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**Deepening Inquiry about Human Body Systems through
Computer-Supported Collective Metadiscourse**

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Abstract

This mixed methods study was conducted in a grades 5/6 classroom with 22 students who conducted collaborative knowledge building about human body systems using Knowledge Forum over a two-month period. Around the midpoint of this inquiry, students used Idea Thread Mapper (ITM) to engage in metadiscourse (metacognitive conversations) to review collective progress in extended online discourse. ITM was designed to make unfolding trajectories of inquiry visible in online discourse for student reflection. Video analysis elaborated the processes of metacognitive conversations supported by teacher scaffolding. Through such metacognitive conversations and reflection, students identified advances and formulated deeper goals and questions for their further inquiry, leading to more advanced understanding of the human body as a complex system that was examined through content analysis.

Introduction

Inquiry-based learning programs need to foster an extended, self-sustained, progressive trajectory of inquiry among students in line with knowledge practices of real-world creative communities (Dean & Kuhn, 2007; Hakkarainen, 2003; Sawyer, 2007; Zhang, 2013). Knowledge productivity in such communities is achieved through a sustained trajectory of inquiry, by which ideas are continually generated, refined, and further built upon by peers to formulate more advanced ideas and problems. This process expands the community's collective knowledge that continually informs further initiatives (Bereiter, 2002; Dunbar, 1997; Sawyer, 2007). However, current inquiry learning programs tend to focus on relatively short inquiry activities carried out by fixed small-groups following tasks and procedures set up by the teacher. Further research needs to test designs to foster sustained, collective trajectories of inquiry in knowledge-building communities driven by student interactive discourse and ideas (Zhang, 2013), with students taking on a high-level collective responsibility (Scardamalia, 2002). This study aims to address this need by elaborating designs that engage students in collaborative, metacognitive conversations to review unfolding, collective trajectories of inquiry supported by a new tool for online discourse tracing and mapping: Idea Thread Mapper (Zhang et al., 2012; Chen et al., 2013).

Instead of relying on teacher-specified procedures of inquiry, students in a knowledge building community need to take on collective responsibility for charting progressive, deepening courses of inquiry for their community (Scardamalia, 2002). They need to monitor the evolving status of their community's collective knowledge emerging from ongoing knowledge-building discourse: their evolving goals and challenges, streams of work and advances, participatory structures, and idea connections (Zhang et al., 2009). Enacting such

collective responsibility requires students to engage in socially shared regulation to plan, monitor, regulate, and adapt their joint processes in order to optimize members' contribution to achieving their shared outcomes (Järvelä & Hadwin, 2013; Volet et al., 2009). Collaborative online environments support sustained collective knowledge advancement by providing students with shared knowledge spaces where their ideas can be contributed, examined, refined, and built upon through sustained discourse and interactions (Scardamalia & Bereiter, 2006; Stahl, 2006). However, current designs of online discourse environments lack effective means to represent and capture collective knowledge progress for reflective monitoring and sustained advancement. In online discussions and messaging, student ideas are distributed across individual postings over time (Suthers et al., 2008). It is hard for students to understand the collective conceptual landscape emerged from the ongoing discourse, to identify advances and focal challenges, and to develop fruitful idea connections (Zhang, 2009). Consequently, student online discourse is often disconnected, short-threaded, and ill-grounded (Guzdial et al., 2001), with peer responses focusing on individual and most recently posted ideas (Hewitt, 2001) and ideas from their own small-groups.

To represent collective knowledge progress in extended online discourse, we recently created a timeline-based collective knowledge-mapping tool: Idea Threads Mapper (ITM). Beyond micro-level representations of discourse as postings and build-on trees (physical conversation threads), we introduced idea threads (or inquiry threads) (Zhang et al., 2007) as a larger, emergent unit of ideas in online discourse. Each idea thread represents a conceptual line of discourse addressing a shared problem. It is composed of a chronological sequence of discourse entries (possibly in several build-on trees) contributed by a subset of the members of a community. Expanding existing efforts to create synthetic representations of collective

knowledge in online discourse (Bell, 1997; Hewitt & Woodruff, 2010; Janssen et al., 2010; Suthers et al., 2008; van Aalst & Chan, 2007), we use student-generated idea threads and syntheses to make shared focuses and unfolding trajectories of discourse visible for student reflection. Idea Thread Mapper (ITM) (<http://tccl.rit.albany.edu:8080/ITM>) was created to assist students to identify and review idea threads emerged from their ongoing online discourse. ITM interoperates with Knowledge Forum (Scardamalia & Bereiter, 2006) and potentially other platforms that support knowledge-building discourse. Using ITM, students engage in metacognitive conversations to identify high-interest focuses of inquiry (e.g., how the lungs work) from their ongoing discourse in an inquiry initiative/project. Students who are knowledgeable about the various focal topics then work in small-groups to select key discourse contributions for each focus. ITM plots the discourse contributions addressing the same focal topic on a timeline, as an idea thread, with build-on links visually identified (see Figure 1). ITM further retrieves contributors (i.e. authors) in each idea thread, who represent a social knot/group in action to address shared issues. Through reviewing the discourse contributions, students co-author a wiki-like synthesis, a “Journey of Thinking,” for each idea thread to summarize the key questions, “big ideas,” and deeper issues. The whole community then maps out the different idea threads to discuss their shared progress, potential connections and clusters, and weak areas, informing deeper inquiry and collaboration in a whole inquiry initiative.

<Insert Figure 1 here>

With students engaging in ongoing knowledge building discourse in Knowledge Forum (or another online platform), ITM supports students’ meta-level reflective discourse about their ongoing discourse: metadiscourse. Instead of talking about specific content-

related ideas, students engage in metadiscourse to construct metacognitive elements and frameworks of their work, addressing high-level questions such as what needs to be understood and achieved, through what efforts and by whom, and with what progress. In linguistics, metadiscourse has been generally defined as “discourse about the discourse.” (Latawiec, 2012) Metadiscourse serves two overarching functions: (a) talk-organizing, to connect and organize the flow of the discourse; and (b) talk-evaluating, to evaluate and position the meanings expressed and reflect on patterns and norms of productive discourse (Latawiec, 2012; Shiffrin, 1980; Vande Kopple, 1985). However, the term “metadiscourse” in linguistics tends to focus on micro metadiscourse markers (e.g. attitudinal quantifiers, emphatics and hedges, topicalizers) used by individuals to organize and evaluate specific ideas to be communicated through oral or written discourse. In the context of collaborative knowledge building, we redefine this concept at a higher social level as “collective metadiscourse,” which is conducted by members of a community (group) to co-review, organize, and evaluate their ongoing discourse in a whole inquiry initiative over an extended time period. Examples of such metadiscourse include student talks to review the state of understanding in the community, identify deeper foci and more advanced goals for their community over time, propose a new phase or direction of inquiry (Scardamalia & Bereiter, 2006; van Aalst, 2009), and re-organize their discourse spaces, group structures, and inquiry activities to best address their evolving goals (Zhang et al., 2009). Despite its importance, such metadiscourse is rarely seen in classroom and online discussions even in inquiry-based settings (van Aalst, 2009).

The purpose of this study is to test classroom processes to engage young students in collective metadiscourse and reflection for sustained knowledge building with the support of

ITM that makes collective knowledge progress visible in extended online discourse. A pilot study was conducted in a Grade 3 classroom that used ITM to engage students in metacognitive conversation and reflection to review focal themes and goals emerging from interactive discourse, identify important ideas contributed over time, and plan for deeper work, with promising findings (Chen et al, 2013). The current study further elaborates on the processes of ITM-aided metadiscourse and examines its role in sustaining knowledge building. Our research questions ask: how do young students engage in collective metadiscourse to co-construct idea threads to represent and advance their collective knowledge in extended discourse, and with what support from their teacher? To what extent does such metadiscourse and reflection contribute to deepening inquiry about complex scientific topics, such as the human body?

Method

Classroom Contexts

This mixed methods study was conducted in a grades 5/6 classroom that had 22 students who investigated the human body systems over a two-month period. The classroom processes integrated knowledge-building conversations, individual and group-based reading, student-designed experiments and observations, and online discourse and interactions in Knowledge Forum, a collaborative knowledge-building environment (Scardamalia & Bereiter, 2006). The researchers worked with the teacher to design procedures of ITM-aided metadiscourse and reflection, which was implemented around the midpoint of the inquiry using approximately 2.5 hours to review progress and plan for deeper inquiry.

Data Analysis

For data analysis, the ITM-aided reflection session 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, showing how the community engaged in metadiscourse focusing on collective knowledge progress. Further analysis was conducted focusing on the teacher’s conversation turns to understand how she scaffolded the metadiscourse and co-reflection. Through a grounded theory approach (Glaser & Strauss, 1967), two researchers developed raw codes to capture the roles of the teacher. 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).

To examine students’ deepening efforts and progress of inquiry, we conducted content analysis (Chi, 1997) of student online discourse in Knowledge Forum, ITM “Journey of Thinking” syntheses written by students to summarize questions and advances in each idea thread, and final presentations that summarized what they had learned. Previous research suggests that understanding complex systems, such as the human body, requires students to go beyond describing the structural components to understand system behaviors and functions: the dynamic mechanisms and workings that allow the structures to carry out certain functions (Hmelo, Holton, & Kolodner, 2000). Novices’ understanding tend to focus more on structures while experts employ behaviors and functions as a key to organizing and

extending their knowledge of complex systems (Hmelo-Silver & Pfeffer, 2004; Hmelo-Silver et al., 2007). A coding scheme was designed based on this structure-behavior-function (SBF) framework to code student discourse and understanding of the nervous system, the most complex sub-system of the human body that triggered most intensive discourse among the students in this study. Following procedures used by Hmelo-Silver and colleagues. (2007), two coders read and re-read all the above data (Knowledge Forum notes, Journeys of Thinking, presentations) and developed a list of codes under each of the three categories: structures, behaviors (mechanisms), and functions (Table 1). This coding scheme was used to code student ideas in the online discourse prior to the ITM session in comparison to ideas summarized in the final presentations. The same coding was additionally applied to categorize student questions raised in the online discourse in comparison to questions identified in the ITM reflection as the focus of their further work.

<Insert Table 1 here>

Structure-related codes were applied to student mentioning of any element of the nervous system, either alone or in connection with its behaviors and functions. Over time, it was found that students indicated more specific body parts and organs. More elaborated level 2 sub-codes were added to some of the structure codes (e.g. brain) to encompass more detailed ideas (e.g. lobes, cerebellum, brainstem, hippo campus, brain waves). Function-related codes were applied to capture the roles of the different body parts in the nervous system without elaborating the specific mechanisms, such as in the following instances: “Sensory neurons bring things like hearing and seeing from your other senses in to your CNS (Central Nervous Systems).” Codes related to system behaviors (mechanisms) were applied to texts explaining the mechanisms by which various structural parts achieve their designated

functions. Below is an example that was coded as behavior-messaging: “If your hand touched something hot, the nerves send a message through the spine then to the brain, then the brain sends the message back to the hand to move away from the hot pot or whatever your hands want to move.”

To gauge reliability, two coders independently coded 39 slides from five final presentations, with inter-rater agreement rates of 100% for structures, 93.75% for behaviors/mechanisms, and 94.29% for functions.

Results

Video Analysis of ITM-Aided Metadiscourse and Reflection

The video analysis of the ITM-aided session for metacognitive conversations revealed multi-level collaborative interactions that gave emergence to collective knowledge goals and themes in support of deepening inquiry (Figure 2).

<Insert Figure 2 here>

(a) Co-identifying high-interest “juicy” topics: Enabling emergence of ideas at the micro level, students engaged in online knowledge-building discourse and face-to-face interactions to generate diverse ideas about how the human body systems work, with 139 Knowledge Forum notes created. In the ITM-aided reflection, students reviewed the diverse ideas in the knowledge-building discourse to identify high-interest, productive topics of inquiry—or collective “juicy topics” as called by the community. 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 as a whole class to generate a collective list of high-interest topics that represent the community’s collective focuses.

The teacher's role to support the co-emergence of "juicy topics" focused on framing and stimulating co-reflection. She highlighted the epistemic need to review "big ideas" and focal topics to review collective knowledge progress: "*We have been talking a lot about our ideas, theories and questions in the [Knowledge Forum] database...*" She further discussed with the students what might be considered as a "big idea" or "juicy topic": "*\"big ideas\" that you came across in the view...will help us really understand important things about the human body and help us to...progress what we know as a class.*"

Students then proposed topics of inquiry based on their personal understanding of the community's discourse. 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 teacher facilitated and participated in the conversations to co-construct "juicy topics" and recorded the accepted proposals on a board. A few topics proposed, such as the brain, was directly accepted by the community. Relatively minor topic proposals, such as eyes, were integrated into broader topics (e.g. brain). Topics proposed using intuitive language (e.g., hurt) were conceptualized and elaborated to clarify the deeper, scientific concepts (e.g. immune system), with the teacher modeling her thinking about what counts as a "big idea" or "juicy topics."

S1: ...So I know that when you hurt your ankle, first it has this big red line on it where you hurt it. And then it turns greenish-blue when it's healing but is not yet better and healthy, because it's going to take very long time. And then it turns yellow and it gets better. So I'm wondering why does that happen.

T: So you are wondering about healing, basically the healing process of the body. Should we call the “big idea” there “healing in the body?” Or would you like to name it something else?

S1: The immune system.

T: The immune system, so how for you is that the immune system?

S1: Because it helps healing.

T: Beautiful. So I’m going to write the immune system as a “big idea,” and that to me seems as a “big idea” in the human body. The immune system is working everyday to keep us healthy...

Through such reflective conversation, students generated a collective list of eight “juicy topics:” the brain (including eyes), messaging in the body, central nervous system, heart, respiratory system, muscles, nutrition and eating, and immune system.

(b) Co-constructing idea threads by selecting and reviewing idea contributions: To review knowledge building progress related to the high-interest topics, students created idea threads using ITM. Focusing on a focal topic (e.g., messaging in the body), the teacher worked with the students to decide key terms to be used to search for Knowledge Forum notes in ITM (e.g. message, signal, nerve). They reviewed the notes found and selected notes that contributed to the community’s understanding of the focal topic. ITM displayed the selected notes on a timeline as an idea thread with the authors and build-on links further identified, representing a focal line of work enacted by a subset of the community members. This idea thread then became accessible and editable to all the community members. Following the processes to construct the above thread, as an example, students then worked as small-groups to create idea threads focusing on the rest topics that they had co-identified.

Members of each group discussed notes they had read related to their focal topic and decided what keywords should be used to search for note contributions. They co-reviewed the notes found through the searches and selected relevant notes to be included in their idea thread.

The teacher's role in this process focused on modeling ITM use, co-reviewing idea contributions, co-interpreting patterns of conversations in each thread, and providing technical support. For example, reviewing the sequence of the notes selected for the idea thread on messaging in the body, the teacher said: *The other thing that is really exciting is that we can see here [pointing to the early notes]...some ideas ... some questions as well, OK? So I wonder, then as time went on, as we did more research...there is actually some more detailed information. The neurons, we never had that word before in our early notes... All of a sudden we now have new knowledge. Neurons and messages from the touch sensors and the brain... So it is...a progression of ideas and that is what this tool is so useful as showing.*

(c) Whole community reflection to synthesize collective advances and co-plan deeper work: With all the idea threads mapped out (see Figure 1) and projected on a screen, the whole class reviewed their collective work in the different lines of inquiry. They looked at the length of each idea thread and density of build-on links, identified major advances and weak areas, and discussed how the different streams of inquiry related to one another. 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 particularly important to help tie all the other parts together.

Teacher: [pointing to the map of idea threads on the screen]...this is the beginning and this is the end, ...and then the shaded regions is how much time we have spent on the different topics. Anyone, just take a look at this, what this landscape might mean to us in terms of our knowledge? S1.

S1: What we are doing the most about, and what we could do more broad, like for a longer time [other students agree: "yeah!"] ...and that way the end...

(Students over talking)

Teacher: Not the end, [laugh] just where we are today... Do you see what S1 is saying? And how that might make sense for what we are looking at? So certain things like the heart, nutrition and eating [pointing to these threads on the screen], we actually had a lot of questions at first, but we haven't really pursued them in the view [on Knowledge Forum]. We haven't continued questioning. We haven't continued building knowledge about that. We have to go back to that. We have to continue to build knowledge because we identified them as something that is really important for the human body. But look, what's the one that we have spent the longest amount of time on, that, actually spent the entire study?

Students talk together: The brain!

Teacher: The brain, right? Does anyone have an idea why that could be kind of significant, why the brain might be something that has spanned our entire study? S2?

S2: Because the brain is important and connect to the whole body, the muscles, the heart, and the immune system.

Teacher: So S2, you think that the brain connects to all these things. S3, do you want to add on?

S3: Well, the brain is basically the center of everything, like what S2 said, it's...

(Students over talking)

Teacher: So it is logical that it's the thing that started first and has continued to keep us interested, and maybe it's linked to these other big things like central nervous system, immune system, muscles and messaging. This is also really helpful too because things that we started wondering about, that we haven't gone back to. I see here that the heart and nutrition are the areas that maybe because we got so invested in the brain we stop talking about. But if you guys said these are important, we'd better get back to them.

Elaborating the community's reflection on the whole inquiry, 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.*" Deeper issues and problems were identified for further inquiry, such as how the spines move the message, as related to messaging and the central nervous system; what causes obesity as related to the idea thread on nutrition, and how people see colors, as related to eyes and the brain. These deepening problems became the focuses of the subsequent knowledge building work.

Content Analysis of Deepening Discourse and Understanding

We applied the structure-behavior-function coding scheme to analyzing student questions raised in their online discourse prior to the ITM reflection as well as questions

identified in the ITM “Journeys of Thinking.” As Figure 3 shows, while structure-related questions (e.g., *What are neurons?*) remain stable, behavior- and function-based questions substantially increased in the ITM reflection, highlighting deeper focuses of inquiry for the community. Questions seeking explanations about the mechanisms (system behaviors, such as *how does the body know when to move*) by which different body parts achieve their functions increased to 62.5% from 7.14%. This dramatic change suggests that ITM-aided metadiscourse and reflection was able to help the students to monitor gaps and problems of understanding and generate explanation-seeking questions as a way to sustain and deepen their knowledge building.

<Insert Figure 3 here>

Focusing on questions and issues identified in the ITM reflection, students conducted further inquiry and shared new understandings in their final presentations. As Figure 4 shows, compared to their understanding in the online discourse prior to the ITM reflection that focused more on structures of the nervous system, students’ final presentations summarized more substantial understanding of the mechanisms (behaviors) (e.g., *“to get to the brain it is through neurons that are mostly in the spine and it can send electrical messages to and from the brain.”*) and functions of the nervous system (*“Nerves carry messages from the brain”*).

<Insert Figure 4 here>

Discussion

To develop a sustained, collective trajectory of inquiry for productive knowledge building, members in a community need to co-monitor and regulate their knowledge building discourse over time. This study tested using ITM to support collective metadiscourse in a

Grade 5/6 community that engaged in deepening inquiry and discourse about human body systems. The video analysis of the ITM session generated a grounded theory about ITM-aided collective metadiscourse as multi-level emergent processes. The fifth- and sixth-graders co-constructed core, high-interest topics based on their monitoring of diverse ideas in the extended knowledge-building discourse to represent the shared goals of their community. Students who are interested in different topics formed into small-groups to select important ideas addressing each high-interest topic to construct idea threads, and reviewed and “rose above” the specific idea contributions through co-authoring “Journeys of Thinking” syntheses. The community worked together to review the map of idea threads to identify shared advances, weak areas, and potential connections for the whole knowledge building initiative, informing deeper efforts to be enacted by the members individual and collaboratively.

Such collective metadiscourse helps a community to monitor and regulate metacognitive components and frameworks of its knowledge building: to review the state of understanding in the community, identify deeper foci and more advanced goals over time, and re-organize their collaborative discourse and inquiry accordingly. In line with the talk-organizing and talk-evaluating functions of metadiscourse (Latawiec, 2012; Shiffrin, 1980; Vande Kopple, 1985), ITM-aided collective metadiscourse in a knowledge building community helps students to organize and evaluate their extended knowledge building discourse across multiple social levels: to connect and organize individual, distributed discourse entries into unfolding conceptual streams (idea threads) each indicating a focal area of work enacted by a sub-group of students as authors/contributors; and to map out the different, interconnected idea threads of the whole community to understand the collective

landscape of the community's knowledge work. The progress in each idea thread is evaluated and synthesized by each small-group through writing a "Journey of Thinking" reflection that summarizes the goals, advances as well as deeper gaps and issues. The community examines the collective map of idea threads to evaluate the progress of knowledge as a whole, with key advances and weak areas highlighted to the attention of all members.

The content analysis of the deepening questions and ideas suggests that ITM-aided metadiscourse is able to facilitate student monitoring of diverse interconnected themes in their community's knowledge space beyond their personal contributions, and to leverage individual and group efforts to identify and address deepening issues to advance their understanding. As the content analysis based on the structure-behavior-function framework indicates, through ITM reflection, students formulated deepening questions to understand the human body as a complex system and explain how the structural parts interact to achieve their functions. Sophisticated explanations were generated in the subsequent inquiry to address these deepening questions and further shared across the community.

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.

In conclusion, this exploratory study sheds light on the processes by which young students engage in collective metadiscourse using ITM to sustain and deepen their

knowledge building. Such collective metadiscourse and reflection is critically needed in order to foster students' collective regulation of knowledge building for sustained idea advancement. Building on the findings of this exploratory study, our subsequent studies tested refined design of ITM-aided metadiscourse organized as ongoing efforts instead of only in one ITM session, and conducted more comprehensive data analysis to examine the impact of such metadiscourse and reflection on sustained knowledge building (Zhang et al., 2014). ITM currently requires student manual efforts to identify high-interest topics from their distributed discourse and select relevant discourse contributions for each topic. We have been testing automated analyses, such as topic models, to assist student identification of inquiry topics and discourse contributions (Sun et al., 2014). These automated analyses will be incorporated into ITM to ease the implementation of ongoing metacognitive conversations and reflections for productive outcomes.

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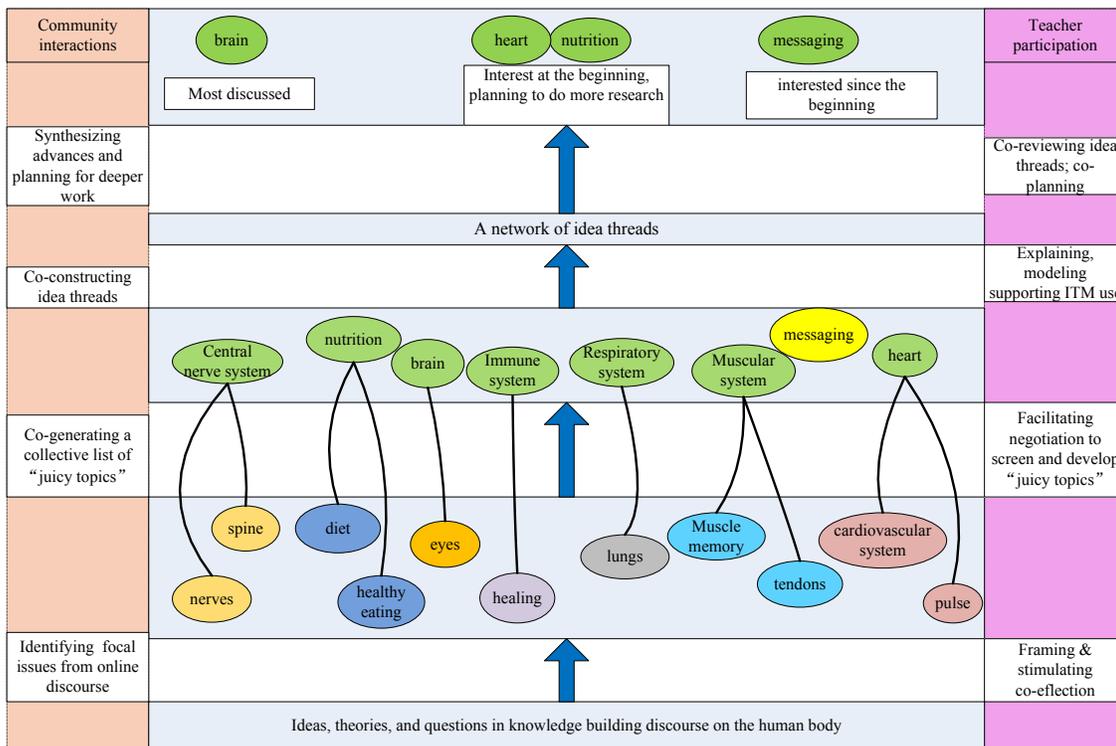


Figure 2. Multiple levels of emergent interactions to reflect on collective knowledge progress.

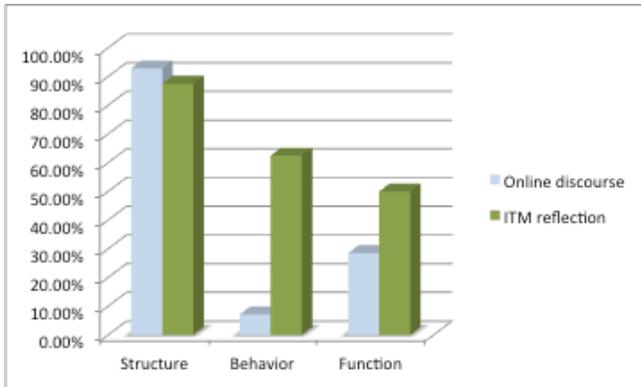


Figure 3. Coding of questions raised in online discourse and in ITM reflection based on structures, behaviors (mechanisms), and functions of the nervous system. The percentages of the three categories do not add up to 100% for each dataset because some of the questions had multiple codes each.

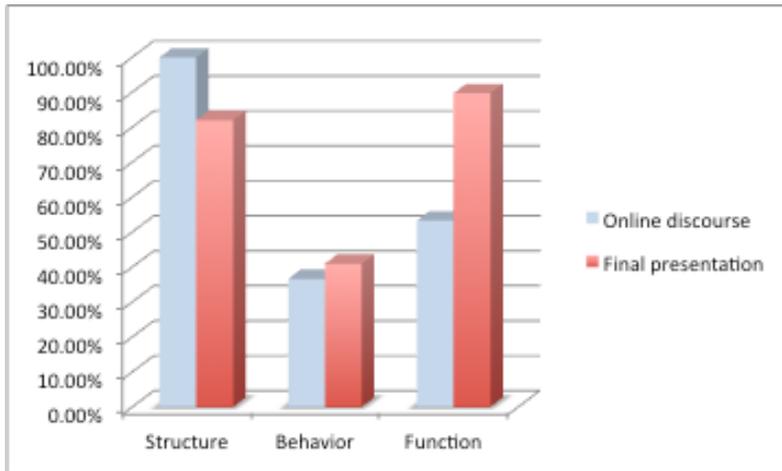


Figure 4. Coding of ideas in the online discourse and final presentations based on structures, behaviors, and functions of the nervous system. The percentages of the three categories do not add up to 100% for each dataset because some of the ideas had multiple codes each.

Table 1. Coding of Student Ideas and Questions Based on Structures, Behaviors, and Functions of the Nervous System.

Category	Code for Final Presentations	
Structure	Brain	1.1 Sub brain (Lobes, cerebellum, brainstem, hippo campus, brain waves) 1.1.1 two different sides of cerebrum 1.2 Brain Damage (Central Palsy) 1.2.1 Sub types of CP
	Spine	2.1. Sub Spine (Spinal cord, spinal column, vertebrae, nervosas tissue, disc, lumbar, cervical, thoracic)
	Neurons	3.1 Sub Neurons (inter neurons, touch sensors, sensory nerves, motor nerves, peripheral nervous system, support cells, nervous circuit) 3.1.1 Peripheral part (Myelin sheath) 3.2 Neurons Damage
	Body Part	4.1 Sub Body Part

		(head, neck, feet, legs, skin, lung, chest, heart)	
	CNS (Central Nervous System)		
Behaviors	Connecting		
	Messaging		
	Defending, Protection and Support		
	Storing and Processing information		
	Movement Control		
	Feeding and Oxygen		
	Causes of dysfunction/disease		
Function	Information Transmission		
	Movement		
	Thinking/Reasoning/Decision-Making		
	Memory		
	Language		
	Sensation	Sight	
		Hearing/Listening	
		Feel/Sensation	
		Touch	
		Taste	
		Temperature	
Supporting/Protecting			

	Controlling	
	Play	
	Reflex	
	Heart-Beat	
	Breathing	
	Dysfunction	Multiple Sclerosis(M.S.)
		Parkinson's Disease