Raising Meta-cognitive Awareness of Collaborative Knowledge Building Practices

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Abstract: This present study discusses the design and the facilitation of a collaborative knowledge building workshop, a move towards the enculturation of knowledge building practices. This skill-based workshop aims to raise students' meta-cognitive awareness of the four key phases of knowledge building, namely, idea generation, idea connection, idea improvement, and rise-above in the progressive knowledge building inquiry cycle, by means of explicit instructional approach. Data was mainly obtained from students' discourse and groups' postings on idea cards at each stage of the progressive inquiry cycle. Students' discourse was transcribed for content analysis to identify indicators of meta-cognitive awareness of the four key stages of knowledge building processes. A post-workshop survey was also administered to examine students' perception of the collaborative knowledge building experience in the workshop. Data analysis showed that students did demonstrate meta-cognitive awareness of knowledge building processes. However, most groups still faced difficulty arriving at the rise-above stage owing to time constraints, coupled with the difficulty to achieve higher-order collective critical thinking and advancement of ideas.

Keywords: Knowledge building; explicit instruction; meta-cognitive awareness; progressive knowledge building inquiry cycle

Introduction

"Knowledge Building", defined by Scardamalia and Bereiter [1], is "the production and continual improvement of ideas of value to a community" with the emphasis of "what the community accomplishes will be greater than the sum of individual contributions" (p. 1370). Hitherto, there have been extensive research studies [2] [3] on this pedagogical approach. However, a few studies actively attempted to resolve the widely existing problem: that is, learners tend to lack the necessary skills and appreciation for collective cognitive responsibility for knowledge building. To cultivate a knowledge-building community, it is important to equip students with the necessary skills and knowledge for collaborative knowledge advancement. The collaborative knowledge-building workshop in this study is a deliberate attempt to streamline the process of working with knowledge following the progressive knowledge building inquiry cycle. In this paper, we present (a) how we incorporated knowledge building principles into the design of this workshop, and (b) how explicit facilitation of knowledge building principles raised students' awareness of knowledge building principles and work processes.

1. Theoretical Background

Knowledge building boasts of twelve interconnected principles encompassing socialcognitive and technological dynamics, which serve as a useful benchmark to attest the feasibility and adaptability of “component skills” such as critical thinking and collaboration. In terms of technological dynamics, Knowledge Forum [4] functions as "a comprehensive knowledge building environment that would provide a means of initiating students into a knowledge-creating culture" (p. 18) [5]. To equip students with the ability to co-construct knowledge, neither theoretical inculcation nor vacuum practice is sufficient. Johnson and Johnson [6] (as cited in [7], p. 188) urged to go beyond theoretical guidance, “not only must group members be taught the skills required for effective collaboration, but they must also be prepared, and given the opportunity, to use them”. Pena-Shaff [8] further expounded that “it is important to provide students with a rubric with specific guidelines about what they will be required to do, how much they should participate and whether they will need to reference the literature” (p. 445), which necessitates “structuring the collaborative process in order to favor the emergence of productive interactions”(p. 62) [9].

Realizing the need to equip students with necessary knowledge construction skills, we adapted the knowledge building theoretical framework in our workshop design and Archer and Hughes’s “explicit instruction” (p. 1) [10] in our implementation process. Explicit instruction is a direct approach to teaching “with a series of scaffolds where students are guided through the learning process with clear statements about the purpose and rationale for learning the new skill, clear explanations and demonstrations of the instructional target, and supported practice with feedback until independent mastery has been achieved” (p. 1). There are several studies that have proven the effectiveness of explicit guidance and/or scaffolding to hone students’ collaborative and problem-solving skills. Weinberger et al. [11], an experimental study was conducted to compare the effects of interaction-oriented and content-oriented structuring tools. One of their conclusions was that given more explicit facilitation and instruction to students, students displayed higher levels of engagement, interaction and collaboration. Another study by Marin and Halpern [12] employed explicit instruction to develop adolescents’ critical thinking skills and concluded that students who received explicit instruction of guidance produced greater gains than those with implicit instruction. Given the effectiveness of explicit guidance and the need to foster students’ ability in co-constructing understanding, our study was designed to explicitly train students to understand and be aware of knowledge building work processes.

2. Methodology

Premised upon the twelve socio-cognitive and technological affordances of knowledge building [13] as overarching design principles, such as improvable ideas, idea diversity and rise above, we designed and implemented this workshop based on the Progressive Knowledge Building Inquiry Cycle Model [2], consisting of four main phases: (1) Idea generation; (2) Idea connection; (3) Idea improvement; (4) Rise above.

2.1 Design Considerations

2.1.1 Design consideration 1: Explicit instruction

In this workshop, besides facilitator’s explicit guidance, scaffolds in textual forms, as one form of explicit instruction, were also provided to guide students through the knowledge building work processes. Semi-structured scaffolds in sentence openers such as “My idea is” and “I need to understand (INTU)” were given to students at an idea generation stage, while at idea improvement and rise-above stages, students were supposed to use “A better idea is", "My new question is" and "New Information is". Scaffolds "are designed to encourage students to engage in expert-like processing of knowledge; they help to move beyond simple question-answer discussion and elicit practices of progressive inquiry" (p. 410) [14]. The description of workshop design (see Table 1) shows how the elements of explicit instructional tactics are translated into actual design and delivery of teaching collaborative knowledge building practices.

2.1.2 Design consideration 2: Opportunistic grouping

In the first two phases of our workshop, which are *idea generation* and *idea connection*, groups are organized randomly; while in the *idea improvement* and *rise-above* stage, an opportunistic grouping method is adopted. Opportunistic grouping is a form of collaboration that students are flexible to form, disband, and recombine group members based on their common interests or goals that emerge during collaboration. A study by Zhang et al. [15] drew a conclusion that opportunistic collaboration, when compared with fixed-group collaboration, can give rise to "more pervasive, flexible, distributed collaborations, and greater diffusion of information and knowledge advances"(p. 34).

2.1.3 Design consideration 3: Expert facilitator

In order to ensure a smooth and effective workshop, the role of facilitators cannot be neglected, as Chai et al. [16] put it, "fostering collaborative learning among students requires skillful facilitation from teachers who are knowledgeable about many aspects of collaborative learning" (p. 7). Facilitators play a significant role in stimulating students to integrate their prior knowledge with new knowledge in tasks that they are engaged in. Hmelo-Silver and Barrows [17] described an expert facilitator as someone who would "use a variety of questioning tactics to help support this knowledge-building discourse" and push students to "explain their thinking" and "problematize their ideas" (p. 90). In our workshop, four researchers with research experiences in a knowledge building pedagogy acted as expert facilitators.

2.1.4 Design consideration 4: Knowledge wall

In our workshop, instead of using a technological platform such as Knowledge Forum [4], we employed a non-technological space, Knowledge Wall [18] consisting of idea cards and mahjong papers, as a measure of enculturation. Three different colors of idea cards were used in this knowledge building practice, with yellow ones representing ideas generated in idea generation, pink ones representing improvable ideas and orange ones for rise-above ideas. Specifically, students were asked to write their individual ideas on idea cards, connect ideas by drawing a line with a pencil, read all the cards posted on the knowledge wall, and write new ideas to respond to other ideas. Students were encouraged to search on the Internet to find authoritative information to support and improve their ideas. We encouraged students to use textual scaffolds such as "My idea is" and "I need to understand" for them "to engage in expert-like processing of knowledge; they help to move beyond simple question-answer discussion and elicit practices of progressive inquiry" (p. 410) [14].

2.1.5 Design consideration 5: Group presentation

So et al. [2] proposed that it is of high importance to emphasize "metacognitive reflective thinking" (p. 482) continuously through the whole inquiry cycle in order to make students reflect on their cognitive thinking of collective learning process. Presentations in front of the whole classroom community create a good opportunity for students to reflect on their cognitive thinking of collective learning processes.

2.2 Research Context

The workshop was conducted in one of the future schools in Singapore. Two classes (altogether 43 students) of Secondary One students attended the workshop. The workshop was divided into two sessions and each lasted for two hours. Brief description of workshop design is presented in Table 1.

Table 1: Brief Description of Workshop Design

Phases	**Procedure**
Session I	
Tune-in	Facilitator introduces progressive knowledge building inquiry cycle & topic: Early Explorers & Food Matters to generate discussion.
Idea generation	Students generate ideas and develop own line of inquiries on idea cards using given scaffolds e.g. "My idea is…/ I need to understand"
Idea connection	Students compare and contrast own ideas with other diverse ideas for idea connection.
	Presentation & Sharing
Session II	
Tune-in	Students view inquiry threads of ideas, e.g. nutrition, survival on knowledge wall. Students form new groups based on common interest to further idea development and improvement.
Idea improvement	Students in new groups conduct further research Students think about how the new knowledge help them answer their initial questions and lead to better ideas using scaffolds such as "A better idea is … / My new question is …"
Rise above	Students identify the problems and knowledge advances; summarize what has been learned; state any new concept/ theory/ synthesis.
	Presentation & Wrapping up

2.3 Data Collection

Each workshop session was audio- and video-recorded, and transcribed for content analysis. In addition, a collaborative learning survey adapted from Brown et al. [19] was administered to examine students' perceptions about their collaborative knowledge building experience in the workshop. We collected multifaceted data, i.e., postings on idea cards, experimental groups' interaction discourse and presentation, and a collaborative learning survey.

2.4 Data Analysis

All data was analyzed separately according to the four phases of the process knowledge building cycle since different data sources were observed at different phases. We first divided the corpus of discourse according to the four knowledge-building phases, i.e., idea generation, idea connection, idea improvement and rise-above, according to the timeline of recording transcriptions and colors of idea cards. For phase 3 & 4, we coded students' conversation in this third stage into "inquiry threads", which "can be defined as a series of notes that address a shared principal problem and constitute a conceptual stream in a community knowledge space" (p. 125) [20]. We also identified inquiry threads by reading through all the audio transcriptions in the idea generation stage and tracing the specific problems that were addressed by the group members. In the final rise-above stage, orange-color idea cards and group presentation were analyzed.

3. Findings and Discussions

3.1 Quantitative Data Analysis

The Brown et al.'s (p. 123) [19] collaborative learning survey was adapted and administered to all participants after the two-day workshop, which was a 28-item Likert-scale survey ranging from 1 (strongly disagree) to 5(strongly agree) on the five key constructs: self-perception, perception of team members, teamwork, progress and satisfaction. The number of students participating the survey was only 17 because, as homework, some of them forgot to do and submit their survey. However, the results were not biased because of randomness of the 17 participants. We found that students' perceptions towards the overall workshop are positive with all the mean values above 4.00. Specifically, students valued peer collaboration highly with a mean value of 4.31.

3.2 The Characteristics of Student Discourse

3.2.1 Indicators of Students' Metacognitive Awareness of Knowledge Building Processes

Analysis of students' postings on idea cards and their interaction discourse showed that semi-structured scaffolding statements such as "I need to understand…" do assist students in the progressive knowledge building inquiry cycle. Besides, we also tracked students' in-depth knowledge construction endeavor such as progressive inquiry and collective convergence of shared knowledge. Table 3 is an overview of some examples that are indications of students' meta-cognitive awareness of the four phases in the progressive knowledge building inquiry cycle.

Table 3: Examples Indicating Four Phases of Progressive Knowledge Building Cycle

Phases of KB	Indications of Meta-cognitive awareness of Knowledge Building
Idea generation (Yellow-color idea cards)	• I need to ensure a balanced energy level and/or calories, etc. for every meal. • My idea is to bring food that is more solid (not liquid based). This is to minimize the spillage of liquid based food. For example: potato.
Idea connection (Groups' interaction discourse)	• Did you see anything related to canned food? • Yeah, it is almost the same. So it's related. • It's not related to this.
Idea improvement (Orange-color idea cards)	• A better idea would be to bring light food that is nutritious and easy to cook/prepare, e.g. instant noodles. A new question would be how much nutrients an average person needs daily. • New information is that an average person needs about 2000 calories a day.
Rise above (Orange-color idea cards)	• Summary of learning points: I learn that not all food is nutritious and convenient, so we must try to find more of them. • Problem areas & specific knowledge advances: we thought instant noodles were nutritious but only some were so. We need to find out the ones that are nutritious.

Here, we specifically identified the "idea connection" discourse in Table 3 to explain in greater details. The primary data source for observing students' efforts to connect ideas is group verbal interactions in which they might discuss with their group members about similarity and/or incompatibility of two or more ideas. When students read similar ideas on the Mahjong paper, their performance displayed meta-cognitive awareness about idea connection by using statements such as “I just link everything” and “we can draw a line”. Besides students’ discourse, group presentations could also reveal groups’ cognitive thinking process and the underlying reason for generating and grouping ideas.

3.2.2 Progressive Problem Solving

Qualitative analysis of students’ interaction discourse and ideas cards reveals evidences of idea improvement behaviors. To examine the internal mechanism of idea improvement for our focus group, we observed and analyzed students’ interaction discourse with the inquiry thread of “preservation and nutrition”. Table 4 below is an example that shows the progressive improvement of our focus group’s initial inquiry about “how much should a person bring potentially”.

Table 4: Overview of Progressive Problem Solving Process

Progressive Improvement Process	Students’ Interaction Discourse
Question-initialization	How much should a person bring potentially?
Question-refinement	It should be how much a person needs.
Information from Internet Sources	The average man can carry about 10kg.
Conflict and repairs	Yea, but you don’t need to carry 10 kg; you only need to carry how much you need.
2nd Question-refinement	How many of let’s say this thing can roughly pack in order to like survive for the adventure trip.
Enquiry-clarification and negotiation	How much nutrients does an average person need in order to let's say just … meet his daily needs…based on metabolism.
2nd Information-seeking from Internet Sources	1. We need new information. Can just research on how much does an average person … consume. 2. An average person needs about 2000 calories. Average. 3. The average person needs about. Should I choose the bigger number or the smaller number? About 60 grams of fat.
2nd Enquiry-clarification	Do we need more new information?
Knowledge convergence	1. We need to do this (referring to ‘fat’)? 2. No. We must write the calories, write in calories form.

The analysis of students’ discourse above revealed that in the process of improving ideas around inquiry thread “preservation and nutrition”, students initiated questions, refined conflicting ideas, sought external expert knowledge and converged at shared understanding, progressively solving their problem and created better ideas. Multiple examples were noticed in students’ inquiry threads that followed the pattern of progressive improvement above.

3.2.3 Constructive Use of Authoritative Sources

From students’ interaction discourse, it was encouraging to observe that students cited authoritative sources for deeper understanding and explanations through online research. For example, in an effort to figure out one question about how much food a person needed to bring for an exploration, one student searched the information from the Internet that said “an average person needs about 2000 calories”, which is a sign of students’ attempt to seek for external authoritative information rather than merely relying on their prior knowledge. But the expert resources here from our students were presented by merely providing an excerpt of online information, which was labeled as “introducing resources” rather than “going beyond resource material” (p. 135) [20]. They did not make any evaluative uses of resources nor use them for extending communal understanding.

3.2.4 Rise-Above

Rise above is characterized by group members' reflection of their progressive knowledge building processes by writing on the idea cards all the learning points and improvable problem areas for further knowledge advances. From the performance of students' presentations, we noticed that students gained certain in-depth understanding, which is beyond what they wrote on initial idea cards. For instance, students synthesized and reached the conclusion that "explorers should bring 9 or 10 packs of instant noodles with them". That is a cognitive calculating process, revealing how students' thinking went through a series of refining raw resources and then formulating a better idea:

> *"The new information is we found that we need about 2000 calories a day so each instant noodle contains about maybe 200 calories, so we know the certain amount of instant noodles we need to bring convenient food like instant noodles for 9 to 10."*

4. Discussion and Conclusion

This study has practical implications for future cultivation of students' knowledge building and collaborative skills in other educational settings that share similar features. To raise students' meta-cognitive awareness of knowledge building work processes, it is important to provide explicit instruction and/or guidance of sub-skills underlying knowledge building pedagogical models. This does not mean that explicit instruction of knowledge building principles should be employed for every learning situation. Instead, the need for such explicit skill training depends on the cohort of learners and the socio-cultural conditions of the classroom. Albeit that the study did show some encouraging findings, it has some limitations. The first limitation is related to time duration on skill training. The conditions for performing knowledge building activities/ tasks differ from that of procedural tasks, as students need longer time to digest and practice the skill sets. The second limitation is that we need to take into consideration students' prior knowledge, the individual learning capacity and motivation, as Scardamalia and Bereiter [21] put forth: when no reference material is referred to, "students' prior knowledge was the only basis on which their questions could be formed." In our next study, we intend to incorporate SECI model [22] into the current Progressive Knowledge Building Inquiry Cycle and further investigate whether students have acquired the essence of progressive knowledge building inquiry practices through engaging students in authentic learning tasks.

Acknowledgements

This research is supported by the FutureSchools@ Singapore project under the National Research Foundation's (NRF) Interactive and Digital Media (IDM) in Education Research and Development (R&D) Programme.

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