Conversational UX Design for Kids: Toward Learning Companions

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Abstract

Kids' use of conversational interfaces is growing along with the ubiquity of conversational agents in our pockets and on our countertops. Kids already use these interfaces for a variety of daily tasks, and supporting kids' learning is a highly promising area for conversational interface design. In particular, companion conversational agents, which act as a peer to the student and not as an authority figure, can support learning while providing a fun, engaging experience. However, there are many open research questions around the design of companion conversational agents for kids. We discuss findings to date on companion agent dialogue with middle school students as we have investigated these agents within a challenging serious game. We also discuss important areas for future research related to companion conversational agents within the growing field of conversational UX design.

Author Keywords

Conversational interfaces; dialogue agents; learning companions.

Introduction

Companion agents hold great potential to advance learning by engaging kids in conversation. Prevailing theories of learning, including social constructivism,



Figure 1: The Crystal Island game for middle school science learning, featuring the agent interface icon in the lower left corner. When the learning companion agent initiated dialogue, a notification was presented using a sound effect and a visual alert in the upper left corner of the screen.



Figure 2: Textual dialogue interface (an in-game cell phone) with the companion conversational agent, Alisha. The students have access to this interface at all times.

hold social interaction as an essential part of learning, and the benefits of learning-centered dialogue are empirically supported [5]. For example, conversational exchange with teachers improves learning, and engaging in peer dialogue can deepen students' thinking and improve written work [5]. Perhaps the majority of research on conversational agents for learning has been conducted in the context of tutor agents, which focus on emulating human tutors [4]. However, learning companion agents hold benefits distinct from human peer dialogue and from tutorial dialogue: they support learning while retaining an engaging, fun conversational style [3]. This paper discusses the design and development of Alisha, a conversational agent designed to support middle school students as they play a challenging, open-ended game for science learning.

Designing a Learning Companion Prototype

In the game, students must investigate the cause of a mysterious illness on an island called Crystal Island [7]. The process of forming hypotheses, reading relevant materials, and finally solving the mystery can pose substantial challenges and lead to frustration for some students. We have been developing a *learning companion* to support students in the game. Learning companions are virtual characters who know slightly more than the student about the task at hand, but have the social characteristics of a peer. Students working alongside learning companions have shown improved comprehension, self-efficacy beliefs, and attitudes toward learning [3]. Our work aims to bring these benefits into a challenging, open-ended game-based learning environment for microbiology (Figure 1).

Initial Spoken Conversation Study. To begin our design process, we investigated how students would interact with a learning companion, and what types of support they need. We conducted a Wizard-of-Oz study with 24 eighth-grade students. Students played the game and spoke with a virtual character embedded in one of the main game interfaces (Figure 2) whose conversational intelligence was provided by a human in a different room. We noticed that students responded to the agents' encouragement to take desirable strategies within the game, but students spoke to the agent very little, even after we provided a short practice session in which students spoke to the agent before beginning gameplay.

Design Consideration: Text vs. Speech. When asked about how comfortable they felt talking to the agent, kids frequently reported "feeling awkward". We took this report of awkwardness particularly seriously because the kids had been seated in a lab with privacy, not in the classroom where their peers would overhear them where we would expect even greater awkwardness. Based on these observations from the initial study, we decided to move forward with textual conversations rather than speech. Adolescents' preference for text is not surprising given the popularity of text-based messaging platforms in this age group.

Student Feedback on Design Prototypes. Over the course of the following year, we created numerous prototype iterations each informed by user feedback. For selecting from among possible personae, we conducted focus groups with middle school students. Next, we gathered user feedback on a high-fidelity but development-minimal simulation of the conversational agent: one researcher played through the game on a



Figure 3: Student workstations for interacting with Alisha in middle school science classrooms.

Selected Dialogues:

Alisha: Can you remind me about the last thing we were working on together?

Summer: We were trying to figure out the cause of the sickness here Sridevi: We were on an island, solving an outbreak

Jorge: i cant move Justin: how do I get on top of the trailer

Table 1: Sample responses from different students to the same question from the learning companion. (All names are pseudonyms.) These examples are illustrative of a trend we observed in which girls (blue) tended to send longer messages and remain more on-topic than boys (green) did. large screen in front of the class while another acted out conversational moves that Alisha might make during gameplay. Then, after implementing a prototype of the chosen agent persona, we conducted another study with different middle school students, 21 in total (12 male and 9 female), collecting interaction logs from the game and the conversational agent (Figure 3). These logs confirmed the extent to which kids responded to the agent or initiated conversation, the content of the conversations, and the game contexts in which kids were particularly receptive to dialogue.

Design Consideration: Persona and Backstory. The agent backstory in the pilot study described above was a middle school reporter working on a story for her school paper, which had numerous desirable affordances for dialogue writing. However, the students' frustrations and feedback led us to believe that this backstory set expectations too high regarding the conversational capabilities of the agent. Students wanted to engage in open-domain chats with Alisha, but she was only capable of task-related dialogue and very light social conversation. To manage this expectation, we modified Alisha's persona and backstory to that of an artificially intelligent agent who had been sent to work with the student on the island. Alisha became an "AI in Training," who was friendly, knowledgeable, and relatable, but still learning how to help scientists. This backstory preserved the agent's helpfulness and authentic-question-asking while allowing her to set appropriate expectations regarding her limited conversation scope.

Design Consideration: User Gender. Girls had positive reflections on the agent's emotionally supportive language and references to the character's

past experience, while boys said that they would have preferred concrete hints and answers about the task at hand. In our previous work with undergraduate computer science learners, we saw a similar pattern: female students benefitted from affective, or emotional, feedback, while males did not [8].

Implementation of Conversations. The companion agent dialogue supported two modes of interaction: user-initiated and system-initiated. Alisha initiated conversation when triggered by any one of a set of gameplay states. Alisha uses information such as the student's location in the gameworld and their interactions with informational texts to decide when and how to make a dialogue move. Alisha focuses on specific overarching goals through her dialogue, including support for self-regulated learning [6] and affect regulation [1]. We designed conversation moves to support four self-regulation skills: note taking, reflection, hypothesis forming, and goal setting/planning [2]. Alisha uses guestions, hints, and suggestions for self-questioning to promote these skills: for example, when a student uncovers a new piece of information, she may say, "Let's see how that fits into our mission objectives. That could help us make a plan." This dialogue move is intended to encourage learners to reflect on their goals and avoid feeling "stuck". When learner dialogue moves or ingame behaviors indicate that the learner may be bored, frustrated or angry, the agent is designed to offer affective support. The design of the agent's affective support was informed by the strategies used in an evidence-based design process of a successful affective learning companion [1]. This approach is focused on conveying empathy and shared experience. For example, to convey empathy to a frustrated student,

Alisha: Let's head someplace with a little less water and a little more evidence. :P Student: no

Student: no

Alisha: Learning to investigate diseases is tough! Sometimes I need to take a break and do some nice, relaxing calculus problems!

Alisha: But it's important to make sure we stay on track for our mission!

Alisha: Hey, I noticed that you spent some time in the infirmary.

Alisha: Patients are one of the best sources of information. What did you learn? Student: Her symptoms are coughing, fever and diarrhea. She eats eggs, milk, and toast for breakfast.

Alisha: That's great info! I remember from basic training that symptoms are a really important clue to diagnosing an illness.

Alisha: It's a good idea to record notes like that on your Diagnosis Worksheet!

Table 2: Example interactions between Alisha, the virtual agent, and students.

Alisha might humorously leverage her backstory: "This is a tough mission! My circuits sometimes get fried when I feel like I'm not making progress."

Conclusion

We were interested in designing a conversational agent that could simulate empathy and shared experience with the user in support of challenging tasks. When designing conversational flows for empathy, designers should observe interactions between students and agents to identify moments of emotional importance. We focused on evidence of confusion, frustration and boredom. Previous research showed us that these emotional displays are of high importance, so when the system detected these states, it engaged students in an empathetic dialogue by sharing an experience that mirrors the detected state of the student (Table 2). To simulate the agent having a shared experience with the user, the dialogue utterances make direct references to entities in the environment and events that have recently occurred with collaborative language to indicate that the agent was co-present.

We have noted several interesting phenomena worthy of future exploration. Students became more expressive when we shifted from speech to text input. They also appeared more invested with the virtual agent as we developed a rich background for the character and modified how that agent was introduced. It is also clear that user gender has a significant impact on how users engage with companion conversational agents, and much further research is needed into this characteristic as well as other potentially influential factors including personality, exposure to technology, and level of knowledge. The emerging field of Conversational UX design should shed light on how we can best support users of all ages, in all contexts including learning.

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