Characterizing Metacognitive and Progressive Dialogue in Knowledge-Building Classroom

Yuyao Tong, The University of Hong Kong, tongyuyao2016@gmail.com
Carol K. K. Chan, The University of Hong Kong, ckkchan@hku.hk

Abstract: This study investigates how secondary school students engaged in metacognitive and progressive classroom dialogue in a computer-supported knowledge building environment. Thirty-one Grade 9 students studying in Art and Design participated in the study using Knowledge Forum® (KF), a multi-media collaborative inquiry workspace. A key design involved the integration of online KF discourse and classroom discourse in the form of meta-reflection talk - knowledge building principles were embedded in classroom dialogue to support idea development and rise-above dialogue. Knowledge Building Discourse Explorer (KBDeX), a social network analysis tool, was used to track students' changing collective responsibility over time. Classroom dialogue analyses identified dialogic moves into three areas including articulation and elaboration, building-on and connection, and collective reflection and idea development. Analyses illuminated how students engaged in collective meta-reflection and progressive dialogue. Implications of enriching classroom dialogue using knowledge-building perspectives involving meta-reflection and progressive dialogue are discussed.

Introduction

Helping students engaging in productive classroom dialogue represents a focal point of educational studies (Howe & Abedin, 2013; Mercer, 2019). A major research theme in dialogic education is to examine teacher and students' engagement of classroom dialogue and its influence on learning outcomes (Howe et al., 2019; Michaels, O'Connor, & Resnick, 2008). Analysis of dialogic moves is a major area in research on classroom dialogue (Hennessy et al., 2016; Howe et al., 2019), yet few studies have examined metacognitive reflection and idea development in classroom dialogue for creative knowledge work. The purpose of this study is to characterize knowledge-building dialogic moves in classroom talk and to examine how students engaged in metacognitive reflection and idea development progressive dialogue for collective knowledge building.

Theoretical perspective

Classroom dialogue, as a mediator for teaching and learning in schools, not only supports the sharing and construction of knowledge but also creates opportunities for exchanging ideas. Research involving many years of classroom dialogue has shown the importance of dialogue for students' learning, reasoning, and knowledge development (Mercer & Littleton, 2007), as well as the effective pedagogy that teachers implement in the classroom (Howe & Abedin, 2013). Compared with Initiate-Response-Feedback (IRF) patterns, dialogic discourse researchers (Alexander, 2017; Mercer & Littleton, 2007) classify classroom dialogue as "talk" or "dialogue" emphasizing students'' agency to engage in discussion actively for developing, reflecting, modifying, and building their ideas. Mercer (2005) explained, "Exploratory Talk" that students should critically challenge each other's ideas using explicit reasoning. Michaels, O'Conner, and Resnick (2008) initiated a similar dialogic education approach, called "Accountable Talk", emphasized learning community and rigorous thinking. There is now some emerging interest in examining the role of talk on joint creation of knowledge (Mercer, 2019).

Examining student dialogue is also developing as a key theme in the classroom supported by technology (Major et al., 2018) in computer-supported collaborative learning (CSCL). Researchers have identified different metaphors of learning including knowledge acquisition, knowledge participation and knowledge creation (Paavola & Hakkarainen, 2005). Knowledge building (KB), also called knowledge creation puts emphasis on the contribution made by students to the community for collective knowledge advancement and creative knowledge work through progressive dialogue and sustained idea improvement (Scardamalia & Bereiter, 2014). Knowledge building is a principle-based dialogic pedagogy that teachers focus on a set of principles (Scardamalia, 2002, e.g. "epistemic agency", "improvable ideas") instead of on a procedure-based pedagogy.

In KB classrooms, students worked collectively to generate problems, improve ideas, and revise theories through progressive dialogue like what scientists did in the scientific community to create value to the frontiers of their community knowledge. Therefore, progressive dialogue represents a crucial component of the

KB approach where students take collective efforts to advance the state of its community knowledge (Scardamalia & Bereiter, 2014). Progressive knowledge building dialogue lays emphasis on seeking collective inquiry progress, developing rise-above inquiry, and reflecting in meta-dialogue by keeping track of progress (Chan et al, 2019). To support progressive dialogue, an asynchronous inquiry discourse platform, Knowledge Forum® (KF), was designed to support students' theory-building and knowledge creation via progressive inquiry and dialogue. KB classroom talks are conducted to help students further their inquiry in KF writing for knowledge advance.

There is now substantial research evidence demonstrating different forms of classroom dialogue and the crucial role played by classroom dialogue in learning and academic outcomes for students (Howe & Abedin, 2013). However, current studies generally focus on classroom dialogue moves emphasizing articulation, interaction, and build-on rather than highlighting metacognitive and progressive talk for idea development, which are important aspects of knowledge creation. As well, various classroom dialogue approaches emphasis teacher talks (e.g. accountable talk) and key roles of student agency need to be examined, in particular, their increasing collective cognitive responsibility in classroom dialogue. In the research of KB, the analysis of dialogue is mainly focused on online discourse (Hakkarainen, 2003; van Aalst, 2009; Zhang et al., 2007). Nevertheless, in order for students to engage in collective knowledge creation, classroom dialogue and specifically, their meta-discourse on KF, how they discuss KF writing would be an important kind of meta-knowledge for knowledge building (Bereiter, 2019).

Accordingly, the goal of this study is to examine classroom dialogue from the perspective of KB with the emphasis placed on progressive dialogue, that is, how students engaged in metacognitive reflection and idea development. Specifically, two research questions were addressed: (1) How did students show increasing collective responsibility in classroom dialogue? And (2) What characterized the knowledge-building dialogic moves in the classroom? To what extent, how did students engage in metacognitive and progressive classroom dialogue for collective knowledge building?

Methods

Design of the KB environment with intertwined online and classroom dialogue

This study drew upon the data from students' classroom dialogue in a designed KB environment involving thirty-one Grade 9 students studying the topic on "Arts and Design" over four months. The key design was to integrate online and offline discourse to scaffold students' engagement of productive knowledge-building dialogic moves. Specific designs included: (1). creating a knowledge-building dialogue culture by engaging in productive classroom dialogue (Lesson 1-4). This involves the use of artifacts and KB Wall to post ideas for students to publicize their ideas in the community. To visualize students' ideas growth and to facilitate them in dialogic engagement, the teacher provided dialogic prompts such as "My theory", "My questions"; (2). developing progressive dialogue in KF (Figure 1) intertwined with classroom metacognitive reflection (Lesson 5-7). Following that, students continued their KB Wall inquiry in KF; (3). engaging in discussing of KB principles (Lesson 8-12). Students engaged in a meta-reflection process to collective reviewing of their KF work and comparing KF discourse patterns with principle; and (4). rise-above and deepening inquiry (Lesson 13-15). Based on KF and classroom discussion, each group generated a key theme for further inquiry.

Figure 1. KF View & Notes.

Data analysis and Results

RQ1. Did students show increasing collective responsibility in classroom dialogue?

Students' classroom dialogue was transcribed verbatim and analyzed quantitatively to examine how students changed their trajectory and collective responsibility over time. Knowledge Building Discourse Explorer

(KBDeX) (Oshima et al., 2012), a social network analysis tool, was applied to examine the engagement and dominance of teachers and students in the classroom dialogue. KBDeX has been used widely in KB studies to characterize students' collective responsibility and rotating leadership using the centralities of keywords and students (Ma et al., 2016; Oshima et al., 2012). Analysis of keyword networks and comparison between teacher and students was examined - From Lesson 1 to Lesson 7, both the teacher and students engaged in a productive classroom dialogue and discussed most of the keywords (Figure 2a and 2c – discussed keywords highlighted in red). Nevertheless, over the course of classroom discussion, from Lesson 8 to Lesson 15, in comparison with the teacher who has not conducted discussion about the keywords in the classroom discussion (Figure 2b – framed in blue rectangle, e.g. "comparison", "angel", "value"), students were observed to be more productive to diversify the discussion around all the keywords in the classroom dialogue (Figure 2d – students discussed all the keywords – highlighted in red). -Analysis also illustrate that students made attempt to conduct in-depth discussion and continued effort to create new keywords. Overall, -keywords comparison between teacher and students -suggested that students engaged in a productive classroom dialogue in the designed KB environment taking up increased responsibility.

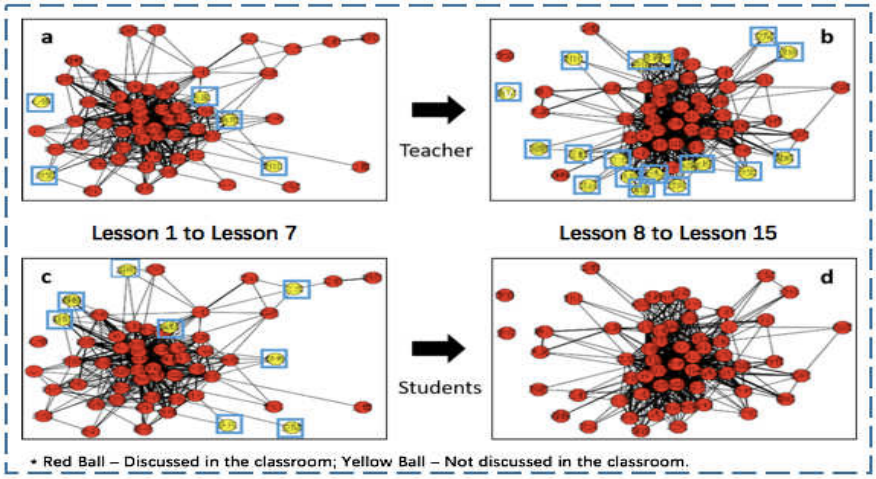

Figure 2. Classroom discourse (keywords network) - teacher & students in two phases.

RQ2. What characterized the knowledge-building dialogic moves in classroom? And how students engaged in metacognitive and progressive classroom dialogue?

Characterization of knowledge-building dialogic moves

The knowledge-building classroom talk was examined qualitatively for characterizing dialogic moves and we developed a coding framework (Table 1) adapting from the SEDA (Hennessy et al., 2016; Howe et al., 2019) that encompassed some aspects similar to KB such as reflection and coordination.

The following categories were identified and classified into three main groups, including articulation and elaboration - engaging in inviting/express ideas with elaboration and reasoning pertains to work on individual ideas, building-on and connection - engaging in inviting/build-on and query with refer back pertains to others' ideas, and collective reflection and idea development - engaging in metacognitive reflection and synthesis for idea development process pertains to collective meta-reflection.

Table 1: Coding scheme for analyzing classroom talk in knowledge building

Category	Codes	Description	Examples
Articulation and elaboration	Invite initial ideas (INI)	Invites diverse ideas of a new (first initiated) problem	"What is your understanding of environmental design?"
	Express ideas (EI)	Expresses initial ideas of a problem	"Environment design refers to design artifacts to protect the environment"
	Invite elaboration (ELI)	Invites elaboration or explanation or clarification or examples of own or others' ideas/contribution	"Can you provide an example to illustrate what kind of artifacts can protect the environment?"
	Elaboration (EL)	Provides elaboration, explanation, clarification, or examples to illustrate own or others' ideas/contribution	"On the one hand, we can apply recyclable materials to the design of an artifact, such as…on the other hand, we can…"

	Invite reasoning (REI)	Invites reasons or comparisons or justification of own or others' idea/contribution	"Why do you consider this artifact is good art?"
	Reasoning (RE)	Provides responses with reasons, comparisons, explanations of own or others' idea	"Because it can be used to resolve our daily life problems"
	Revoice (RV)	Repeat or paraphrases what previous students discussed	Student A said, "art can solve problems."…Teacher followed, "Are you saying that art can be a tool/medium to solve problems we meet in daily life?"
	Agreement/Disagreement (AD)	Invites or provides agreement or disagreement of a statement	"Do you agree with the idea?" "I agree/disagree with it"
Building-on and connection	Invite build-on (BI)	Invites inquiry or add on to sustained the discussion based on previous ideas	"Anyone can add on what student A's idea?" "Anyone want to build on the idea?"
	Build-on (B)	Builds-on ideas that previously expressed	Student A, "the value of artifacts would be raised if many people like it"…Student B builds-on "the value would also be raised if it can be used to solve problems"
	Querying (Q)	Challenging or doubting of one's own or others' ideas/contribution	"Even for artistic innovation, you still need to an inquiry on it to develop understanding…"
	Refer back (RB)	Reference to previous contributions and work	"Student A proposed an idea about…"
	Refer to a wider context (RW)	Linking the current understanding with a wider context or reference extra sources	"It is like nanotechnology that existed many years ago"
	Guided (G)	Guiding the discussion with a focus or pointing out a direction for further discussion	We are reflecting on what we had discussed in this KF thread rather than the other one"
Collective reflection and idea development	Invite reflection (RI)	Invites metacognitive reflection of the state of knowledge or learning processes- what had been learned from both classroom and KF work	"Can you reflect on what we had learned in the previous lessons?" "Anyone can reflect on what we had discussed in KF?"
	Simple reflection (SR)	Reviewing and monitoring what had been learned without explanation or justification	"What we have learned in the previous lessons is about the definition of art"
	Complex reflection (CR)	Reviewing and monitoring what had learned with explanation or justification or comparison	"What we had discussed is…there were three points we made…We believe that there is a relation between them, for example…"
	Invite coordination (CI)	Invites summary or synthesis of ideas	"Can you summarize your group ideas?"
	Simple coordination (SC)	Coordinates different ideas/contributions (ideas from different people or different ideas from one people) without explanation or justification	"Student A think that a good artifact should be recognition by professional artists …but student B thinks that an artifact would be a good one if it recognized by the public"
	Complex coordination (CC)	Coordinates different ideas/contributions (ideas from different people or different ideas from one people) with explanation or justification or comparison	"Student A thinks that artifacts can help resolve problems…but student B think that artifacts cannot be used to resolve every problem if no arts elements included in that problem…our group does not think artifacts are incapable to resolve every problem, such as the mathematics problem"
	Invite idea development (IDI)	Invites improvement or revising of initial ideas to conduct the in-depth discussion and gain an in-depth understanding of an idea	"How can you improve or revise the idea?" "Can you compare your initial idea and current idea?"
	Idea development (DI)	Improves or revises the initial ideas to deepen the discussion to a high-level conceptualization for rise-above	Students conducted a discussion about art and math, followed by a problem in relation to the difference between art and science. Through the discussion, students' understanding of art and science is improved. Student A "art is about finding things like inquiry…and

			science is also related to art"… Student B "Art is about creating, it is not about inquiry like science."

Frequency of codes in classroom dialogue

Figure 3 shows the frequency of dialogic moves based on the framework for teachers and students. For articulation and elaboration, teacher codes a high frequency of turns as invite initial ideas (INI), invite elaboration (ELI) and revoice (RV). In comparison, student codes with a high frequency of turns were coded as express ideas (EI) and elaboration (EL) by students. In the KB classroom, students also take the agency to invite elaboration (ELI) of the community discussion. For building-on and connection, teacher codes a high frequency of turns were coded as invite build-on (BI) for build-on (B) by students. Students also engaged in challenge and query (Q) of others' ideas in the community and connect with reference to others' ideas (RB) that occurred less frequency in the traditional classroom. For collective and meta-reflection, less frequency of coordination and reflection was reported in the literature, especially for students. In this study, students were actively involved in the reflection and coordination process and the frequency of turns coded as a reflection (SR & CR) and coordination (SC & CC) was relatively high. Idea improvement represents a significant component of knowledge-building dialogic moves – the teacher was shown to scaffold idea development moves and students were engaged in idea improvement (DI – teacher and students contributing to the development of ideas). Overall, results indicate –a much wider range of dialogic moves in knowledge building classroom - and students were regularly engaged in reflective talks together with instances of synthesis and idea development.

Figure 3. Frequency of codes in three categories– Classroom Dialogue.

Students' engagement in metacognitive reflection and progressive dialogue

To illustrate how meta-cognitive reflection and idea development are manifested, two examples from the KB classroom dialogue were included.

Example 1. Metacognitive dialogue of collective reflection

Dialogue A (Table 2) comes from the transcript data of Lesson 3 and Lesson 4, and it is part of the recording that how students engage in metacognitive reflection process with collective review conducted of what they had learned. In the series of lessons, the teacher was not only invite students to engage in classroom dialogue for discussion of ideas, but also invite students to engage in collective sustained reflection on the state of knowledge-building effort as a community. In the previous lessons, the teacher had collaborated with students to develop understanding of arts, and at the start of Lesson 3 and Lesson 4, the teacher raised a question on, "Can you reflect on what we have learned and discussed from the previous lessons?" The following dialogue A described how students engaged in metacognitive reflection dialogue.

Table 2: Dialogue A – Metacognitive dialogue of collective reflection

Turn	Agent	Classroom Dialogue	Code
1	T	We will start with discussion around something important today. Before we get started, I would like to raise a question, we have been discussing about knowledge building for three lessons, what is the topic and theme we discussed in the last three lessons? *Can you reflect on what we have learned and discussed from the previous lessons?*	**RI**

2	S1	Visual elements	**SR**
3	T	Good, what else?	U
4	S2	Re-creation	**SR**
5	T	Yes, anyone else? I am asking about the big theme.	G
6	S4	What is art and how to appreciate a piece of art?	**SR**
7	T	You got all of them, anything else?	U
8	S4	What we had learned in the three previous lessons are about what is art and how to appreciate a piece of art.	**SR**
		…	
9	T	Now everyone open you learning diary and I will give you one minute to reflect, *have your thoughts about art change before and after these few lessons*?	**RI**
10	S3	The concept of art. *Prior to these lessons*, I had no understanding as to why a very ordinary artwork, such as a blank piece, can be sold for a hefty price. However, a*fter attending these lessons*, I consider that someone is selling an artwork, a kind of creation. In addition, I usually assume that a painting is a painting. I did not expect to take into account this different meaning and other visual elements.	**CR**
11	T	Thank you. Are there other classmates want to build-on or query her ideas? You have great points here.	BI
12	S2	Previously, I considered that a picture must be beautiful to be called a picture, but now, I think the painting should contain something. After reading this art, I can learn something from that.	**CR**
13	T	Can you be a bit more specific?	ELI
14	S2	There is a meaning inside the art	EL
15	T	Anything else? Are there any classmates who want to add something?	BI
16	S4	I considered good art and bad art before the lessons. After the lessons, I believe that a good artwork should carry a meaning in it and it contains different artistic elements.	**CR**
17	T	Thank you. Are there any classmates want to say something? I would like to see more classmates who would like to say more.	BI
18	S12	*Before these lessons, I was not aware of* what art is and did not understand how to use art to comprehend authors' thinking, but *after these lessons, I gained understanding that* we can use visual elements as tools to know what the author was intended to express in the artwork.	**CR**

As shown in Table 2, after being questioned by the teacher about what they had learned from discussion conducted in the previous lessons (Line 1, "Can you reflect on what we have learned and discussed in the previous lessons?" – invite reflection), students made simple reflection to share what they had learned (Line 2, "Visual elements" to Line 4, "Re-creation" – simple reflection). However, students failed to provide the critical ideas they had discussed, for which the teacher carried on encouraging students to focus on the key themes (Line 5, "Anyone else? I am asking about the big theme" - guided). It helped students to concentrate on the critical themes (Line 6 to Line 8, "What we had learned in the three previous lessons are about what is art and how to appreciate a piece of art" – simple reflection).

Furthermore, the teacher invited students to make reference back to their learning diary and conduct review of their initial idea and current idea about arts and arts appreciation before and after the few lessons which was purposed to help students to engage in metacognitive reflection dialogue at a deeper level. For instance, in Line 9, the teacher said, "Please open your learning diary…have your thoughts about arts changed before and after these few lessons?" – invite reflection), followed by different students' complex reflection with illustrating and comparing their initial and current ideas (Line 10 to Line 22). For example, S12 reviewed the change to personal understanding of art, "Before these lessons, I did not know what is art…but after these lessons, I understand that we can use visual elements as tools to know what the author wanted to express in the artworks" (Line 18 – complex reflection). Over the course of reflection, students also made attempt to elaborate ideas, e.g. "There is a meaning inside the art" (Line 14 - elaboration). Overall, dialogue A demonstrates how students engage in metacognitive reflection dialogue, which is a significant component of knowledge-building dialogic move, with collective reflection on their understanding of the conceptual knowledge. It transcends the traditional collaborative learning of over-concentration on the inquiry without sustained collective reflection. Moreover, throughout this metacognitive reflection process, students would also gradually develop epistemic agency of collective reflection over time.

Example 2. Progressive dialogue of idea development

Dialogue B (Table 3) comes from the transcript data of Lesson 10 as part of the classroom dialogue recording to

demonstrate how students engaged in progressive dialogue of idea development with reflecting KF work under the context of classroom for the development of deepened ideas. The teacher starts this session with opening students' KF writing in front of the class, which is one of the strategies applied by teachers used to help students reflect on their previous discussion for further theory-building. In the beginning, the teacher referred back to students' KF writing and encouraged students to revise the question and ideas of KF work, "Let us look at our KF discussion..." (Line 82, invite idea development). The following dialogue indicates how students get involved in progressive classroom dialogue for developing and revising ideas.

Table 3: Dialogue B - Progressive dialogue of idea development

Turn	Agent	Classroom Dialogue	Code
82	T	**Let us look at our KF discussion, there is a seed note in this thread, asked by S1, "Is it possible to use art to solve problems?"** What do you think? Let us see the note is followed by other students, some build on and some ask questions. S1 builds on his initial ideas, "Art can overcome our ignorance. **How can we revise or improve this idea**?"	**IDI**
83	S1	Everything can be art regardless of whether you understand or not	EI
84	T	Here is another KF note, "If you encounter some problems, but there is no art, then what can we do?" I like this one, I am wondering whether this is anyone who knows what I am thinking about?	RI
85	S10	Art is everywhere. Animals, threes, forms, everything is art	EI
86	T	**How can we refine this idea? Is there any evidence to support your idea**?	**IDI**
87	S10	When you are out in the street, you look around…building, architecture, there are all about art.	B
88	T	You are saying everything is about art. What about others? Your group has a different point?	Q
89	S4	If you come across a problem such as math, how can you apply art to resolve the problem?	**DI**
90	T	Good point! Math and art, what do others think about their relations?	**IDI**
		…	
97	S4	**Art is about finding out things like inquiry and making something new and science is also related to art**	**DI**
98	T	Can you provide an example?	ELI
99	S2	Scientists invent new things.	EL
100	T	Here this group disagrees.	U
101	S10	**Art is about innovation. It is not about inquiry like science**.	Q
102	S4	Even for artistic creativity, you still need to inquire and find out. It would be better than just listening to others	RE
103	T	Can anyone explanation of the difference between inquiry and innovation?	**IDI**
104	S10	Creativity is about build up something. Inquiry is to find a new thing	B
105	S4	There is nothing new under the sun…when you make an inquiry, you will find something new. It is the same when we are creating…like making/creating an airplane…When you see the birds, you can inquire about flight…and we can follow that to make something new like a plane.	**DI**
106	T	Do you understand what she said? Do you understand that idea?	**IDI**
107	S10	*Based on what you said, inquiry is one of the ways to enhance innovation*.	**DI**

As shown in Table 3, students expressed their ideas and reflected on the revision of question and idea from their KF discussion (Line 85, Express ideas) by S10, followed by teacher's invitation of ideas development (Line 82 to 86, e.g. "How can we revise this idea? Is there any evidence to support your idea?" - Invite idea development), which is a common strategy applied in a KB classroom with emphasis placed on improvable ideas and theory building. Moreover, Line 88 to Line 94 demonstrated how a new question was raised over the course of discussion and how the improvement to students' ideas was made by continued deepening. As initially queried by the teacher about arts and problems solving according to students' ideas in the discussion (Line 88, "are you saying everything is about art…?" Querying), S4 developed ideas by raising a question to prompt ideas development regarding the topic of arts and problem solving (Line 89 - Idea development). Overall, example two demonstrated that students made attempt to deepen their ideas by conducting classroom dialogue and reviewing their own KF work, for integration of online and offline discussion to improve ideas for rise-above.

Conclusion and implications

The study has examined whether and how students engage in a productive KB dialogic moves in a computer-supported KB classroom. The classroom dialogue is analyzed with KBDeX to demonstrate how students play an influential role with increasing collective responsibility to advance community knowledge. Results suggested that how students engaged in collective knowledge advancement with engaging in progressive dialogue was transferred to students who usually play a regular role with following teacher's directions (Zhang et al., 2018).

As suggested by coding of classroom dialogue, students engaged in collective metacognitive reflection and theory-building processes, especially for the involvement in reflective and progressive dialogue for idea development that are less observed in the regular classroom. Ongoing and further work is needed for reliability and validity through testing in different KB classrooms. Many studies have proposed the importance of classroom dialogue, with dialogic classroom in particular. Nevertheless, no systematic work was performed to investigate students' engagement of knowledge building dialogue with emphasis placed on ideas improvement, rise-above, reflection, and coordination. To conclude, this study is of particular significance, examining how students engage in metacognitive and progressive dialogue for enriching dialogic moves in classroom dialogue, and to augment KB research extending online analytics to classroom analysis.

References

Alexander, R. J. (2017). *Towards Dialogic Teaching: Rethinking Classroom Talk* (5th edn). York: Dialogos.

Bereiter, C., Chan, C. K. K., Hong, H.-Y., Lee, J., Khanlari, A., Lin, P.-Y., … Zhang, Y. (2019). The roles of knowledge in knowledge creation. In K. Lund, G. Niccolai, E. Lavoué, C. Hmelo-Silver, G. Gweon, M. Baker (Eds.), *Proceedings of the 13th International Conference on Computer-Supported Collaborative Learning* (pp. 767-774). Lyon, France: ISLS.

Chan, C. K. K., Tong, Y., & van Aalst, J. (2019). Progressive dialogue in computer-supported collaborative knowledge building. In N. Mercer, R. Wegerif, & L. Major (Ed.), *The Routledge International Handbook of Research on Dialogic Education* (pp. 469-484). London: Routledge.

Chen, H., & Hong, H.-Y. (2016). Schools as knowledge-building organizations: Thirty years of design research. *Educational Psychologist, 51*(2), 266-288.

Hakkarainen, K. (2003). Progressive inquiry in a computer-supported biology class. *Journal of Research in Science Teaching, 40*(10), 1072-1088.

Hennessy, S., Rojas-Drummond, S., Higham, R., Márquez, A. M., Maine, F., Ríos, R. M., García-Carrión, R., Torreblanca, O., & Barrera, M. J. (2016). Developing a coding scheme for analysing classroom dialogue across educational contexts. *Learning, Culture and Social Interaction, 9*, 16–44.

Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. *Cambridge Journal of Education, 43*(3), 325–356.

Howe, C., Hennessy, S., Mercer, N. Vrikki, M., & Wheatley, L. (2019). Teacher-student dialogue during classroom teaching: Does it really impact upon student outcomes? *Journal of the Learning Sciences*.

Major, L., Warwick, P., Rasmussen, I., Ludvigsen, S., & Cook, V. (2018). Classroom dialogue and digital technologies: A scoping review. *Educational and Information Technologies, 23*(5), 1995-2028.

Mercer, N., Hennessy, S., & Warwick, P. (2019). Dialogue, thinking together and digital technology in the classroom: Some educational implications of a continuing line of inquiry. *International Journal of Educational Research, 97*, 187-199.

Mercer, N., & Littleton, K. (2007). *Dialogue and development of children's thinking: A socio-cultural approach*. London: Routledge.

Michaels, S., O'Connor, C., & Resnick, L. B. (2008). Deliberative discourse idealized and realized: Accountable talk in the classroom and in civic life. *Studies in the Philosophy of Educ., 27*(4), 283-297.

Oshima, J., Oshima, R., & Matsuzawa, Y. (2012). Knowledge Building Discourse Explorer: a social network analysis application for knowledge building discourse. *Educational Technology Research and Development, 60*(5), 903-921.

Paavola, S., & Hakkarainen, K. (2005). The knowledge-creation metaphor – An emergent epistemological approach to learning. *Science & Education, 14*(6), 535-557.

Sawyer, R. K. (2014). *The Cambridge handbook of the learning sciences*. NY: Cambridge University Press.

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.

Scardamalia, M., & Bereiter, C. (2014). Knowledge building and knowledge creation: Theory, pedagogy, and technology. In R. K. Sawyer (Eds.), *The Cambridge handbook of the learning sciences* (2nd ed., pp. 397-417). New York, NY: Cambridge University Press.

van Aalst, J. (2009). Distinguishing knowledge-sharing, knowledge-construction, and knowledge-creation discourses. I*nternational 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 9- and 10-year-olds. *Educational Technology Research and Development, 55*(2), 117-145.

Zhang, J., Tao, D., Chen, M.-H., Sun, Y., Judson, D., & Naqvi, S. (2018). Co-organizing the collective journey of inquiry with Idea Thread Mapper. *The Journal of the Learning Sciences, 27*(3), 390-430.