

Some Discourse Mechanisms for Knowledge Advancement in a CSCL Context

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Abstract: This paper aims to examine the discourse mechanisms that may lead to students' knowledge advancement in the context of CSCL. The online discussions of one primary (sixth-) and one secondary (tenth-) grade of students were analyzed. First of all, threads with the articulation of elaborated explanations were identified, as their appearance is considered as more indicative of the advancement of knowledge. Then by studying how students worked with the major concepts within each of the threads, three general mechanisms for knowledge advancement were found: 1) setting the conditions and limits of an idea; 2) comparing different concepts; and 3) differentiating concepts. The first mechanism could be observed quite frequently in the discourse of both grades of students while the latter two were more likely to be found in the discourse of the tenth-graders compared to the sixth-graders.

Introduction

One important research agenda in computer-supported collaborative learning (CSCL) is to analyze how learning is accomplished in interactions (Stahl, Koschmann, & Suthers, 2006). Based on the pedagogical approach of knowledge building (Bereiter, 2002; Scardamalia, 2002), this paper aims to examine the discourse mechanisms that may lead to students' knowledge advancement as expressed in their online discussion.

Knowledge Building as a Pedagogical Approach

According to Scardamalia & Bereiter (2006), knowledge building is the process through which knowledge advances in human societies, and that learning can take place in the process. It envisions a new way for organizing school education to prepare students for the knowledge society (Bereiter, 2002). In a school setting, knowledge building focuses on students' collective responsibility for the advancement of the community's knowledge and the improvement of ideas (Scardamalia, 2002). In traditional classrooms in which the interaction is mainly face-to-face, knowledge building is difficult to implement as ideas generated by students are not easily recorded for the purpose of further improvement. Thus the implementation of knowledge building in schools is usually integrated with an asynchronous online platform, the Knowledge Forum® (KF), purpose-built to create a knowledge building environment for students to make their ideas explicit in the form of notes so that they can be built onto for their continual improvement (Scardamalia, 2002).

A Concern for Knowledge Advancement

Knowledge building concerns with the knowledge advancement made by students in their inquiry. However, what constitutes a knowledge advancement is not clearly defined in the literature. According to the major works in the field (e.g., Hakkarainen, 2003; Lee, Chan & van Aalst, 2006; Zhang, Scardamalia, Lamon, Messina, & Reeve, 2007), explanation-oriented discourse is regarded as an indication of the engagement in knowledge building, as it reflects a deepening in understanding of the students compared to fact-oriented discourse. In previous studies, it has been examined the pedagogical designs which were more likely to bring about the engagement in knowledge building (e.g., Lee et al., 2006; Zhang et al., 2007; 2009). In analyzing how students might advance their knowledge, the most widely researched area is the importance of questioning. For example, in Hakkarainen's (2003) study, it was reported that explanation-oriented questions rather than fact-oriented ones were more likely to lead to deepening in students' explanations. In another study, Zhang et al. (2009) differentiated teachers' questions into "questions for ideas" and "questions on ideas", and found that the latter was more useful in helping students to deepen their understanding. van Aalst (2009) differentiated three types of discourse: knowledge-sharing, knowledge-construction and knowledge-creation, with the last one the most compatible to the theory of knowledge building. van Aalst (2009) found that the student-group with the best summary note written illustrated a discourse profile closest to knowledge-creation, which was characterized by a strong sense of community-belonging and a high proportion of explanation-oriented questions asked. However, van Aalst (2009) did not examine the process through which knowledge was advanced in his study. The discourse mechanism that may trigger students' knowledge advancement is still a research area that needs to be explored.

Method

Research Setting

The data analyzed in this study were part of the “Learning Community Project” (LCP), which was launched to promote knowledge building and support its implementation in secondary and primary schools in Hong Kong. A total of two databases, one primary and one secondary, were analyzed to see if different patterns were found. As an extended period of inquiry is needed for productive knowledge building discourse to emerge (Hakkarainen, 2003; Zhang et al., 2009), these two databases were chosen because they had the longest period of inquiry among all databases at the time the analysis was conducted. The first database composed of 41 tenth-grade students in a secondary school; they formed six groups inquiring on topics of Water Quality, Plastics, and Ideal Vehicle. The students and their teacher were both new to knowledge building. The second database composed of 44 sixth-grade students in a primary school. They formed seven groups to inquire on topics of Global Warming, Energy Crisis, and Species Extinction. Two teachers were involved in the facilitation of knowledge building in the second database. One of them and about one fourth of the students had the experience of participating in knowledge building activities in the previous year. The other teacher and the remaining students were new to this pedagogical approach. In both cases students had a period of about six weeks to conduct their inquiry. Throughout the process they had to engage in the discussion on KF.

Knowledge Forum®

The asynchronous online platform employed in this study is the Knowledge Forum® (KF), which is specifically designed to facilitate the engagement of knowledge building (Scardamalia & Bereiter, 2006). Students can contribute their questions and ideas in the form of notes, and other students could respond and further improve the ideas by writing build-on notes. In writing a note, students may use the function of “scaffolds”, which are meta-cognitive prompts in the form of word cues such as “New information”, “New idea”, “I need to understand”, and “My theory”, so that they can better identify the nature of their note content (e.g., “New information” or “New idea”), identify a knowledge gap (e.g. “I need to understand”), and build or modify their theories (e.g., “My theory”, “This theory cannot explain”, “A better theory”). Notes and their build-on notes were linked physically in the form of build-on threads. Thus within a thread, there were a series of related notes. The analyses in this study were conducted based on the contents of notes situated in build-on threads.

Data Analysis

The first step in the analysis was to identify the notes which indicated a good quality from the perspective of knowledge building. Following the widely employed analytic procedures in the literature (e.g., Hakkarainen, 2003; Lee et al., 2006; Zhang et al., 2007), the level of explanation of a note was employed as the indicator of knowledge building. The coding scheme adopted was the one developed in Zhang et al.’s (2007) study, in which a total of four levels of explanation were classified: 1) Unelaborated fact; 2) Elaborated fact; 3) Unelaborated explanation; and 4) Elaborated explanation. Notes with the descriptions of terms, phenomena, or experiences were classified as facts, while those with the provisions of reasons, relationships, or mechanisms were classified as explanations (Zhang et al., 2007). In addition to the differentiation of facts and explanations, the coding scheme also takes into consideration whether the contents are unelaborated or elaborated. On the other hand, students’ questions asked in their notes were classified as fact-oriented or explanation-oriented (Hakkarainen, 2003; Zhang et al., 2007).

As the focus of this study is on the possible mechanisms for knowledge advancement, not all of the threads were studied as they might not indicate advancement. Only threads with notes classified as “elaborated explanations”, that is, the highest level based on the coding scheme of levels of explanation, were further analyzed. The major concepts being explored in each of the threads were then identified. After identifying the major concepts, the next step was to look at how students worked with these concepts, to see whether some general mechanisms for knowledge advancement could be observed.

Results

Discussion Notes and Build-on Threads

A total of 620 and 630 discussion notes were generated by the tenth-grade and sixth-grade students respectively, which resulted in a total of 76 and 69 build-on threads respectively. Each of the threads was labelled according to the topic being explored in the thread. Examples of build-on threads found in the discourse of the sixth-graders were “Solar energy” and “Wind energy” when they were inquiring on topics of Global Warming and Energy Crisis. Examples of threads found in the discourse of the tenth-graders were “Use Ultra Violet to clean water” and “LPG (Liquefied Petroleum Gas)” when they were inquiring on topics of Water Quality and Ideal Vehicle respectively.

Levels of Explanation of Discussion Notes

Presented in table 1 was the classification of notes with different levels of explanation. First of all, it should be noted that only notes with some knowledge contents articulated were classified. Notes simply with the words, “I agree”, “We can have a further discussion on this topic”, or those with only copy and paste contents were not subjected to the classification of levels of explanation. Moreover, notes with only questions asked were classified according to the orientation towards fact or explanation rather than levels of explanation. Hence, the numbers summed across columns in table 1 were smaller than the total numbers of notes reported earlier.

It can be seen from table 1 that for both grades of students, about half of the notes classified according to their levels of explanation were unelaborated facts, and less than 10% were classified as elaborated explanations. The results suggested that the construction of explanations did not occur frequently. Hence it is especially important to examine the discourse mechanisms that might trigger the deepening in explanations.

Table 1: Distribution of notes with different levels of explanation.

Grade		Unelaborated Fact	Elaborated Fact	Unelaborated Explanation	Elaborated Explanation
Sixth-grade	Number	237	73	86	34
	%	55.1	17	20	7.9
Tenth-grade	Number	231	72	81	41
	%	54.4	16.9	19.1	9.6

Threads to Further Investigate

To further analyze the discourse mechanisms for knowledge advancement, threads with notes classified as elaborated explanations were analyzed. A total of 22 (28.9%) and 17 (24.6%) threads of the tenth-grade and sixth-grade students respectively were with notes with elaborated explanations classified. The findings suggested that not all of the threads involved the construction and deepening of explanations.

Identify the Major Concepts Explored in a Thread

The next step in the analysis was to identify the major concepts being explored in each of the threads identified in the last section. For example, in the thread of “Acid rain”, the major concepts being explored were, “neutralization”, “acidic”, “alkaline”, “pH value”, “release of heat”, and “habitat”; in the thread of “Solar energy”, the major concepts being explored were, “sunlight”, “renewable”, “cost”, “power”, “weather”, “solar energy board”, and “the saving of energy”. It was then examined how students worked with these major concepts within the thread, for identifying the mechanisms that might lead to knowledge advancement, as presented in the next section.

Discourse Mechanisms for Knowledge Advancement

In analyzing how students worked with the major concepts within a thread to make knowledge advancement, there were some general patterns observed. The three most frequently observed mechanisms for knowledge advancement were “setting the conditions and limits of an idea”, “comparing different concepts”, and “differentiating concepts”. Summarized in table 2 was the number of threads with the appearance of each of the mechanisms observed. The findings suggested that the first mechanism, that is, “setting the conditions and limits of an idea”, appeared quite frequently in the discourse of both grades of students, while the other two mechanisms seemed to appear more frequently in the discourse of the tenth-graders but not the sixth-graders. The details of each of the mechanisms will be as presented in the following sections.

Table 2: Number of threads with the three common mechanisms for knowledge advancement observed.

Students	Set conditions and limits of an idea	Compare different concepts	Differentiate concepts
Sixth-grade	9	2	2
Tenth-grade	6	9	7

Mechanism 1) Set Conditions and Limits of an Idea

For both grades of students, one frequently observed mechanism leading to knowledge advancement was the “setting of conditions and limits of an idea”. The sixth-grade students tended to discuss whether something was applicable in the place they are most familiar with, that is, Hong Kong. They usually started with the discussion of a certain form of energy; then they used the characteristics of Hong Kong, such as its weather, size, and geographical features to identify the conditions and limits of the idea related to the adoption of this form of energy. Presented in table 3 are the contents of notes taken from the build-on thread of “Wind energy” of the

sixth-grade students. The first column presents the student who wrote the note. The second column presents the scaffold used in the note; if no scaffold was used, the cell was presented as empty. The third column presents the note contents.

In the example presented in table 3, with a characteristic of Hong Kong (full of buildings) articulated, students tried to set limits of the idea of wind energy, then they continued the discussion by utilizing a geographical knowledge that it is windier in higher places to suggest that windmills might be built on the top of buildings.

Table 3: Note contents taken from the thread of “Wind energy” of the sixth-grade students.

Student	Scaffold	Note Content
G6_11		<i>“Hong Kong is a place full of buildings, I think there is not enough space for wind to blow.”</i>
G6_12		<i>“I think that if we build a wind farm beside the mountain, maybe the wind is stronger and we don’t need to build it by the side of buildings.”</i>
G6_13	New idea	<i>“Ha, interesting idea, but it is a better idea if we build it on TOP of the mountain, it will get more wind there.”</i>
G6_14	New idea	<i>“How about we make a windmill on the top of the building? When you stand up on the Alps, you feel the gale, so we can get more energy!”</i>

Mechanism 2) Compare Different Concepts

In addition to the “setting of conditions and limits of an idea”, another general mechanism for knowledge advancement observed was that students often “compare different concepts”, which was especially found in the discourse of the tenth-grade students. As presented in the contents of notes taken from the thread of “LPG” in table 4, students compared LPG (Liquefied Petroleum Gas) to Hydrogen as the suitable energy source for an ideal vehicle. Through the comparison, they explored the environmental effects of different fuels in terms of the products they produced.

Table 4: Note contents taken from the thread of “LPG” of the tenth-grade students.

Student	Scaffold	Note Content
G10_21	I need to understand	<i>“Our ideal car must use LPG?”</i>
G10_22	New idea	<i>“Yes, because it is not a new technology. It is not difficult to be used.”</i>
G10_23	New idea	<i>“There is not a must in using LPG as there are many substitutions like hydrogen, solar power and electricity. If you are concerning about the environmental effects of different fuels, then hydrogen could be better than LPG because the only product would be H₂O, or at most, oxides. However LPG will still produce carbon dioxide and nitrogen oxide.”</i>

Mechanism 3) Differentiate Concepts

Another general mechanism for knowledge advancement observed was the “differentiation of concepts”, which was more frequently found in the discourse of the tenth-grade students (see table 2). In threads with this mechanism identified, students often clarify the difference between different concepts, which might lead to the advancement of knowledge. Unlike the mechanism of “comparing different concepts” presented in the last section, in the discourse illustrating the “differentiation of concepts”, students often got confused with some of the concepts, hence in the subsequent notes these concepts were clarified and differentiated from one another. As presented in the contents of notes taken from the thread of “Acid rain” in table 5, one of the tenth-grade students said that “red tide” is toxic, then another student tried to differentiate the difference between the concept of “toxic” and that of “the consumption of oxygen”.

Table 5: Note contents taken from the thread of “Acid rain” of the tenth-grade students.

Student	Scaffold	Note Content
G10_41	New information	<i>“Some of the algae are toxic, they will make the fish die. Water may be polluted by the toxic algae and the dead fish. Some algae may produce bio-toxins. Filter-feeding shellfish, particularly the bivalves, such as scallops, oysters and mussels, can accumulate these algal bio-toxins such that they</i>

		<i>become toxic to humans.”</i>
G10_42	My opinion	<i>“In my mind, I remember that red tide is non-toxic, but it will affect the water life. It’s because red tide is a kind of algae, it needs to breathe in oxygen in order to maintain their life, so the oxygen amount in the water will be decreased. When the algae died, oxygen is used to decompose the dead body and there is a lot of oxygen consumed. The water life will be killed because of lacking of oxygen.”</i>

Discussion

Knowledge building emphasizes the advancement of knowledge made by students. However, less research has been conducted for identifying possible mechanisms for knowledge advancement. Three general mechanisms were identified in this study. They are “setting the conditions and limits of an idea”, “comparing different concepts”, and “differentiating concepts”. On Knowledge Forum®, there is a scaffold with the wording, “This theory cannot explain...”, which is closely related to the first mechanism of “setting the conditions and limits of an idea”. However, from the discourse examples taken from this study, students did not seem to reason in a way of identifying what a theory cannot explain. Rather, the sixth-grade students often started with a certain form of energy, then they tended to argue that this form of energy cannot be applied in Hong Kong because of its characteristics. In addition to the setting of conditions and limits of an idea, students can also advance their knowledge by comparing and differentiating concepts. The findings may provide pedagogical insights for the implementation of knowledge building. Getting students to compare different concepts and to differentiate concepts that they are easily confused with may be helpful for making knowledge advancement.

One limitation of this study is that the period of inquiry, which is about six weeks, may not be long enough compared to previous studies (e.g., Hakkarainen, 2003; Zhang et al., 2007), which might take several months for students to engage in productive knowledge building. It is possible that some other mechanisms for knowledge advancement could not be captured because they may take a longer period of inquiry to emerge. For example, one important principle of knowledge building is “rise above” (Scardamalia, 2002), which articulates that students should go beyond current practices, targeting at more inclusive principles and higher-level formulations of problems. However, mechanisms similar to “rise above” were not observed in this study. Although there were examples of notes that students tried to bring together different viewpoints expressed earlier, they could not take them to a higher-level. As the period of inquiry in this study may be too short for all possible mechanisms for knowledge advancement to be observed, further studies may be conducted with databases in which a longer period of inquiry is involved. Moreover, as there may be cultural differences in the engagement in knowledge building (Lai & Law, 2006), studies may be conducted in different cultural contexts to see whether different mechanisms can be observed.

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