Computer-Supported Metadiscourse to Foster Collective Progress in Knowledge-Building Communities

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Abstract: This study investigates metacognitive conversations in two grade 5/6 classrooms that engaged in knowledge building about the human body using Knowledge Forum. The metacognitive conversations were supported by Idea Thread Mapper (ITM), which makes collective progress in online discourse visible for collaborative reflection. The analyses elaborate the processes of the metadiscourse and the teachers' role.

Introduction

Inquiry-based learning programs need to foster a self-sustained, progressive trajectory of inquiry among students in line with knowledge practices of real-word creative communities (Sawyer, 2007). Instead of relying on teacher-specified procedures, scripts, and resources of inquiry, students take on collective responsibility for monitoring and advancing their community's knowledge (Scardamalia, 2002). Previous research suggests the importance of metacognitive conversations—metadiscourse—as a means to fostering collective responsibility. Through metadiscourse, students review the conceptual landscape generated through their knowledge-building discourse, monitor core problems and goals, reflect on what they have achieved as a community, and identify deeper goals and collaborative actions (Zhang et al., 2009). Despite the importance of metadiscourse, this discourse pattern is rarely seen in computer-supported collaborative classrooms (van Aalst, 2009). In online discourse through threaded discussions, chatting, and messaging, student ideas are distributed across individual postings over time (Suthers et al., 2008). It is difficult for students to understand the conceptual landscape of their collective work, to identify knowledge advances, and to reflect on gaps and challenges.

To represent collective knowledge in extended online discourse, we recently created a timeline-based collective knowledge-mapping tool: Idea Threads Mapper (ITM). An idea thread represents a line of inquiry composed of a series of conceptually related discourse entries that address a shared focal problem, extending from the first to the last discourse entry (Zhang et al., 2007). Interoperating with Knowledge Forum (Scardamalia & Bereiter, 2006), ITM helps students to review shared focal themes, as communal goals, that have emerged from interactive discourse and identify and review ideas contributed to address each focal goal over time. ITM integrates three levels (or units) of ideas in knowledge-building discourse: an *idea* contributed in a discourse entry (e.g., Knowledge Forum note), an *idea thread* consisting of multiple entries addressing a focal issue, and a *network of idea threads* for a whole inquiry initiative (Figure 1) (see Chen et al., 2013 for more details). This study investigates how ITM can be used to support metacognitive conversations among young students for sustained knowledge building. Our research questions ask: how do young students engage in metadiscourse to co-construct idea threads to represent and advance collective knowledge in extended discourse, and with what support from their teacher?

Method

This study was conducted in two grades 5/6 classrooms, each of which had 22 students who investigated the human body systems over a two-month period. The two classrooms were taught by two teachers: Teacher A in her first year and B in his sixth year working with knowledge building/Knowledge Forum. By analyzing these two classrooms as two cases, we attempted to discover a grounded theory (Glaser & Strauss, 1967) about how ITM-aided metadiscourse is conducted to support knowledge building. The classroom processes integrated knowledge-building conversations, individual and group-based reading, student-designed experiments and observations, and interactions in Knowledge Forum. The researchers worked with the teachers to design procedures of ITM-aided reflection, which was implemented around the midpoint of the inquiry using approximately two hours to review progress and plan for deeper inquiry.

For data analysis, the ITM-aided reflection session in each class was video recorded. The videos were transcribed and analyzed using a narrative approach to video analysis (Derry et al., 2010). Two researchers first browsed the videos and transcriptions to develop an overall sense of the reflective processes, and then identified "digestible" chunks in the videos—major episodes of the reflective conversations by which students identified and negotiated "juicy topics," selected important discourse contributions, synthesized progress, and planned for deeper inquiries. These chunks were contextualized and linked to develop a storyline for each classroom, showing how the two communities engaged in

metadiscourse on collective knowledge progress. Further analysis was conducted focusing on the teachers' conversation turns to understand how they scaffolded the metadiscourse and co-reflection. Through a grounded theory approach, two researchers developed raw codes to capture the roles of the teachers. They then shared and discussed the raw codes in relation to the data coded, resolved disagreements, and classified the codes into larger themes that indicated different patterns of scaffolding (see Results for the patterns). Complementing the video data, we interviewed five students from each classroom before and five different students after the ITM-aided reflection. The interview focused on student awareness of the important themes explored by their community, advances, problems, and experience with ITM.
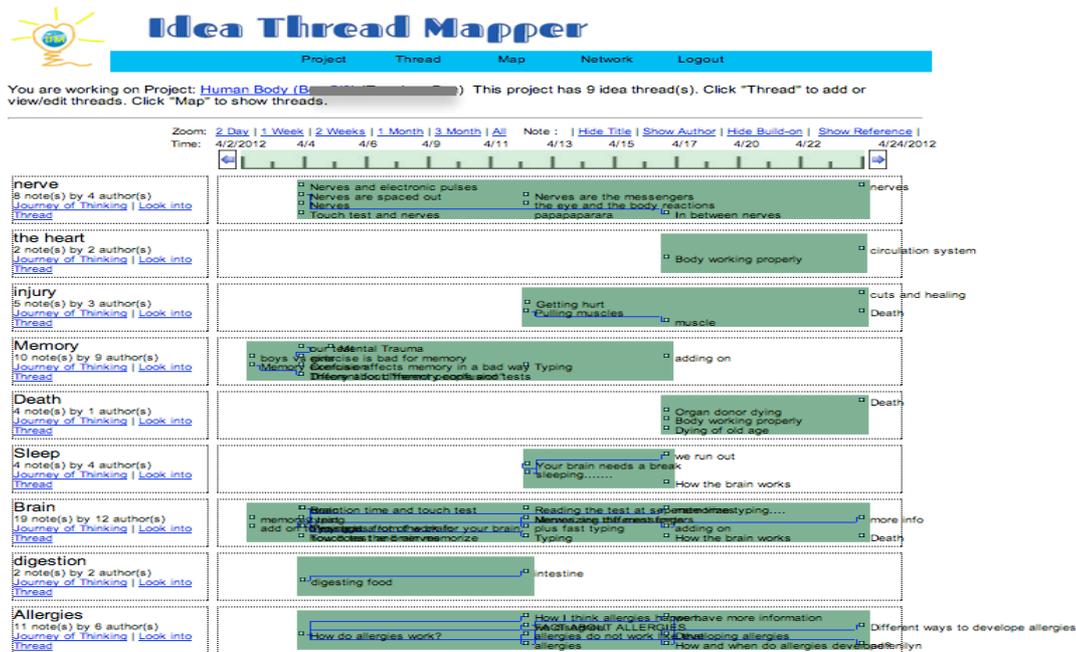

Figure 1. A map of idea threads created by a grade 5/6 classroom studying the human body. Each stripe represents an idea thread addressing a focal theme. Each square in the threads represents a note, and a line between two notes represents a build-on link.

Results

The video analysis revealed multi-level collaborative interactions in the metadiscourse that gave emergence to collective knowledge. Figure 2 shows the multi-level, emergent interactions captured in class B's metadiscourse aided by ITM, with similar processes observed in class A's videos.
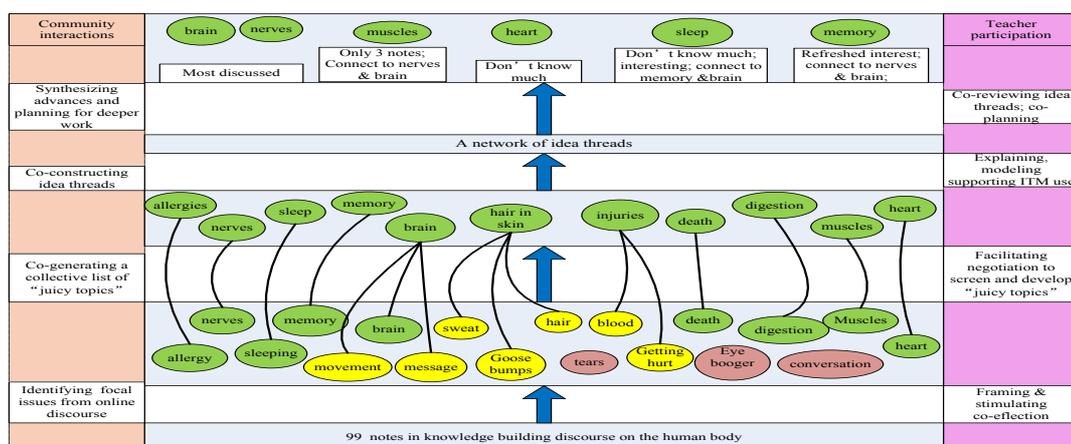

Figure 2. Multiple levels of emergent interactions to reflect on collective knowledge progress.

Identifying Focal Issues and Co-Generating "Juicy" Topics

Enabling emergence of ideas at the micro level, students engaged in online knowledge-building discourse and face-to-face interactions to generate ideas about how the human body systems work, with 139

Knowledge Forum notes created in class A and 99 in class B prior to the ITM session. In the ITM-aided reflection, students reviewed and rose above diverse ideas in the knowledge-building discourse by identifying core "juicy topics." In class A, facilitated by a relatively junior teacher, this was done through two phases: Students first individually reviewed their Knowledge Forum discourse and wrote down important themes in their notebooks. Analysis of the notebooks indicated that each student recorded one to three topics. They, then, shared the topics to generate a collective list of "juicy topics" that represent the community's collective focuses. Classroom B, facilitated by a more experienced teacher, integrated the above two phases into a whole class conversation in which students proposed major topics and co-reviewed the proposals to construct a shared list of "juicy topics."

The teachers' role to support the co-emergence of "juicy topics" focused on framing and stimulating co-reflection. They highlighted the epistemic need to review and organize collective knowledge advances, such as by saying: *"In just about like three weeks, ...we got 99 notes, and I was trying to look at this [Knowledge Forum view] today and I realize that...it's big and complicated... There's a new way of kind of organizing some of these ... into a way that might help us to understand what we have done, what we like to...do more. Um, I want to ask, ... what are some big, 'juicy topics' that have come out here?"* (Teacher B) The teachers further discussed about what might be considered as a "big idea" or "juicy topic:" *"big ideas that you came across in the view that will help us really understand important things about the human body and help us to sort of progress what we know as a class."* (Teacher A)

Students then proposed topics of inquiry based on their personal understanding of the community's discourse. Students in class B proposed a total of 22 possible topics for the community to review, including allergies, nerves, sleeping, and so forth (see Figure 2). These topics were proposed for collaborative review and screening to judge the importance, elaborate the scope of issues explored, and discuss their relations to other issues investigated. The teachers facilitated and participated in the co-construction of core, "juicy topics" and recorded the accepted proposals on a blackboard. Some of the topics proposed were discussed and directly accepted by the community (e.g., allergies, death). Broad topics (e.g., brain) were elaborated and expanded to highlight the more specific focuses (movement, memory). A few topics proposed using intuitive language (e.g., getting hurt, bleeding, healing) were elaborated to clarify the deeper, scientific ideas (e.g., injury, immune system). Meanwhile, a few topic proposals, such as eye-booger and tears, were commented as minor issues. Through such reflective conversation, Class B generated a collective list of 11 "juicy topics:" allergies, brain, sleeping, nerves, hair in skin, memory, digestion, death, injuries, heart, and muscles. Class A generated a collective list of eight "juicy topics," including the brain, messaging in the body, central nervous system, heart, muscles, nutrition and eating, and immune system.

Co-Constructing Idea Threads by Reviewing and Selecting Idea Contributions

To review knowledge building progress related to the "juicy topics" identified, students created idea threads using ITM. In both classes, the teacher explained the purpose and intention of ITM, co-constructed one idea thread with the whole class, as an example, formed voluntary small-groups to construct idea threads, and provided technical assistance. For example, teacher A first introduced and explained ITM: *"We are going to sign in ... this really exciting new tool... If I say an "idea thread," you know what I mean? [Several students talk] Sort of like a chain of ideas that link to each other and that...starts with a question or idea and builds more and more knowledge... and hopefully also more questions as the idea moves along..."* Focusing on a focal topic (e.g., messaging in class A and allergies in class B), the teacher worked with students to decide what key terms should be used to search for Knowledge Forum notes using ITM, review the notes, and selected notes that contributed to the community's understanding. ITM displayed the notes selected as an idea thread, which became accessible and editable by all the community members. Following the processes to construct the above thread, as an example, students then worked as small groups, each of which created an idea thread focusing on one of the topics they previously identified. The teacher's role in this process focused on co-reviewing idea contributions, co-interpreting patterns of conversations in each thread, and providing technical support. Displaying idea threads on a timeline with options to zoom in/out helps students to see idea connections and build-on over time.

Synthesizing Collective Advances and Co-Planning for Deeper Work

With all the idea threads mapped out and projected on a screen (see class B's map in Figure 2), the teacher then worked with the whole class to review their collective work in the different lines of inquiry, reflect on major advances, and identify weak areas. They looked at the length of each idea thread and density of build-on links, and discussed how the different streams of inquiry related to one another. For example, by reviewing their idea threads map, students in class B found that they had conducted long and intensive discourse about the brain, nerves, and allergies, which were core topics that they were aware of prior to the ITM reflection. However, they were surprised to find that the thread on memory had engaged extensive discussions (10 notes by nine authors), and that the thread on heart, a critical part of the human body, only

had two notes, one of which was shared with the idea thread on death. Based on the co-reflection, students discussed areas that were interesting and needed deeper work, including the brain, nerves, heart, and sleep (see the top of Figure 2). Similarly, teacher A facilitated metacognitive conversations among her students as they co-examined their map of idea threads. As an important insight, they realized that the human body is a system where everything is connected and that there are some parts (heart, messaging system) that seem important and tie all the other parts together.

Students further worked in small-groups to write "Journeys of Thinking" that included three sections: our problem, our progress, and we need to do more. Each section has a set of scaffold supports. For example, synthesizing their progress in the idea thread on messaging in the body, students wrote: *"[We used to think:] ... that the body just moved by itself. You just thought it, and it happened! [We now understand:] that the nerves help you move; your brain sends the message that you want move; the vertebrae help you move and send messages."*

As the student interviews suggest, the reflective conversations aided by ITM increased student awareness of their collective knowledge. Each student identified 2 to 3 major topics of inquiry in the individual interview. Idea threads constructed by the community highlighted many more themes (eight in class A and nine in B), bringing important focuses and ideas of the community to the attention of all its members. ITM further helped students to understand their collective trajectory of ideas through its temporal display of notes and build-on links within each idea thread and across the whole knowledge building initiative, and through co-summarizing "Journeys of Thinking" about advances and deeper issues. As the students commented, "*I think that it can help you know what you should study more and look into more.*"

Discussion

The analyses resulted in a grounded theory about ITM-aided metadiscourse as multi-level emergent processes. The fifth- and sixth-graders co-constructed core "juicy topics" based on their monitoring of ideas in the extended knowledge-building discourse; reviewed and selected important ideas addressing each juicy topic to construct idea threads; rose above the specific idea to co-summarize "Journeys of Thinking"; and co-reviewed the map of idea threads to identify advances and weak areas for the whole knowledge building initiative. Such reflective processes helped to increase student awareness of their community's knowledge and inform collaborative, deepening efforts to further advance it. The teachers' role to support the metadiscourse focused on (a) framing and stimulating co-reflection such as by highlighting the epistemic need to review collective knowledge and elaborating what counts as big ideas or "juicy topics," (b) explaining and modeling ITM use (e.g., what makes an idea thread) and providing in-situ technical assistance, (c) facilitating negotiation to co-construct "juicy topics" and review contributions, (d) co-reflecting on the idea threads to synthesize progress, and (e) co-planning knowledge building in areas that needed deeper work. Building on these preliminary findings, we are conducting further design experiments to engage students in ITM-aided metadiscourse on an ongoing basis and examine the impact more comprehensively by using an expanded range of research measures.

References

Chen, M.-H., Zhang, J., & Lee, J. (2013). Making collective progress visible for sustained knowledge building. In: Proceedings of CSCL 2013. Madison, WI: ISLS.

Derry, S. J., Pea, R. D., Barron, B., Engle, R.A., Erickson, F. Goldman, R., et al. (2010). Conducting video research in the learning sciences. *Journal of the Learning Sciences, 19*, 3–53.

Glaser, B. G., & Strauss, A. (1967). *The discovery of grounded theory*. Chicago, IL: Aldine.

Sawyer, R. K. (2007). *Group genius: The creative power of collaboration*. New York: Basic Books.

Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.), *Liberal Education in a Knowledge Society* (pp. 67–98). Chicago, IL: Open Court.

Suthers, D., Vatrapu, R., Medina, R., Joseph, S., & Dwyer, N. (2008). Beyond threaded discussion. *Computers and Education, 50*, 1103-1127.

van Aalst, J. (2009) Distinguishing knowledge-sharing, knowledge-construction, and knowledge-creation discourses. *International Journal of Computer-Supported Collaborative Learning, 4* (3), 259-287.

Zhang, J., Scardamalia, M., Lamon, M., Messina, R., & Reeve, R. (2007). Socio-cognitive dynamics of knowledge building in the work of nine- and ten-year-olds. *Educational Technology Research and Development, 55*, 117–145.

Zhang, J., Scardamalia, M., Reeve, R., & Messina, R. (2009). Designs for collective cognitive responsibility in knowledge building communities. *Journal of the Learning Sciences, 18*, 7–44.

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