Common Knowledge: Orchestrating Synchronously Blended F2F Discourse in the Elementary Classroom

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Abstract: This study reports on the continued development of Common Knowledge (CK) – a pedagogical and technological innovation that supports knowledge building blended discourse. Students use handheld tablets to contribute notes to a community knowledge base, which is publicly displayed on the classroom's interactive whiteboard (IWB). This aggregate display provides students with a powerful visualization of the community's idea flow. The IWB display further provides teachers with "at-a-glance" formative assessment of students' thinking and supports spontaneous adjustments to their orchestration of inquiry activities and blended discourse. This paper presents a study of how CK supports student and teacher discourse in inquiry science.

Introduction & Objectives

A powerful genre of technology for learning involves the capture and representation of student ideas to promote richer discourse in the classroom, collective inquiry, and the growth of ideas (Hakkarainen, 2004; Scardamalia & Bereiter, 2006). This study reports on an innovative technological approach called Common Knowledge (CK), where students use handheld tablet technology to contribute notes arising from their science inquiry, which get dynamically displayed on the classroom's interactive whiteboard (IWB) to facilitate further student- and teacher-led oral discourse. This paper describes how CK supports student reflections and helps teachers guide collective, idea-centred inquiry in elementary science.

Theoretical Foundations

The present research is informed by the theoretical notion of classrooms as Knowledge Communities. Knowledge Building engages student knowledge communities in discursive activity (Scardamalia & Bereiter, 2006), and Knowledge Forum scaffolds asynchronous online discourse (Scardamalia, 2004). Adding a scripted inquiry (Raes et al., 2012) dimension to the knowledge community approach, Slotta and his colleagues have advanced the Knowledge Community and Inquiry model (KCI - Slotta & Najafi, 2012), where students contribute to a collective "knowledge base" which becomes a resource for inquiry activities targeting specific learning goals (Peters & Slotta, 2010). KCI provided a theoretical perspective for the present research. Teachers in this study are veterans of the Knowledge Building approach, which provided further theoretical grounding for our emerging ideas about blended discourse and knowledge building processes within a smart classroom's KCI curriculum.

If language mediates children's thinking and learning (Hicks, 1995), it follows that students working within a knowledge community use language (ideas, utterances, etc) to generate new meaning (Wertsch & Smolka, 1994), with interpersonal communication leading to the development of learners' cognition (Sfard, 2007). Thus the role of discourse in teaching and learning may be viewed as social meaning construction - a necessary aspect of children's conceptual development, by Vygotskyan accounts. Collaborative knowledge construction can occur via asynchronous online discourse and synchronous face-to-face (F2F) oral discourse, if pedagogically-sound technological and teacher scaffolding are provided (Greeno, 2011; Linn & Slotta, 2006; Scardamalia & Bereiter, 2006). Several researchers have developed design principles for learning environments (Engle & Conant, 2002) and orchestration (Penuel et al., 2012) that foster productive spontaneous and ongoing discourse (Lemke, 2009). Indeed, a group's online discursive progress emerges from accumulated spontaneous individual actions (Wise et al., 2012).

Computer-Supported Discourse for Collaborative Learning

A variety of projects have tapped into the potential for technology to script discourse for F2F collaborative learning. The Peer Instruction approach with clickers (Crouch et al., 2007) uses a participant structure to scaffold discourse. CollPad (Nussbaum et al., 2009) uses Pocket PC touch devices deliver collaboration scripts that facilitate reciprocal problem solving. A 'collaboration script' is a set of instructions for how learners interact with one another, and how they approach a task (Dillenbourg, 2002). These approaches add some "orchestrational load" to the teacher, in terms of guiding inquiry discourse informed by their real-time monitoring of the community's idea flow, while simultaneously managing the classroom and engaging in multiple small group interactions in rapid succession. Hence, discussion productivity relies upon a teacher's talent for on-the-fly analysis and facilitation. Furthermore, the approaches to date do now typically allow learners to access the individual contributions of peers - inhibiting learners from forming a complete picture of the community's collective idea flow.

Technological advancements over the past 2 decades have led to the development of extensible messaging and presence protocol (XMPP) affording real-time instant messaging and co-authorship (e.g., Google Docs); as well as "smart classroom" infrastructure enabling pedagogically-oriented scripting to support a distributed array of classroom technologies (Slotta, 2010), for collective and individual inquiry (Raes et al., 2012). "Blended learning" has traditionally been defined as the combination of asynchronous online learning activities with F2F learning (Graham, 2009), and the *act* of "blending" has been asynchronous until now. Our work leverages these technologies for *real-time blending* of F2F synchronous online discourse with F2F oral classroom discourse – hence our term "synchronously blended F2F discourse". This project explores the orchestration of real-time blending of the two discursive modalities. We report on an ongoing program of design research (Collins et al., 2004) to develop a technological and pedagogical innovation known as Common Knowledge (CK), a handheld computer tablet and IWB system enabling student note contribution of questions, theories, and ideas; and "tagging" of these. Notes dynamically appear on tablets and the classroom's IWB, allowing teachers and students to drag notes into topic clusters during oral discussions, swiftly filtering topics as the discussion progresses. By conceptually connecting student reflections, CK provides new pedagogical opportunities for teachers and students to progress on their collective understanding and engage in inquiry practices.

Method & Data Sources

Data sources from our classroom observations included field notes, video recordings, teacher and student interviews, and data logs of CK discussions. We analyzed the data in terms of teachers' orchestrational and discursive scaffolds (Fischer & Dillenbourg, 2006; Fong et al., 2012; Prieto et al., 2011). Participants were 2 veteran grade 5/6 teachers, 'Brad' and 'Jen', in a private elementary school located in a large Canadian city, with 21 and 22 students, respectively (approximately equal numbers of grade 5 and 6 students). Brad had been teaching for 8 years, and Jen for 4 years. The school has an emphasis on inquiry and Knowledge Building pedagogy. Students were engaged in a broader inquiry biodiversity curriculum – WallCology Embedded Phenomena – within which the present study was deeply integrated. In WallCology, students were tasked with investigating a virtual 'live' ecosystem located within their classroom's walls (Moher & Slotta, 2012). We integrated CK discussions into this inquiry curriculum, specifying discussion goals (Nussbaum, 2005) and pre-programming science content and process keyword tags. Teachers also launched spontaneous CK discussions, as they felt warranted.

Findings and Discussion

The goal was to produce a schema for productive inquiry discourse that informs future iterations of CK and the scripting of its enactment. A grounded theory approach was used, to see what orchestrational patterns emerged from classroom enactments. We observed that student CK contributions displayed on the IWB spurred a variety of teacher discourse moves. These moves were coded from video analysis using Fischer & Dillenbourg's (Fischer & Dillenbourg, 2006) 3 dimensions of orchestrational coordination (cognitive, pedagogical, and technological), as well as a fourth dimension, "curricular", capturing teachers' direct treatment of the subject-matter content (Figure 1).

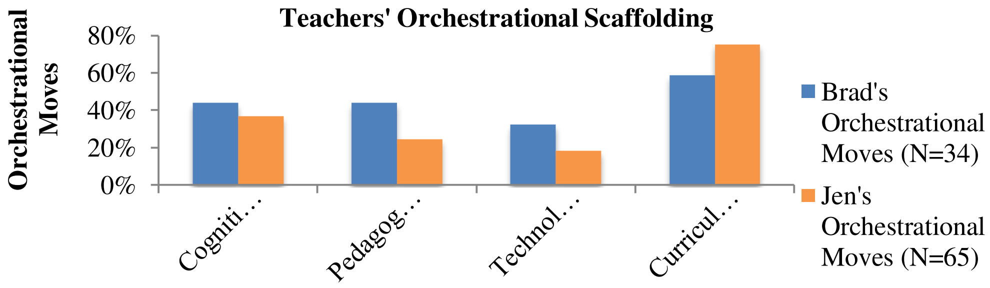

Figure 1. Teacher coordination of discourse in their classrooms.

Video analysis revealed an ongoing cycle of "Release Redirect Reflect Refocus (4Rs)" orchestration cycle, for managing synchronous CK and oral discussions. Throughout this cycle, a grounded theory approach to coding teachers' individual speech turns revealed some prominent discursive moves (Figure 2): "Technology Instruction (TI)", "Solicit Ideas (SI)", "Encourage Hypotheses & Theories (HT)", "Resolve Divergence (RD)", and "Motivate Alternative Approaches (MA)".

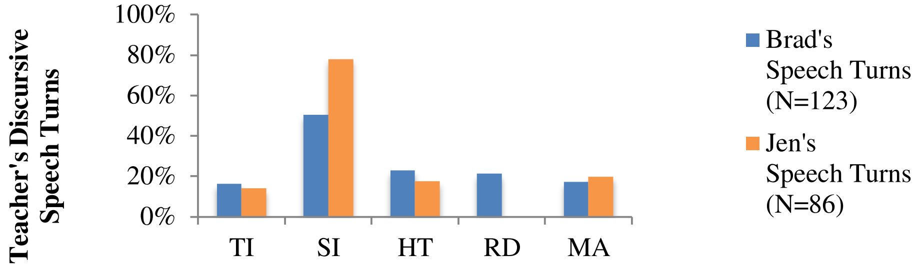

Figure 2. Teachers' discursive moves.

Within the "Reflect" phase of the cycle, teachers' speech turns revealed several types of revoicing or repeating, paraphrasing, or referring to a student's written or spoken contribution to position students in relation to each other and to the academic content (O'Connor & Michaels, 1996). These revoicing functions included: Clarification, Norming, Role Casting, Highlight Common Themes, Highlight Unique Perspectives, Connect, and Relate.

Conclusion & Scientific Significance

Common Knowledge helped to engage students in scientific inquiry processes, and supported a new form of discourse within the classroom – "synchronously blended F2F discourse". Public visualizations on the classroom's IWB of the community's CK notes provided equitable access to at-a-glance formative assessment of emergent idea trajectories, and enabled the physical grouping of ideas by topic. This visualization was a common referent for topic-focused discourse, and a representation of the knowledge community's distributed cognition. These orchestration patterns imply that future iterations of CK must include an *inquiry script* informed by the 4Rs orchestration cycle, to relieve teachers of the cognitive and pedagogical dimensions of orchestration load. CK improvements should include a *collaboration script* that will further relieve teachers' cognitive load, to coordinate student grouping combinations for various stages within this inquiry script. It is our hope that these scripts will facilitate knowledge convergence within a knowledge community. On-the-fly scaffolding could be developed using real-time data mining for smarter filtering and commenting, to address emergent common themes and divergent perspectives within CK discourse. Visualization of idea-note relationships will further reduce teachers' cognitive load in their efforts to guide productive synchronously blended inquiry discourse.

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