is key to seeing them persisting in the field, and therefore important to the grand goal of broadening participation in computing. This research will establish how we can pursue this goal through the use of narrative.

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