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The Analysis of Small Group Knowledge Building Effort among Teachers Using an Interaction Analysis Model

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Abstract: In this paper, we investigate teachers' interaction in Knowledge Forum using the interaction analysis model [12]. The teachers were given two tasks that were designed to engage them in building knowledge in the belief mode and the design mode [1]. The patterns of online interactions generated by these two tasks were compared. The results indicate that there is no discernable difference. It also indicates that the teachers' interaction lack depth and they are oriented towards task completion. Implications of the results towards teacher development are discussed.

Keywords: Teacher education, knowledge-building community, interaction analysis

1. Introduction

The emergence of a 21st century socioeconomic landscape that is propelled by innovation and technological advancements has challenged many educators to rethink what schooling means. The distinct talent for individuals to excel in the Knowledge Age, according to Bereiter and Scardamalia [1], comprises of the "ability to work collaboratively with conceptual artifacts in design mode" (p. 702). Schooling, however, has been conceptualized and operationalized to build individual ability in assimilating cultural artifacts in the belief mode (ibid). This misalignment between socioeconomic needs and current schooling system has prompted many educators to search for alternative ways of renewing schools' pedagogical practices. In this paper, we focus on the application knowledge-building community (KBC) model for teacher professional development. Arguably, engaging teachers in KBC can help to foster 21st century skills and dispositions. However, innovative teacher education courses that answer to the new challenges are currently lacking [2].

2. Literature Review

Computer-supported collaborative learning (CSCL) refers to the field of study which focuses on "group-based collaborative learning supported by computers, where learning could take place either face-to-face, via computer networks, or through both modalities" [3] (p. 580). Broadly defined, collaboration involves the joint engagement in group processes such as negotiation and sharing as they embark on shared meaning-making [4]. Many researchers argue that CSCL are appropriate form of technology for the cultivation of knowledge society skills [1,4,5]. However, it cannot be guaranteed that networked

collaboration will inevitably lead to higher level understanding, and that all participants in the community jointly contribute to new knowledge creation [6,7]. As such, there is the need to analyze such interactions to gain insight into the collaborative learning process and to understand the variables involved in effective collaboration.

Among the studies which analyzed online discourse employed in educational settings, it seems that not many of these have focused on the analysis of teachers' online discourse [8]. As mentioned by Chai and Khine, it is important that teachers should be able to carry out substantial knowledge building interactions among themselves before they can implement CSCL effectively in the classroom. Their analysis of the interactions among a small group of teachers indicates that the teachers were not quite able to engage in progressive discourse. More research is thus necessary to verify this preliminary finding and to uncover the factors that contribute to this phenomenon.

Among the CSCL platforms, Knowledge Forum™ (KF) is a well-researched environment. This online platform runs on a multimedia database. The participants can simultaneously create and post notes that are added to the database; review other postings; response to peers' notes; search and retrieve records; and organize notes into more complex structures [9]. The graphical linkages of postings display the interconnectivity and dialogical nature of knowledge and enable the development of ideas to be traced. In addition, KF further support knowledge-building through various scaffolds. Scaffold prompts such as "My theory", "I need to understand" and "Putting our knowledge together" allows the participants to think about and articulate the intent of the information they want to relay and these can be customized to facilitate the discourse [10].

KF is a platform designed specifically to support the Knowledge Building Community (KBC). A KBC is a group of individuals committed to sharing and advancing the group's knowledge [8]. The knowledge building (KB) process is similar to that of scientific and scholarly inquiry wherein conceptual artifacts are proposed, evaluated and improved upon through active discussion in the community. Simply put, conceptual artifacts are ideas treated as real objects rather than as tacit knowledge or knowledge residing in the mind. The central idea of knowledge building is the fostering of collective cognitive responsibility [10]. Translating this into an educational setting would entail students to be collectively and directly involved in building new knowledge, through progressive discourse that involves the uptake of sustained collaborative inquiry, understanding and improvement of ideas. In short, knowledge building is defined as "the production and continual improvement of ideas of value to a community" [11] (p. 1370).

Bereiter and Scardamalia [1] called for the need to provide a balanced education that embraces the importance of both the belief and design modes of dealing with knowledge and ideas. The belief mode centers on activities that deal with evaluating and deciding among knowledge claims. On the other hand, design mode is centered on pragmatic concerns beyond the pursuit of truth and justification, primarily focusing on the creation and improvement of ideas. Traditionally, only advanced graduate students in universities are expected to deal with ideas/knowledge in the design mode since they are expected to contribute some form of new knowledge as part of their academic rigor. As suggested by Bereiter and Scardamalia, KB is one plausible approach to bring design mode activity into the school curriculum. In the essence of KB, by being fully immersed in the process of creating and improving ideas, students are actually working in the design mode. Design and technology courses and non-curriculum based activities such as drama dance choreography can be said to operate under the design mode. However, a large part of the academic curriculum which utilizes approaches such as lecture-based teaching or inquiry learning operates in the belief mode. Henceforth, steps should be taken to help develop students into knowledge producers and not mere consumers of knowledge by inculcating in them habits of the design mode; stated differently, to help transform knowledge work from belief mode

to design mode. Computers can be a useful means in transforming the role of learners from being passive consumers to that of active designers that contribute to personally meaningful activities [12].

However, based on the literature review, there is no study which has explicitly tried out the use of the knowledge building as a pedagogical approach that differentiates knowledge activities in the design mode from those in the belief mode. It is thus the aim of this present study to test out the feasibility of using knowledge building to support the transformation of teachers' knowledge-building activities in the belief mode into the design mode and to identify potential obstacles against such transformation. The present study intends to address the following three research questions: 1. Given a belief-mode activity (Task A), how do teachers build knowledge collaboratively? 2. Given a design-mode activity (Task B), how do teachers build knowledge collaboratively? 3. Are there discernible differences in interaction patterns between carrying out a task in the belief mode and in the design mode?

3. Method

The participants in this study were 26 graduate students enrolled in an elective Master course that is entitled "Engaged Learning in Knowledge Building Communities". The course spans across 13 weekly evening sessions. Each session lasted 3 hours. The participants are or were practicing teachers in Singapore schools. The teaching subjects of the teachers include Languages, Humanities, Sciences, Mathematics and Design and Technology, ranging from the primary school level to junior college level.

The course is aimed at introducing course participants to the knowledge building model by having the participants themselves immerse in a KBC that seek to explore and discuss issues related to the theoretical underpinnings of KBC and the fostering of KBC in local schools. The course instructors provided a brief introduction of KBC and KF at the start of the course. In the follow up classes, participants were instructed to seek and form, among themselves, groups of 4 to 5 members to carry out KB-related tasks A and B.

Task A consists of groups investigating various KBC-related topics. Four weeks duration was given to the groups to prepare a follow-up presentation to the whole class on what they have studied. Task A is regarded to be carried out in the belief mode since it mainly consists of members' attempt at expanding the group's collective understanding of the allocated concept (such as community of practice, community of learners), through the evaluation of warranted beliefs. Groups are then given the second task (Task B) to design a series of lesson ideas for the implementation of KBC in the Singapore school context. Task B is supposedly carried out in the design mode since it requires groups to develop a series of lesson ideas that is to be scrutinized and improved upon by the community.

The data collected for this study consist of the notes posted online in KF, by individual group members, which reflect their discussion on two different activities, Task A and Task B. There are a total of 7 groups in the course module but as a preliminary analysis only 3 groups' postings on both Task A and B are analyzed in details. We adopted purposeful sampling for the selection of the groups' postings. These groups are arbitrarily assigned as Group 1, Group 2 and Group 3.

All postings contributed in each group were analyzed using the interaction analysis model (IAM) which was developed by Gunawardena, Lowe, and Anderson [13], and has been used in a number of studies [6, 14,15]. The IAM model presents the development of co-construction of knowledge as a series of five progressive phases as shown in Table 2. The model was applicable to analyze activities in the design mode (i.e. Task B). Nevertheless, some adaptations were made to the actions for each phase to better reflect the

relevant operations involved in the design mode. In particular, to be critical, a “phase 0” code is added and used to represent postings which are task-oriented and not a collaborative part of any inquiry or design, i.e. centered on task-performing and task-coordinating activities.

In total, 530 messages have been coded. Based on the first 101 postings from two groups that are coded independently by two raters, the percent agreement is 70.3%. Discrepancies were discussed and after an agreed upon assignment of codes was determined from these discussions, the first rater continued to code the rest of the messages.

Table 2: IAM for the analysis of design mode activity (Task B)

Phases		Examples of design mode action stipulated for each phase:
I	Sharing/Comparing of information.	Statement of initial proposal, idea
II	Discovery and exploration of dissonance or inconsistency among ideas, concepts or statements.	Identifying feasibility, strength or weakness of proposed ideas; stating areas of disagreement
III	Negotiation of meaning/ co-construction of knowledge.	Negotiation or clarification of ideas; identification of areas of improvement; proposal and negotiation of new ideas embodying compromise, co-construction
IV	Testing and modification of proposed synthesis or co-construction.	Testing against an existing cognitive schema, personal experience, formal data collected or contradictory information in the literature.
V	Agreement statement(s)/ applications of newly-constructed meaning.	Summarization of agreement(s) and metacognitive statements that illustrate new knowledge construction and application.

4. Findings and Discussion

A total of 530 messages, from 3 groups, were coded. Tables 3 and 4 summarize the results. It can be observed from Table 3, that a high percentage of the online correspondences, dealing with Task A (belief mode), fall under Phase 1 (sharing and comparing of information). Phase 0 postings (task-oriented) are the next higher contributions. Occurrence of correspondences under Phase 2 (discovery/ exploration of ideas) and Phase 3 (negotiation/con-construction) are minimal while those belonging to Phase 4 (testing proposed synthesis) and Phase 5 (statement/application of newly-constructed knowledge) are essentially non-existent.

Likewise, the same conclusions can be drawn about the type of communication carried out in the design mode activity (Task B) for all the 3 groups studied (see Table 4). Most of the communication is under Phase 1. The next higher portion of communication is task-oriented in nature. Although those of Phase 4 and 5 are not observed at all, it was observed there are some communication of the Phase 2 and 3 types. But, there is still no evidential relationship between the intensity of discussions (based on number of postings) and the quality of contributions towards co-construction of knowledge.

For the groups studied, the findings suggested that there are no discernible differences in the interaction patterns between carrying out a task in the belief mode (Task A) and in the design mode (Task B). Regardless of the nature of activity, it is found that the group members' online discussion usually takes the form of the sharing of opinions and data and the acceptance of these inputs, by other members, is mostly done at face-value without

much probing, clarifying or questioning. Much less occurrence goes beyond Phase 1 to reflect some types of knowledge co-construction.

Table 3: Distribution of KB activities based on coding scheme – for Task A

	Group 1	Group 2	Group 3
Phase	Percentage number of postings (T=38) / %	Percentage number of postings (T=27) / %	Percentage number of postings (T=93) / %
0	13.2	0.0	23.7
1	86.8	88.9	69.9
2	0.0	0.0	4.3
3	0.0	11.1	2.2
4	0.0	0.0	0.0
5	0.0	0.0	0.0

T = total number of postings

Table 4: Distribution of KB activities based on coding scheme – for Task B

	Group 1	Group 2	Group 3
Phase	Percentage number of postings (T=188) / %	Percentage number of postings (T=32) / %	Percentage number of postings (T=152) / %
0	10.6	12.5	16.4
1	84.6	75.0	74.3
2	4.3	6.3	5.9
3	0.5	6.3	3.3
4	0.0	0.0	0.0
5	0.0	0.0	0.0

Below we will further look into reasons that can possibly account for the failure of the teacher participants in establishing among themselves the notion of a KBC.

1. Participants knowledge building capacity. As suggested by Kreijns et al. [6], it cannot be assumed that group members will engage in high levels of knowledge construction given the provision of both cognitive prompts and technological support for such interface as in Knowledge Forum. Furthermore, it cannot be assumed that graduate students possess the necessary skills for effective co-construction of knowledge. Example 1 consists of 3 consecutive notes.

Example 1

[I need to understand] how we should group our students and why do we use this approach. Any suggestions?

[Opinion] The grouping should preferably be based on students' interest in the topics concerned. We would need to find out, in one way or another, which areas of the topics they are interested in. We then group them according to their areas of interest.

[My Theory] is that we should group them according to their characteristics. Maybe each group should have articulate as well as quiet students to help create dynamics of group activity.

As can be seen, the postings were rated as Phase 1 since they were merely personal opinions without much justification based on theoretical groundings. To bring about the synthesis towards a higher level of understanding, students must work seriously to develop their ideas and in the process, make constructive use of authoritative sources [1]. Failure to do so would result in students being stagnant in their current level of understanding and not move beyond naïve conceptions that they hold.

2. Social practices of participants. Most of the participants in this course have known each other through earlier course modules that they attended together. As a cohesive group, with the similar background of being teachers, the group quickly established norms of a classroom community which embraces a climate of sharing. However, could it be possible that the high level of cohesiveness bring about an adverse effect on knowledge building whereby information is received without much qualm as a formality of politeness and respect for one another [8].

3. Role of course facilitator. The frequency of interceptive postings by the course facilitator is only 4 counts from the 6 KF views analyzed. Given that the teachers may not know how to build knowledge collaboratively, and that they may be reluctant to take on the critical stance, more scaffolding from the instructors may be needed to model the process of collaborative knowledge building.

4. Constraint of time. In accomplishing Tasks A and B, it is observed that the groups make an earnest attempt to share information from their literature search and build-upon one another's note. However, a trend is noticed whereby groups switched the discussion mode from seeking to construct understanding to focusing on the churn out of appropriate content-laden PowerPoint slides to present their views to the class and the lesson plan respectively. This trend seemingly occurred at the onset of the approaching deadline for the class presentation and the lesson plan. Thus, one plausible reason for the lack of knowledge building discourse in both modes would be the insufficient time given to the groups for them to develop in-depth knowledge construction. Example 2 provides an account of how participants have to straddle time between their work and the part-time course they are studying. In addition, this lack of time also resulted in groups to focus more on the completion of task at hand, emphasizing more on the product outcome and dwelling upon task-performing and coordination strategies. Example 3 below is an example of note rated at phase 0. It shows a clear orientation towards task completion rather than knowledge building. To employ the KBC for teachers' professional development may require extended time so as to achieve better outcome [16, 17].

Example 2

[Democratizing knowledge] ...Have been tied with some urgent stuff this entire week. Will give my input to rise above all other aspects of this KB plan...

must be a busy period at MOE now. I can empathize. In schools, there are also busy periods too... thanks to all who helped me last time during the presentation... I will try my best to contribute and cover if help is needed this time.

Example 3

[Opinion] Dear all, can I proposed the breakdown of writing the plan as such?
 1) Learning Objective(include SOW, UBD, how we derive our big question, why we want to use KB) -Adam
 2) Target Audience and Design of our activities (how it make use of the KB Principles) - Sally
 3) group dynamics (how big should the forum be, the group size) - Mary
 4) duration for each forum -Adam

- 5) resources needed - Dave
- 6) evaluation rubrics - Dave
- 7) platform (such as KB forum, why we using this platform) –Kelly
- 8) Possible problem of implementation, challenges. - Kelly
- 9) any others.... everybody

Schedule: By April 2nd Post up to portal OKie!:)

5. Conclusion

The present study is one example that relays the complex process of online collaborative learning which constitutes various interplaying variables that have a compounding effect on the effectiveness of the collaboration and hence the learning outcome achieved. As discussed earlier, the participants' knowledge building capacity, their social practices, the facilitators' scaffolding and time constraint are all plausible attributes to account for the lack of knowledge building in both Task A and Task B for the 3 groups. Recommendations to aid in the fostering of the knowledge building discourse would include greater scaffolding, greater focus on the process and the use of e-portfolio for both peer and self evaluations. It is likely that the design mode requires additional technology components to supplement Knowledge Forum and other similar KB environments, i.e. dedicated design environments, in order to stimulate the transitions into this mode of learning.

One important insight to this present study will be the need to equip teachers with a firmer understanding of what knowledge building really constitutes. Since the teacher participants are already facing problems in their personal assimilation of the essence of KB, how confident are we that they will be able to correctly and effectively implement the approach in their own classroom? It is therefore essential for teacher educators to design courses which could facilitate teachers' development so as to enable teachers to be productive knowledge builders.

In addition, while the attributes mentioned above help to address the disparity as to why the extent of knowledge building in a design mode is not significantly different than that in the belief mode, it brings us to question how different really are these two modes. Although Bereiter and Scardamalia [1] advocated these two approaches in dealing with knowledge and ideas, they did not provide succinct examples that highlight the difference in the approaches taken of the belief and design modes. This is necessary because of the importance of helping teachers to develop a deeper understand of not only the design mode itself, but also the complex relationships between belief mode and design mode. Henceforth, there is a need to provide a clearer demarcation of the two modes so as to avoid the misconceiving of one approach for the other. Furthermore, if educators are to provide students with learning experiences in design mode, there is a need to provide guidelines on the operationalization of these modes so that appropriate implementation strategies can be enlisted. It is also recommended that guidelines on suitable epistemological scaffolding be provided so as to assist students in the transition from one mode of operation to the other.

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