Extending Co-Created Cross Community Knowledge Building Discourses

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Abstract: Connecting knowledge communities and databases at a higher social level have been suggested as one of the main focuses for the future knowledge building community and the field of learning sciences (Scardamalia, et al 2017; Stahl, 2013). Bringing Knowledge Building classrooms together and sustaining inquiry-based learning needs new technology and creative designs to facilitate the process over time and across spaces. Innovative research is needed to bridge discourses and practices across Knowledge Building communities over time more smoothly and productively. This study attempts to address this challenge by using a multi-level interaction framework in grade 5 science communities.

Conceptual Framework

Studies have shown that students interacting with multiple communities may have access to new information, gain more learning opportunities, and have a higher motivation (Brown, 1992. Decuyper, Dochy, & Van Den Bossche, 2010). Some studies reveal that community learning may face challenges like ineffective learning outcomes due to poor task design or complicated interaction processes (Mittelmeier et al., 2018). Few studies explicitly addressed the benefits of learning across communities (Rienties and Tempelaar, 2017). Boundaries exist between communities, ideas, identities, structures, institutions, and other entities. Star and Griesemer (1989) assert that boundaries' complexity and ambiguity make them full of potential new possibilities. Existing studies have mainly focused on the inquiry discourse for individual classrooms, and the discourse mainly focuses on the single community level. However, research gaps persist in how students extend their interaction with other communities to sustain and build-on their authentic inquiries over a long time; more studies are required to understand the nature of boundary objects and boundary-crossing learning processes for knowledge creation over time.

Cross-community interactions using boundary objects

The boundary object with the same structure can facilitate the information transition between different communities, which can also be interpreted differently depending on the community's needs (Star and Griesemer,1989). In this study, the boundary objects take the form of Journey of Thinking: a reflection summary with the same structure created by students and their learning processes. After the Journey of Thinking is generated, it is further shared and reviewed with other communities in a shared online space. This synthetic boundary object-Journey of Thinking enables individuals to understand the discussion and extend inquiry progress in other communities. With careful sharing, reading, and building-on, these Knowledge Building behaviors further sustain the cross-community interactions. The newcomers can access the existing knowledge with a clear purpose facilitated by Journey of Thinking. As members access diverse ideas and in-depth thinking beyond their current community, extended connections and insights from the broader scale expand the inquiry process and enrich the research contexts (Zhang, Tao, Chen, Sun, Judson & Naqvi, 2018). Students can conduct advanced research according to the emergence of new challenges or new research inquiries along with Journey of Thinking readings and writings.

The downward impact of cross-community dynamics on within-community inquiry and discourse

The Downward causal effect refers to the impact of the emergent macro-level interactions on micro-level KB activities. It is reflected in two aspects, as elaborated below. On the one hand, students co-generate the interactional frame of Knowledge Building norms, metacognitive meeting rules, distribute workloads and collective responsibilities in each group, and co-generate the online discussion norms. These emergent collective actions then regulate and promote their collective actions. These two processes are inseparable and happen simultaneously, which means that the emergence of students' KB discourse, behavior patterns, and KB norms contributes to the continuing process of collaborative inquiry. However, at the same time, it regulates and accelerates students' behaviors in shared KB environment culture by the mutually agreed norms that are created at that moment. The stable material content structures and discursive patterns guide, direct, and constrain individuals. However, this guidance and constraint often

contain a contingency that is never fully constrained, as the emergence frame is continually evolving. On the other hand, the collective knowledge of the classrooms has to tap into the knowledge accumulated at the individual class level because the individual class is the basis of organizational knowledge creation. "Super Talk" is the collaborative online space where students from the four classes work together to address the same challenging problem. The learning results also impact and transform the dynamic learning back to each class and the individual student. The accumulation of knowledge created in the online space will leverage each classroom's understanding when a student acts as a boundary broker, bringing these new insights back to their home classes. It leverages the home class's understanding and creates new opportunities to reorganize the current classroom's accumulation of knowledge. The collaborative space and boundary objects not only provide students with an infrastructure that enables knowledge creation across communities but also the knowledge infrastructure provides inquiry and learning with a trustworthy, vetted background database created by students.

Methods

Technology and classroom contexts

Drawing upon the results of the previous two years' research (Zhang, Bogouslavsky & Yuan, 2017, Yuan & Zhang, 2019), the research team has been continuously developing and revising features of a new technology tool called Idea Thread Mapper (ITM), an innovative tool embedded in Knowledge Forum to further support students' collaboration both within and across communities (Chen & Zhang, 2016).

This study was conducted in four grade 5 classrooms (with a total of 89 students who were 10-to-11 years old) that studied human body systems over six months using ITM. The four classrooms, labeled as Class 1-4, were taught by two teachers, each teaching two classes. Students in each classroom generated interest-driven questions, co-created wondering areas focusing on various human body systems, and conducted research using various resources. They conducted reflective knowledge-building conversation (called "metacognitive meetings") in their classroom to build on one another's questions and ideas while reviewing their progress. The conversation continued on ITM in their online discourse space organized as various idea threads, each addressing an overarching problem/theme. As progress is made in each idea thread, students co-created and edited *Journey of Thinking* to reflect on their knowledge (Figure 1). The Journey of Thinking was then shared with all the other classrooms. Drawing upon their knowledge built about the various body systems, students in Class 3 proposed a challenging problem for "Super Talk" across the classrooms at the beginning of the 6th month. The other classrooms supported this proposal. Students from the four classrooms worked together to discuss this overarching question. Near the end of the unit, each class had a metacognitive meeting to review knowledge gained from the "Super Talk" and build connections with the different human body systems. To understand how students interact across classrooms, this study attempts to address this challenge by asking three major questions :1) How did students co-create knowledge-building discourses to address challenging research at a higher social level? 2) How did students' within-classroom and between-classroom knowledge building discourses change before and after the cross-classroom interaction? 3) How did the teachers facilitate cross-classroom interactions?

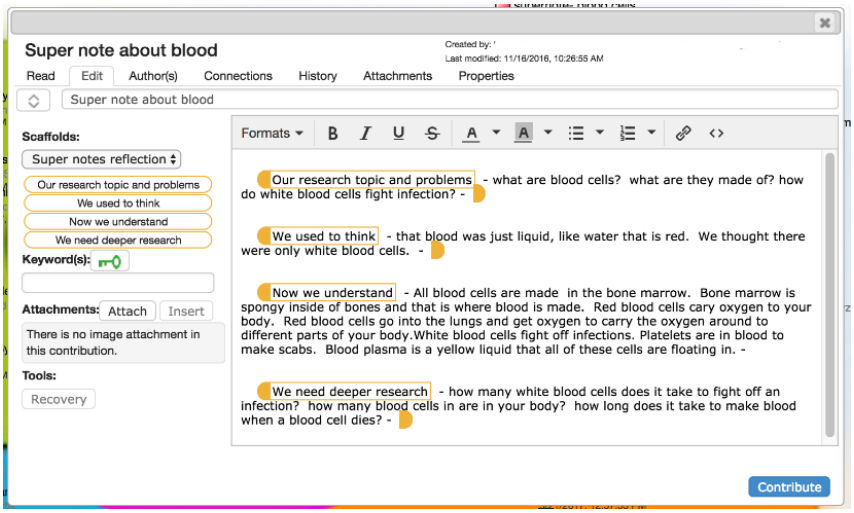


Figure 1. The Journey of Thinking Created by Blood and Cells Group in study-1 using the Journey of Thinking scaffolds: Our research topic and problems, we used to think, now we understand, we need deeper research.

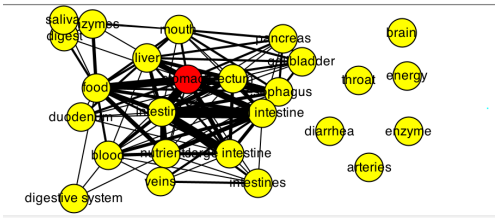
Results

How did students co-create knowledge-building discourses to address a challenging research at the higher social level?

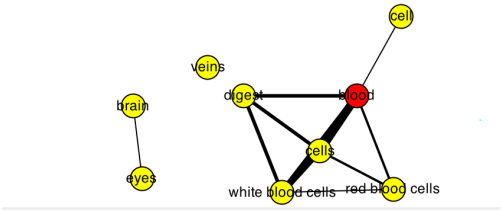
To understand how students collaborate with peers from other communities via "Super Talk," researchers examined the "Super Talk" discourse with 22 students participating in the discussion from four classrooms. Students collaboratively answered the research question from Bone and Muscles, Brain and Nervous systems, Cells and Genetics, and Digestive systems. Approximately 50% of the notes are built-on, reflecting a higher level of student collaboration and knowledge build-on. 86% of the notes show a higher level of elaborated explanations (Zhang, Scardamalia, Lamon, Messina, & Reeve, 2007), which shows students' efforts to produce high-quality notes in the "Super Talk."

How did students' within and between-classroom knowledge building discourses change before and after the cross-classroom interaction?

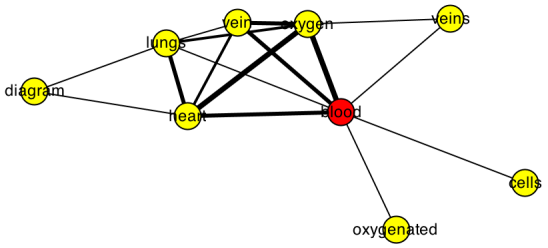
To understand how the within-classroom discourses changed over the six months. A discourse analysis software KBDex (Oshima, 2012) was used to examine how the key concepts co-created from students' face-to-face metacognitive meetings changed over time. The researchers selected one metacognitive meeting from each month to trace the changes of the key concepts from Class 3 (labeled as metacognitive meeting 1-6). The results show several patterns: at the beginning of the semester, students' main focus was on individual organs, for instance, muscles, blood, and brain, respectively. However, in the middle, students started to learn inter-connected concepts between two or more systems. In the last month, the central concept was the cell, representing the main cutting-edge concept that connects every other human body organ (Figure 2).



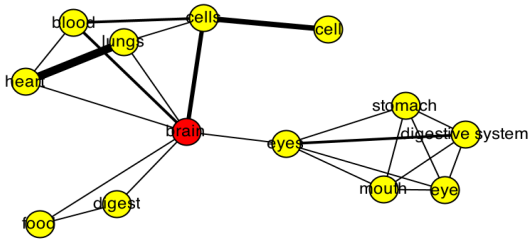
Class 3's Metacognitive Meeting-1



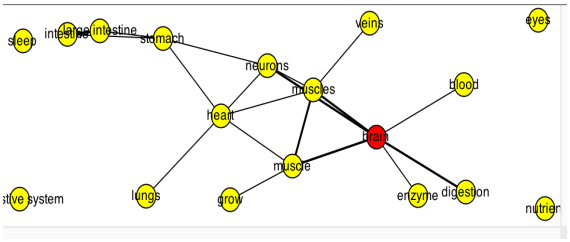
Class 3's Metacognitive Meeting-2



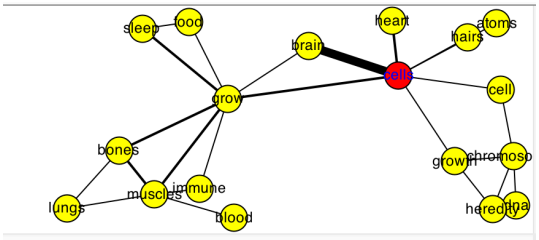
Class 3's Metacognitive Meeting-3



Class 3's Metacognitive Meeting-4



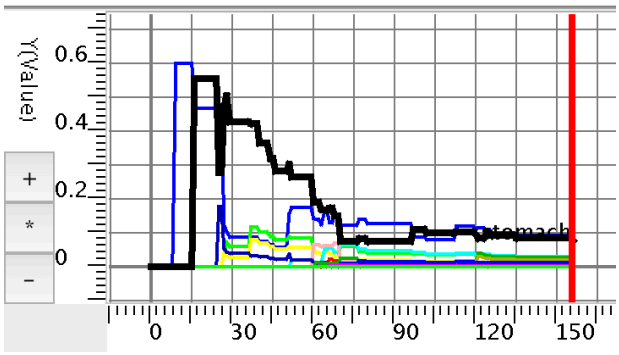
Class 3's Metacognitive Meeting-5



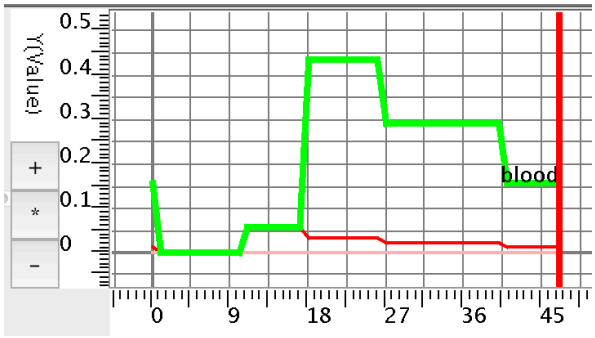
Class 3's Metacognitive Meeting-6

Figure 2: The changes of the main concepts of the metacognitive meetings from the 1st month to the 6th month. (red represents the main systems students mentioned)

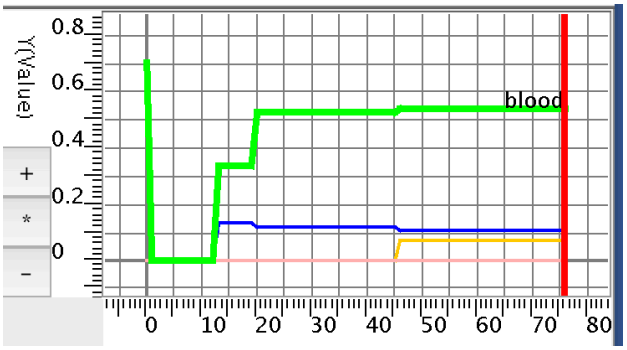
Furthermore, the researchers analyzed each main concept's betweenness centrality (Figure 3). The results support the changes mentioned above. Before the cross-classroom interaction, students gradually built up their knowledge blocks from each concept. As time goes by, they understood the overarching relationships. For instance, in the fourth and fifth months, the concept "Brain" stood out as having the highest betweenness centrality among the discussed concepts, suggesting that students' discourse positioned the brain as the central topic connected with other systems. They consider the brain was the main concept that bridges other separate concepts. However, after the cross-classroom interaction, due to the broker who brought back the fundamental concept, cell, to the local community's discussion, students made extensive connections and considered cells as the fundamental concept that bridges other human organ concepts (Figure 4). As the results show, the concept of "Cell" had the highest gain in betweenness centrality. Student K12, who acted as broker, brought back the concept of cell mitosis from the Super Talk and triggered extended discussion related to cells in the home class. According to the science standards, the concept of cell and mitosis is required by Grade 8 and Grade 9-12, respectively.



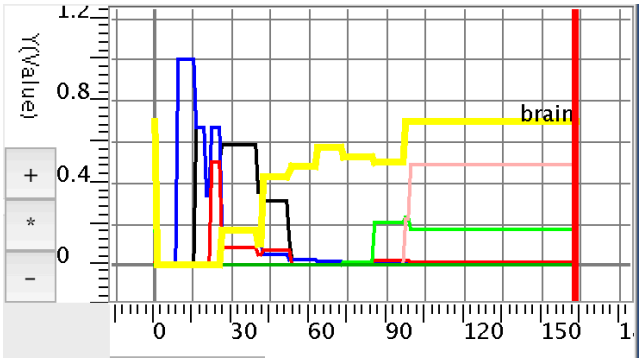
Class 3's Metacognitive Meeting-1-Stomach



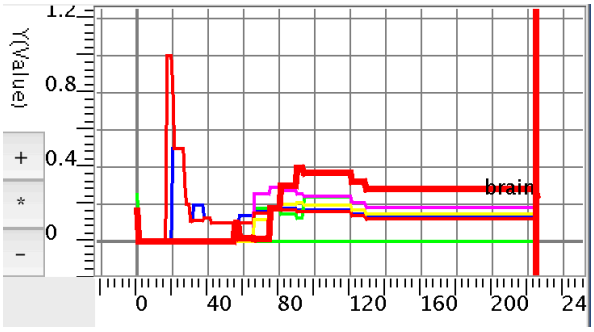
Class 3's Metacognitive Meeting-2-Blood



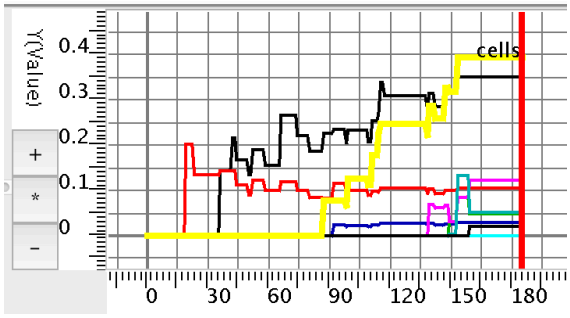
Class 3's Metacognitive Meeting-3-Blood



Class 3's Metacognitive Meeting-4-Brain



Class 3's Metacognitive Meeting-5-Brain



Class 3's Metacognitive Meeting-6-Cells

Figure 3. Betweenness centrality of the key concepts discussed in the metacognitive meeting before and after the "Super Talk" meeting over the six months.

How did the teachers facilitate the cross-classroom interactions?

To understand how the teacher facilitates the cross-classroom interaction, the researcher applied a new set of metacognitive meeting coding schemes (Yuan & Zhang, 2019). The metacognitive meeting has many formats and has been held to address different questions under different circumstances; for instance, the metacognitive meetings were held with specific themes at the beginning of the semester. Towards the end of the semester, the metacognitive meetings focused on connections between various expert areas. Through the qualitative analysis of the metacognitive meetings' video recordings, the researcher found several main patterns of how the teachers facilitate the metacognitive meetings to deepen students' conversation in idea advancement. For instance, at the beginning of the metacognitive meeting, the teacher first directed the discussion by highlighting the main concepts and then opening up the conversation by giving students a chance to share. Instead of directly offering the knowledge in the middle of the conversation, the teacher deepened the conversation by continually asking updated questions for clarification and explanation. The teacher invited other students to join the conversation to contribute their knowledge to the focal research question and give positive feedback and confirmation. Finally, the teachers ended up the conversation by summarizing the information that students mentioned and encouraged them to reflect on their learning experiences.

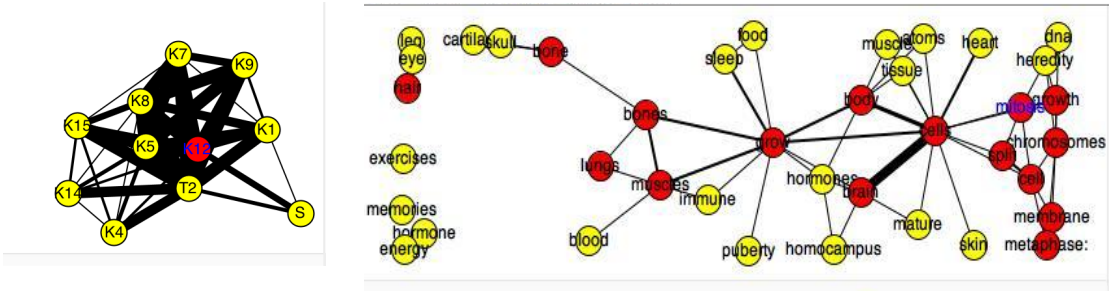


Figure 4. Student K12 from Class A brought in a major concept from "Super Talk" back to the home class and triggered extended connections in MM

Scholarly significance of the study or work

Based on the results mentioned above, this study sheds light on the possible designs and processes to enable collaborative knowledge building across a network of classrooms in a broader learning environment and ongoing learning process. The findings elaborated on a multi-level, emergent interaction approach to supporting student knowledge building in their local and cross-community spaces over an extended period. It is crucial to approach collaborative knowledge space as an essential component of learning space design for learning communities. This study also further demonstrates the possibility to extend the design of collaborative knowledge space to include a cross-community layer.

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