Collaboration in a Non-Digital, Computational Game Space

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Abstract: An investigation of collaboration was conducted in a non-digital, computationally-minded board game, *Pandemic*. A heightened collaborative context was developed for the game, as a means of investigating collaboration and play. Content codes to capture collaboration (help-seeking) and computational thinking were applied to verbal utterances (n=80 turns), with Discourse analyses applied to uncover interpersonal dynamics in the space.

Introduction

In this paper, computationally-supported collaborative learning is investigated within a tactile play space. The forms of collaboration and computational thinking that arise through the play of a single commercial, cooperative, strategic board game, *Pandemic* (Leacock, 2007), are discussed. The game was designed as a computational system for players to cooperatively play against; with a deep look at the play of this game, the conception of "computation" is broadened to incorporate algorithmic, rule-based practices, while also pragmatic benefits of such systems for researcher manipulation and experimentation are advocated.

Previous work has developed understandings of the forms of computational thinking (see Berland & Lee, 2011; Berland & Duncan, 2012), and help-seeking (Duncan, Boecking, & Berland, 2012) within the game. A common thread has been a focus on the naturalistic play within the game's rule constraints, and how changes to the computational game structure of the game can elicit different collaborative and computational practices. The emphasis in this paper is upon unpacking *collaboration* within a specific context for learning — how can we understand the ways that such manipulations to the collaborative, computational structure of a game give rise to different forms of interaction? And what might this indicate about how games work as computational and interactional rule-based systems?

Method

Pandemic is a commercial, collaborative game in which participants work together to rid the world of four diseases simultaneously ravaging the globe. Adopting individual roles (e.g., the Scientist or the Medic) with unique abilities/responsibilities, players are encouraged to work together in whatever way they see as most effective. Participants in this study were provided all game components, along with an additional rule dictating that one of the unused roles in the game would be controlled by all players as if it were another person, referred to as the "ghost player" condition.

Data from two (n=2; n=3) runs of the game were analyzed in the present study. Both sets of players were undergraduates at a Midwestern University in the United States, and all participants were unfamiliar with the game before participating in the study. Participants were video recorded during play, with the verbal interactions of each group first transcribed for further analysis. All verbal interactions between players were transcribed. In order to capture vocalized consequences of the heightened collaborative context (the "ghost player" condition in these play sessions), a set of codes to capture "help seeking" (Nelson-LeGall, 1981; Aleven, et al, 2006) utterances was also developed, including capturing when help on Rules were *Requested, Given, Received and Argued,* as well as when help on Strategy was *Requested, Given, Received, and Argued*. Please see Berland & Duncan (2012) for computational thinking codes.

Results

Computational thinking codes were quite highly applied, with Simulation and Algorithm Building the highest-coded of the two "ghost player" groups (the only codes crossing 40% applied). Strategy-based help-seeking codes were applied somewhat more than rules-based, perhaps indicating a trend toward strategic discussions in this heightened collaborative context. Since *when* each player was speaking was key (the "ghost player"), the context of the game at each point was captured in three forms for each player/turn combination and which player's actual in-game turn was occurring: "On Turn" contexts, "Non-Turn" contexts, and a "Ghost" context. The percentage coded for each varied widely across the set of computational thinking and help-seeking codes. Most relevant for this study was the variation within the "Ghost" player/turn contexts.

Several patterns emerged in this comparison. First, there were zero codes applied for the rules-based help-seeking codes within the Ghost contexts; on "ghost player" turns, no participants in either group had utterances that indicated a discussion of the game's rules. Additionally, strategy help-seeking codes were similar for most codes other than Strategy Argued, which appeared to be quite a bit higher (20% of the Ghost context player/turns vs. 8.3% of the Non-Ghost contexts). And, for the computational thinking codes, two major trends seemed apparent from these data: (1) There appeared to be a greater proportion coded for each of the computational thinking codes for most of the codes, and (2) Algorithm Building coded greater in Ghost contexts than that for the Non-Ghost contexts (60% for Ghost contexts vs. 55% for Non-Ghost contexts).

Finally, following Duncan & Berland's (2012) and Duncan's (2010) connected content coding/Discourse analysis approach, content coding was used to select data for qualitative Discourse (Gee, 2010) analyses. For each of the help-seeking codes, the greatest proportional disparity between Non-Ghost contexts and the Ghost context was Strategy Argued, while for the computational thinking codes, the code with the greatest degree of saturation (and most applied code overall) was for Algorithm Building. Thus, these two highly-applied codes were singled out for co-occurrences: In the first (2-player) participant group, Algorithm Building and Strategy Argued co-occurred four times: in turns 2, 6, 11, 14. In the second (3-player) group, the codes co-occurred once (in turn 10). Of these, two player/turn combinations (group 1, turn 6 and group 2, turn 10) were also during the "ghost player" turn, and thus coded as Ghost contexts. Group 2, turn 10 was selected to further investigate; in this turn, players (Aqua, Bryson, and Claire) discussed strategies for the "ghost player" and ridding the board of different disease tokens (yellow and black, in this case), as well as the placement of the "Ghosty's" token on the map and strategies for future players (Claire, in this case).

Discussion

First, the heightened collaborative context of the "ghost player" condition seemed to give rise to a number of computational thinking practices, as evinced through the computational thinking codes (matching results found by Berland & Lee, 2011). With the addition of the help-seeking codes to the analysis, however, it seemed collaboration was potentially complicit in the computational thinking practices found within the space. The lack of rules-based help-seeking during the Ghost context was a surprise; the heightened collaborative context of the "ghost player" may have given rise to a greater degree of strategic discussion since the lack of player investment in a particular role in the game (as it was the fictional player's turn) may lead to players' feeling less of a need for rules clarification.

Additionally, the Discourse analysis highlighted a gap between the Strategy Argued/Algorithm Building activity and the *consequential* actions of the group. Though a heightened collaborative context seemed to encourage more discussion of strategy and potential computational, there was still a general deficit of computational thinking in this context. This disconnect may be reflected in the role of Claire in this case — while the game (and our manipulation) was structured to foster collaboration between the participants, *individual* goals and play style clearly played a role. Claire was the only player in this case to discuss her own goals, and to suggest an imperative for future action; it is notable that the Strategy Argued/Algorithm Building in this case was ultimately unrelated, indicating that individual roles may have driven some choices.

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