The Development of Students' Knowledge Building Competence: A Longitudinal Study

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Abstract:

Students may develop their Knowledge Building understanding and competence as they engage in Knowledge Building practice. However, few studies have examined the development of students' Knowledge Building competence from a longitudinal perspective. This study defines students' Knowledge Building competence as their ability to engage in and contribute to Knowledge Building discourse. This exploratory research tracks a group of 20 students from grade 1 to grade 3 and studies how their Knowledge Building competence develops. The preliminary results indicate that the students' Knowledge Building competence tends to increase, suggested by the increasing percentage of contributions such as elaborated integration and student proposals. The results also suggest that all the participants have greater contributions over the years. Qualitative analysis of representative students' Knowledge Building trajectories is in progress.

Introduction

Knowledge Building is a socio-constructivist approach with theory, pedagogy, and technology aligned (Scardamalia & Bereiter, 2006, 2014). It advocates students taking responsibility to deal with the emergent and unpredictable needs of knowledge work and continuously advance community knowledge. Taking collective responsibility requires students to know "what needs to be known" and ensure others "know what needs to be known" (Scardamalia, 2002, p.2). Therefore, students need to engage in high-level cognitive work such as deciding what to explore, planning how to achieve shared goals, evaluating community knowledge status, identifying knowledge gaps, and adjusting community goals, which are usually assumed by teachers (Scardamalia, 2002). Although previous studies suggest the effectiveness of this high-level cognitive work on helping students advance community knowledge (e.g., Resendes, Scardamalia, Bereiter, Chen, & Halewood 2015; Yang, van Aalst, Chan, & Tian, 2016), it should not be taken for granted that students could deal with the high-level epistemic agency and engage in Knowledge Building (authors).

Students improve ideas by engaging in progressive Knowledge Building discourse (Scardamalia & Bereiter, 2006). Progressive discourse is about identifying weaknesses and achieving greater explanatory coherence of ideas (Thagard, 2007). Explanatory coherence can be judged from two perspectives: explaining more phenomena and facts and deepening the explanation of why the theory works (Thagard, 2007). Knowledge Building discourse includes face-to-face Knowledge Building Circle discourse and online Knowledge Forum discourse. In a Knowledge Building Circle, a teacher and students sit in a circle that everyone is equal to participate in peer-to-peer discourse to collectively develop norms and build ideas (Reeve, Messina, & Scardamalia, 2008). Knowledge Forum is a software environment developed to support Knowledge Building practice (Scardamalia, 2004). Knowledge Forum enables students to contribute to a shared space, to read and build on ideas, to introduce authoritative sources, and to rise-above diverse ideas.

Researchers have developed different approaches or instruments to analyze students' Knowledge Building discourse concerning various types and depth, which indicate students' Knowledge Building competence. For instance, Yang et al. (2016) use the question, idea, and community categories to analyze Knowledge Forum notes contributed by Grade 11 students. Among them, the question category includes fact-seeking, explanation-seeking, and metacognitive questions. The idea category contains simple claims, elaborations, explanations, and metacognitive statements. The community category is about negotiations of fit and synthesizing notes. Hmelo-Silver and Barrows (2008) categorize the statements generated in medical students' collaborative knowledge building discourse into two major dimensions: collaboration and complexity. The former consists of new ideas, modifications, agreement, disagreement, and "meta," while the latter includes the levels of simple, causally elaborated, and elaborated. Informed by these coding schemes and grounded in our data, we analyzed the types and depth of students classroom-video transcripts and online Knowledge Forum notes. We coded the Knowledge Forum discourse into questions, ideas, information, restatement, integration, regulation and metacognition and their relevant sub-categories.

Little research exists that examines the development of young students' Knowledge Building competence longitudinally and how teachers' design would facilitate this development. Therefore, this study attempts to explore

this research gap. The data analyzed include the Knowledge Building Circle recordings and related Knowledge Forum notes of a group of students from grade 1 to grade 3. The research questions guiding this study are:

1. How does students' Knowledge Building competence develop over time at the collective level?
2. How does students' Knowledge Building competence develop over time at the individual level?

Methods

Participants and research context

The study was conducted in a private laboratory school in a major culturally diverse city in North America. The school has a well-established culture and practice of inquiry-based learning and Knowledge Building. A group of 20 students (11 girls) participated in this design-based research from grade 1 to grade 3 (i.e., three years). The students were six to nine years old. The class represented the city's diversity in terms of multi-ethnic, economic, and gender balance. Before commencement, this project was given ethical approval by the school and the university's review board. Consent forms had been signed by the parents/guardians of the participants.

In grade 1, the class aimed to understand the Life Stages of a Butterfly, and the inquiry session lasted for about 40 days. Entering in grade 2, the students mainly worked on the Growth and Changes in Animals and related topics for about 120 days. In grade 3, the students studied Soils in the Environment for about 70 days. The grade 1 teacher had more than 15 years' experience with implementing the Knowledge Building approach in her class. Both the grade 2 and 3 teachers were early in their teaching career, and the Knowledge Building approach was relatively new to them.

From grade 1 to grade 3, the Knowledge Building sessions, including Knowledge Building Circle and Knowledge Forum work, usually took place twice a week and one hour each time. The students began to work in Knowledge Forum at the end of grade 1 as they were developing their computer competences. Entering in grade 2, the students became more capable of working in Knowledge Forum, and therefore, engaged in offline Knowledge Building talks and online Knowledge Forum activities simultaneously so did they in grade 3. Over the three years, various learning opportunities supported the students in researching their questions and sustaining their interest. Some anchors were used to arouse students' interests and curiosity. For instance, in grade 2, a salmon tank was set up in the classroom to hatch salmon eggs. The students went on field trips or invited knowledgeable people to their classrooms to discuss relevant authoritative resources and experiences. For instance, the grade 3 students visited the Humber Arboretum to learn, observe, and experiment soils. The students read relevant books, watched videos, and annotated information for evidence, which also inspired new questions.

The students engaged in monthly metadiscourse to uncover what they had learned, what they still wondered, and how they could improve ideas. In grade 2, questions such as "What have you learned about salmon? How have your ideas about salmon changed? What do you still wonder about salmon? How did you feel during this work?" guided students' monthly metadiscourse. Furthermore, we found that in grade 2, the percentage of explanations and idea integration was relatively low in students' discourse. Therefore, in grade 3, we designed the Knowledge Building sessions to help the students reflect on the distribution of the idea improvement types to identify areas for further work. To support the students to integrate ideas and elaborate on explanations, we also designed peer reading and writing activities, provided scaffolds to support idea synthesis, documented students' oral ideas, and asked the students to write more in-depth notes.

Data collection and analysis

Knowledge Building talks and Knowledge Forum notes were collected from grade 1 to grade 3. The Knowledge Building talks were transcribed verbatim, and each utterance was coded as a unit. Similarly, each Knowledge Forum note was coded as a unit. In grade 1, there were 295 student contributions in total, including utterance and notes, in grade 2, there were 2,188 student records, while in grade 3, there were 1,756 pieces of student contributions. Using an idea improvement coding scheme (Zhu et al., 2019), two researchers coded 432 units, accounting for 19.74% of grade 2 records.

The coding scheme includes seven main categories:
Questions: fact-seeking question, explanation-seeking question, idea-deepening question
Ideas: simple claim, partial explanation, elaborated explanation
Information
Restatement
Integration: simple integration, elaborated integration
Regulation
Metacognition: reflection, student proposal

The agreement between the two researchers was 73.55%. The disagreements between the two researchers were discussed and resolved. The first author coded the remaining data.

Preliminary results and discussions

How does students' Knowledge Building competence develop over time at the collective level?

Figure 1 shows the percentage of different idea improvement types contributed by the participants when they were in grade 1 to grade 3. It shows that over the three years, the students had decreasing levels of simple claims and partial explanations, but increasing levels of idea-deepening questions, elaborated integration, regulation, and student proposals. These results indicate that the cognitive efforts involved in students' contributions increased (e.g., elaborated integration) and the students also took greater epistemic agency (e.g., regulation, proposals). The changes may be related to two reasons. The first one is the development of students' Knowledge Building understanding, which may make them understand that they need contributions such as explanations, elaborated integration, and student proposals in order to advance their community knowledge. The second one is the development of students' Knowledge Building competence, whether due to natural development or the facilitation of the design. Another study (zhu et al., manuscript submitted for publication) with the same dataset suggests that the metadiscourse design helped the students reflect on their learning and propose future research directions.

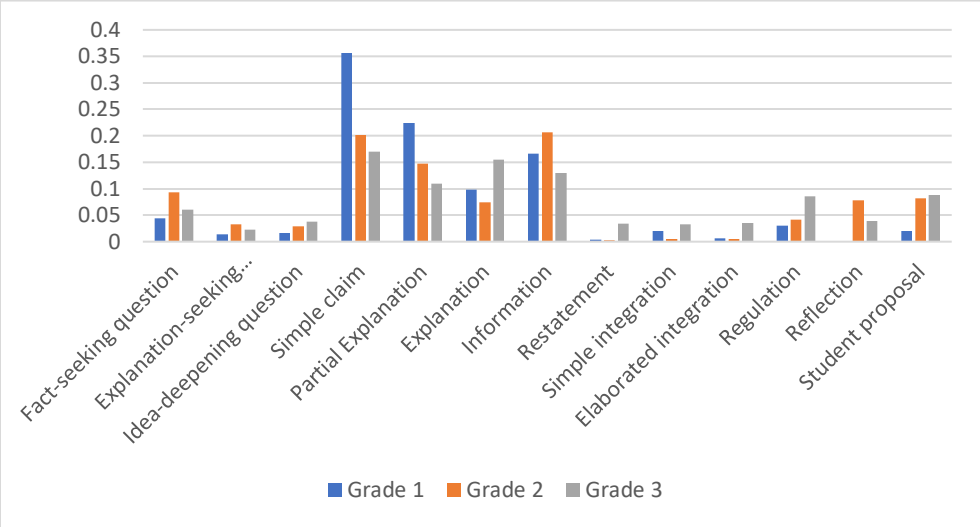

Figure 1. The percentage of different idea improvement types by the students from grade 1 to grade 3

How does students' Knowledge Building competence develop over time at the individual level?

Figure 2 shows the frequency of participants' contributions in Knowledge Building circles and Knowledge Forum. Overall, most of the students contributed much more utterance or notes in grade 2 and grade 3 than they did in grade 1, suggesting that the students had more active Knowledge Building as time unfolded. It should be noted that the Knowledge Building lasted for different durations in different school years, for about 40 days in grade 1, 120 days in grade 2, and 70 days in grade 3. The grade 3 Knowledge Building was interrupted by the Covid-19. But overall, the Knowledge Building inquiry and discourse were more sustainable in grade 2 and grade 3 than that in grade 1, suggesting students' continuous interest in the topics that they inquired.

S1 and S8 had relatively fewer contributions in the three years. Both S1 and S8 only had one contribution which fell in the simple claim category when they were in grade 1. Differently, in grade 2, S1 had 14 contributions, including one explanation-seeking question, two simple claims, three partial explanations, four information, two regulation, one reflection, and one student proposal. S8 had eleven contributions, consisting of two fact-seeking questions, three simple claims, five information, and one regulation. In grade 3, S1 and S8 had three and two contributions respectively. In grade 2, both S1 and S8 contributed most of their utterance in small group activities, in which they built ideal and current salmon habitats and audit the school recycling work. However, in whole class or half class Knowledge Building discourse, they tended to skip their turns of speaking nor did they voluntarily talk much.

S3, S9, S11, and S20 had more contributions than any other participants in each grade. Figure 3 shows the frequency of S9's idea improvement types over three years. S9 had an increasing number of contributions in all subcategories. Further research can qualitatively analyze S9's and other students' (e.g., S18, S20) contributions.

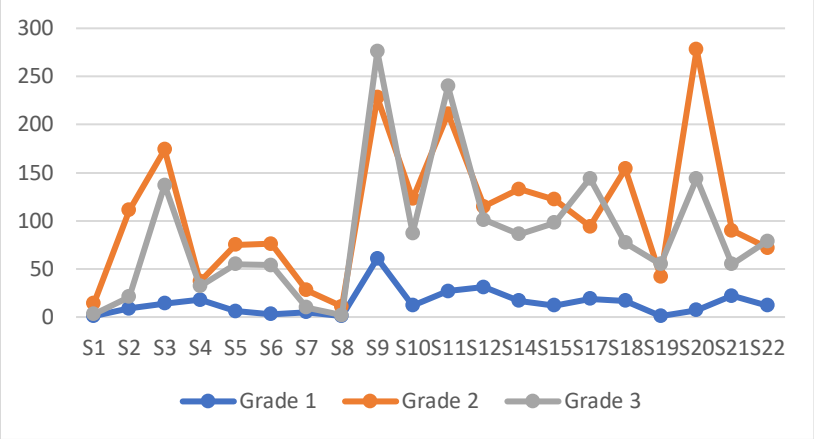

Figure 2. The contribution frequency of different participants from grade 1 to grade 3

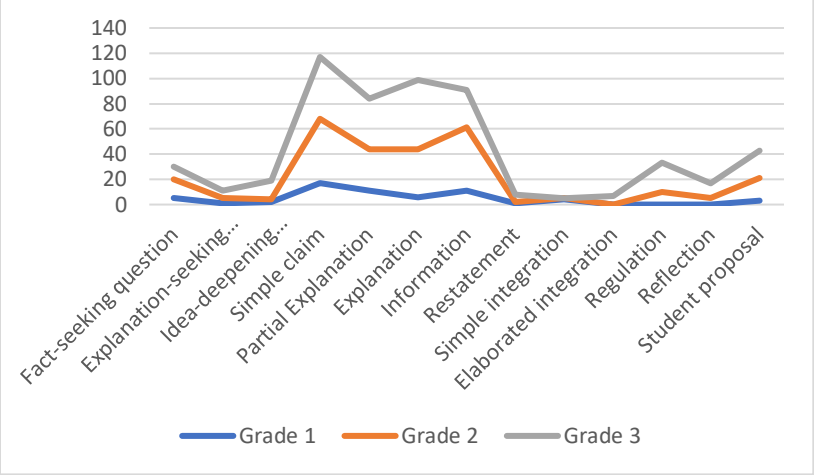

Figure 3. S9's contribution frequency from grade 1 to grade 3

Conclusions and future directions

This ongoing exploratory research examines how young students' Knowledge Building competence develops over the years. The preliminary results suggest that as time unfolded and with appropriate design, students' Knowledge Building competence tended to increase, suggested by the increasing percentage of contributions that require high cognitive efforts. The results also indicate that in general, the participants had greater contributions over the years. Further analysis of the Knowledge Building trajectories of students with different contribution levels is in progress. In addition to S1 and S8, we will provide thick descriptions of representative students who took agency as early as they were in grade 1 and students who gradually gained agency in their Knowledge Building process. We will also analyze in what context the students began to take high-level epistemic agency, and how this affected their following Knowledge Building. In the future, in addition to students' Knowledge Building talks and Knowledge Forum notes, we also plan to collect more types of data, such as students' reflections or interviews to understand students' knowledge building progress - the progress for developing knowledge building competence.

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