Studying Shared Regulation in Immersive Learning Environments

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Abstract: We examined the regulation of shared problem solving in a museum exhibit. We found that we had to augment our dialogue codes to properly embrace the dynamic nature of the observed learning regulation. These changes reflect aspects of shared regulation that occur when learning takes place (1) in an immersive open-ended learning environment, where (2) learners work together in large groups. We present preliminary results, arguing that designers and researchers may benefit from recognizing how planning and evaluation acts can be tactically embedded in immersive learning environments.

Keywords: SRL, SSRL, informal learning, immersive learning environments.

Introduction and background

This work is part of a larger project with the goal of designing a digital, data-driven dashboard to help museum educators facilitate an immersive multi-user exhibit, Connected Worlds (CW). The exhibit allows visitors to engage in collaborative problem solving, and it became apparent that they needed support with the exhibit content and with managing the problem solving process as a group. Designing a dashboard that would bolster socially shared regulation of learning (SSRL) (Järvelä & Hadwin, 2013) required us to understand how visitors work with each other in the exhibit. We began studying the visitors by developing a dialogue coding scheme rooted in the self-regulated learning (SRL) and SSRL literature, but found that the traditional SRL and SSRL conceptions didn't quite capture our group dynamics.

Generally, SRL models have a preparatory phase, which includes familiarizing with the task, followed by a performance phase, which includes strategy use and monitoring progress, and finally an appraisal phase, where learners evaluate and reflect on their performance and plan for future performance, when appropriate (Panadero, 2017). The SSRL framework (Järvelä & Hadwin, 2013) adapted SRL to social learning scenarios, viewing SRL phases as co-constructed by individuals and distinguishing between three levels of learning regulation (self, group members, and the group as a whole).

Phases of SSRL inform the design of scaffolds in asynchronous CSCL settings. For example, goal setting requires different types of information than monitoring, and depending on the target of the regulation, the presentation of the scaffolds may change (Järvelä & Hadwin, 2013). This paper demonstrates that when a learning environment is highly immersive and includes large numbers of learners, additional aspects of SSRL surface. We developed a modified coding scheme that builds on and extends SSRL to immersive CSCL environments (Levy-Cohen et al., 2021), revealing the prevalence of tactical planning and evaluation in group regulation. The following questions guided our study: *How do groups regulate their learning in an immersive digital learning environment? What SRL processes and sub-processes come to play?*

Methods

Setting, sample, and procedure

Connected Worlds is an ecological simulation at the New York Hall of Science. Visitors need to work collaboratively -- within their team and with the other team -- to help the interconnected biomes (Desert, Grasslands, Jungle, and Wetlands) thrive, by routing water to biomes and engaging in forestry management (see Mallavarapu et al., 2019). A volunteer group new to the simulation was recruited (N=26, 22-57 years of age, M=33), and randomly divided into two separate 30 minute sessions (N= 12, and N=14) and again into one of four smaller teams (one team per biome). Visitors wore digital lapel recorders to capture their conversations.

The data from the recorders were transcribed and segmented into speaking turns. Three transcripts (~12% of the total corpus) were randomly selected. Only the speaking turns of the person wearing that recorder were coded. Initial data analysis applied *a priori* codes taken from the SRL and SSRL literature and further elaborated through inductive coding by three researchers (Miles et al., 2014). Emerging codes and themes were recorded and then compared to create a revised codebook. For interrater reliability scores below 80%, we reviewed the disagreements and used those discussions to revise the codebook.

Initial findings and discussion

All the SRL and SSRL codes were represented in the transcripts (e.g., Grounding: 19%, Monitoring: 44%, Planning 5%, and Evaluating 5%; of 103 total speech turns). We were surprised by the low incidence of Planning and Evaluating codes, as the participants were clearly coordinating in an organized fashion. The challenge was that the traditional Planning and Evaluating definitions didn't quite fit in the context of an immersive learning environment. Traditionally, self-evaluation takes place when individuals assess their learning progress and compare it to a goal they set for themselves (Zimmerman, 2008). We could seldom detect clear goals in learners' talk, although participants were clearly making judgments about the current scenario, and making and adjusting plans. For example, viewing one participant's traditional codes over time (Figure 1) suggests the participant only evaluated sporadically. We thus decided to code Evaluations with clear, persistent goals (e.g., "Wait, they're getting enough [water] too, and we are, so they're good.") as *Strategic* Evaluations (SE) while an evaluation of the satisfaction of an emergent, implied goal as a *Tactical* Evaluation (TE) (e.g., "Okay, we need to direct it more that way."). This added lens reveals that TE is a major part of group coordination (55% of speech turns) and is often interleaved with SE (18% of speech turns). This suggests that the support tool needs to incorporate dynamic indicators that can be easily inspected, like gauges, in addition to data visualizations that require longer time to derive insights (e.g., line graphs). We came across similar challenges when coding for planning events. For example, while participants proposed plans with larger, strategic goals (e.g., "Let's set up an irrigation system") they also proposed more immediate, tactical plans (e.g., "Let's shunt the reservoir water over there"). The information needed to decide how much water to move in the moment is different from the information one needs to construct a strategic division of resources.
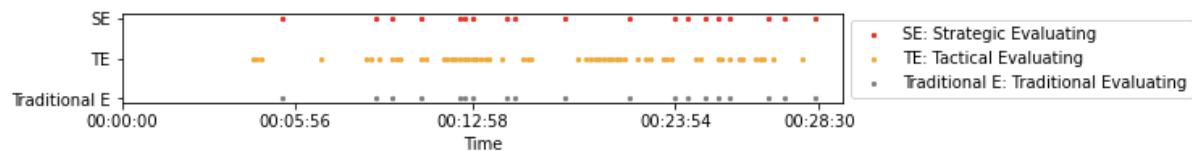

Figure 1. One participant's speech, comparing traditional Evaluating and revised Tactical/Strategic Evaluating.

Conclusion

The coding of our full transcript corpus is incomplete, but by inspecting a limited sample through the lens of our coding scheme we have been able to infer several preliminary findings. First, the degree to which groups collaborate seems to align with social regulatory processes, especially high frequencies of monitoring and grounding processes. We also found that using the traditional definition of Evaluating would grossly underestimate the amount of Evaluating work done by groups in immersive settings. The interleaving of Tactical and Strategic talk suggests that we should investigate what role Tactical Planning and Evaluating plays *vis a vis* Strategic Planning and Evaluating in immersive learning environments. For example, is TE decompositional (addressing smaller components of larger goals), or evolutionary (leading to shifting of larger goals over time)? A decompositional view suggests supports and strategies (like "divide and conquer") that break goals into tasks, whereas an evolutionary view would suggest that learners may need support comparing and contrasting.

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