Robots to Help Us Feel Safe: A Problem-Based CSCL Experience

Andrea Gomoll, Indiana University, agomoll@indiana.edu

Abstract: This case study works to understand the trajectory and success of one computer-supported collaborative learning (CSCL) experience highlighted as transformational by the instructor who taught it. Reflective co-design sessions held between researcher and instructor, which featured shared viewing of video data collected throughout this CSCL experience, is analyzed in order to unpack this implementation and how it might inform the design of other CSCL experiences that address locally relevant problems.

Keywords: Problem-based learning, case study, engineering design, robotics

Introduction

Opportunities to grapple with current events and to learn through the negotiation of real human problems are essential as we work to give voice to citizens of the world (Gutierrez, 2008). The case study presented here is motivated by the need to empower teachers and learners to address the events and problems that they perceive as relevant in their classrooms. Students engaged deeply in a problem-based CSCL environment as they identified a local need and designed, built, and programmed a robot to address it. This environment supported the development of user-centered design practices as students considered the social worlds around them and how to meaningfully design technologies for these spaces. The design task provided a CSCL context for students to negotiate shared goals and understanding (Suthers, 2006). This study examines what made this particular experience meaningful for students and the instructor and how this understanding can be used to inform broader CSCL design.

Problem-based learning (PBL), a student-centered instructional approach to collaborative learning that presents students with an ill-structured and authentic problem, provides a promising starting point in the effort to empower student voices (Savery, 2006). Well-designed PBL experiences provide a context for students to use their voices to create change in their local communities (e.g., Svihla & Reeve, 2016). This case study explores the emergence of a socially relevant problem in a PBL afterschool robotics experience. Over the course of ten weekly sessions, students grappled with the problem statement "design a robot that can serve a need in your local community." The wider school community was concerned about student safety, a concern exacerbated by the increasing frequency of shootings in US schools. Following the shared experience of a "lockdown" procedure where students and staff are required to huddle in the back of their classrooms with doors locked, students designed a robot to help the school community to feel safer during these procedures.

Method

Nine students ages 12-14 participated in this afterschool robotics curriculum in the rural Midwestern United States. This group included three female students and seven male students. All students were white. We identified critical events within the afterschool robotics unit to unpack this particular PBL experience. Interaction analysis (Jordan & Henderson, 1995) was used to zoom in on the interactional accomplishments that constructed this case. We asked: 1) What student actions and key facilitation moments are identified by the instructor as transformative within reflective co-design? 2) How did students take up the problem statement? 3) How can the trajectory of this unit inform the design of future PBL units that empower students to create change?

Data sources included video data collected for each afterschool session as well as video data collected during four debrief and co-design sessions held with the first author and instructor. These sessions were used to inform the design of the next iteration of the robotics unit. Joint video analysis of scenes from the afterschool club supported the effort to create, deepen, and sustain a locally meaningful experience for students. Co-design video was analyzed in order to better understand where the instructor highlighted critical events and how these events were taken up by students. Data sessions were held with research team members to identify critical events across the data set. Extracts will be presented in this poster highlighting key themes in facilitation and student uptake of the design problem.

Results

The instructor of the afterschool club pinpointed this experience as the "realest PBL unit" she had ever facilitated. Preliminary analysis indicates several aspects of facilitation and student activity that made this robotics experience meaningful for students and instructor. The instructor highlighted students' shared experience of a lockdown procedure (and her move as a facilitator to foreground this experience) as important in the trajectory of the students' motivation to solve a local problem through the design of a hallway patrol robot. Time spent brainstorming, as well as probing questions provided throughout the brainstorming process, were also identified as supportive of students' engagement. For example, the extract featured below was highlighted by the instructor as a turning point in students' brainstormed design ideas. Here, students were able to articulate a design solution connected to the shared experience of a lockdown procedure:

> Instructor: We don't know what's going on outside of our classrooms. We're just in here waiting to see when it's going to be over…So is there something that robots could do to help us know…what more is going on when we can't look out our windows?
>
> Brandon: …Maybe the robot could be outside with cameras and like the teachers can see on a tablet…what's going on using those cameras.

This initial brainstorm triggered a flurry of ideas related to a robot that could provide a live video feed of the hallways and make the school safer during lockdowns. The instructor was inspired to share student ideas with the school principal, office staff, and safety committee members. This discussion led to the organization of a feedback session where students presented initial design ideas and a user testing session where prototypes were tested by these stakeholders. Feedback sessions were recorded, and students had the opportunity to reflect on their presentations as they moved forward. Beyond the success of prompting related to shared experiences (seen in the extract above), the instructor found that students made great progress with their design ideas when they were given these chances to interact with local stakeholders and present their working ideas.

Discussion and conclusions

The robot design challenge presented here provided an authentic context for students to collaborate around a problem that was personally meaningful and socially relevant. It was empowering for both students and teacher—as seen in a culminating design showcase held with community members, presentations given by participating students at a local schoolboard meeting, and ongoing co-design reflections with the instructor. In understanding this particular case, identified for its poignant social relevance, we understand how to better design future curricula that amplify student and teacher voices and create change. CSCL experiences hold great potential as contexts that can support learners as they communicate, co-construct, and shape their collaborative learning. Technology can provide some of this support, but the design of CSCL experiences must also consider facilitation and the structure of learning environments (Jeong & Hmelo-Silver, 2016). Across this curriculum trajectory, key moments of inspiring student engagement, identified within the work of co-design, were used to inform the design of future CSCL experiences. For example, design principles informed by this analysis include 1) situating problem statements within local contexts, 2) providing ample space and time for brainstorming, 3) modeling how to address unexpected challenges, and 4) providing opportunities for students to reflect on their ongoing work using video. These design insights not only informed the development of a next iteration of this particular robotics curriculum, but they might also be taken up in a wide variety of CSCL contexts.

References

Gutiérrez, K. D. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, *43*(2), 148-164.

Jeong, H., & Hmelo-Silver, C. E. (2016). Seven affordances of computer-supported collaborative learning: How to support collaborative learning? How can technologies help?. *Educational Psychologist*, *51*(2), 247-265.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences*, *4*(1), 39-103.

Savery, J.R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning, 1*(1), 9-20.

Suthers, D. D. (2006). Technology affordances for intersubjective meaning making. *International Journal of Computer Supported Collaborative Learning, 1*, 315-337.

Svihla, V., & Reeve, R. (2016). Facilitating problem framing in project-based learning. *Interdisciplinary Journal of Problem-Based Learning*, *10*(2), 10.