Using Activity Theory to Understand the Synergy Between Human and Computer Support in Collaborative Inquiry Learning

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Abstract: We draw on activity theory to design and analyze collaborative learning systems to help understand the synergies between human and computer support in scaffolding collaborative inquiry learning. We report on a classroom implementation of a game-based learning environment focusing on how scaffolds (i.e., rules) embedded in the tools support collaborative inquiry. Findings suggest that the uptake of certain scaffolds can sometimes uncover tensions in activity, highlighting which scaffolds can be computer or human-supported.

Background

Taxonomies of adaptive collaborative learning support highlight how to scaffold computer-mediated interactions by attending to factors such as timing and type of support (Magnisalis, Demetriadis, & Karakostas, 2011). Moreover, foundational research on intelligent collaborative learning systems have specified collaborative models that focus on human interactions engaging with these systems. Although these models and taxonomies are widely use, they are not always guided by learning theories. Additionally, it is unclear which scaffolds can be adaptive through technology, and which elements require teacher support. In this work, we present how Activity Theory was used to design for synergy between human and computer support for collaborative inquiry learning.

Theoretical framework

Activity Theory provides insights on how to organize social relations in classrooms so that participants can engage with one another to make a particular activity successful. In any given activity system, the collective object or goal plays a vital role in mediating and organizing interactions. In working towards this collective object, each individual's activity is artifact-mediated, or influenced by tools, the division of labor, and rules associated with each community. These mediators are historically and culturally shaped, and transform the way that individuals can perform tasks (Cole & Engeström, 1993). Drawing on these concepts, Activity Theory informed the design of hard and soft scaffolds in a game-based learning environment (Saye & Brush, 2017). Hard scaffolds are supports embedded in the game-based learning environment (e.g., tools), whereas soft scaffolds include unscripted guidance from teachers, peers, and facilitators. By attending to these aspects of activity, we were able to determine which scaffolds supported learning without facilitator intervention, and which required facilitator support.

Scaffolds in CRYSTAL ISLAND: ECOJOURNEYS

In CRYSTAL ISLAND: ECOJOURNEYS, students engage in a problem-based learning scenario about why tilapia at the local hatchery are sick. There were three hard scaffolds, 1) narrative roles, which allowed students to gather information, 2) organized collaborative space called the brainstorming board, which that allowed students to share their observations, and 3) a voting feature, which prompted students to choose whether they agreed or disagreed on the relevance of shared observations to the problem. Individual students collected unique data, then shared, and negotiated their shared understanding of the problem. To further coordinate sharing and negotiating ideas, a facilitator also provided soft scaffolds in the in-game chat.

Methods

We draw on data from a classroom study conducted in the Midwestern United States. A total of 45 participants (22 females, 23 males, 11 groups) played the latest iteration and engaged over nine classroom sessions. Student and facilitator in-game interactions were logged, and six groups were video recorded. We adopted an interactional analysis approach to analyzing our data (Hall & Stevens, 2015).

Results

The hard scaffolds in the brainstorming board provided opportunities for students to participate and share their perspectives about the problem (see Figure 1). In our design, soft scaffolds could be delivered based on specific actions related to the board. For instance, when students first started using the brainstorming prompts, the facilitators typically used the pre-defined prompts. However, whenever students had questions or had disagreements, facilitators often went off-script and engaged in verbal discussions to clarify student uncertainty. Across all the groups, students' attention to the notes shared by their peers often surfaced confusion and questions. In noticing this tension or contradiction, facilitators then pivoted from the learning environment to verbal discussions. This signaled two critical observations, 1) that detecting tensions in activity could inform the intersection between human and computer support, and 2) the importance of supporting student-generated questions. Our design also illuminated the limits of hard scaffolds in the game-based learning environment. Although simple soft scaffolds such as prompts that are dependent on in-game user actions can be easily delivered by the system, uncertainty that surfaced in discussions were still best addressed by the facilitators.

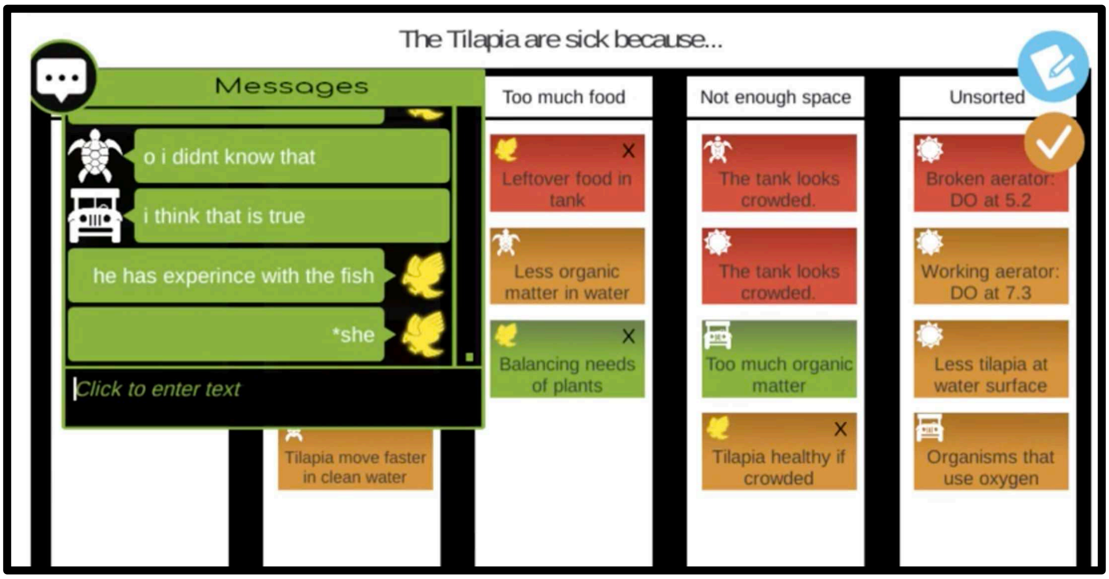

Figure 1. The brainstorming board.

Conclusion

Activity Theory supported the development of how we might design for the intersection between human and computer support. In the work reported here, we have demonstrated that attending to different scaffolds that mediated collaborative inquiry learning surfaced tensions in the activity system. Future work will be needed to unpack further how soft scaffolds can be delivered and trigger next actions for teachers and facilitators in computer-supported collaborative environments.

References

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