An Analysis of Interaction and Participation Patterns in Online Community

在线社区中交互与参与方式的分析

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话语分析

ABSTRACT

This paper presents findings from the pattern of participation and discourse analysis of the online interaction among in-service teachers in the teacher training institute in Singapore. It was found that the teachers formed a knowledge-building community and jointly discussed issues related to integrating information technology into the classroom. There was evidence that teachers formed a socially cohesive community and their participations were active. However it was found that in-depth and sustainable online interaction were lacking. The authors suggest searching for ways to promote deep and sustainable online interaction, especially in terms of getting participants to detect the gap in ideas and challenging assumptions.

Keywords

Knowledge building community, Computer-supported collaborative learning, Online interaction

Introduction

In this information age, lifelong learning and collaboration are essential aspects of most innovative work (Stahl, 2000). It is imperative for educators to nurture in our next generation learners the habit of community participation and collaboration. Computer Supported Collaborative Learning (CSCL) systems are the tools designed to support the building of shared knowledge and knowledge negotiation (Stahl, 2003). However, implementing CSCL systems into classroom teaching and learning is a complex process that involves substantial teachers' learning. This study is based on a straightforward assumption that if teachers are unable to demonstrate substantial knowledge building interactions online among themselves, it is doubtful that they will be able to implement CSCL effectively. To date, there seems to be few studies that focus in the analysis of teachers' online discourse (Zhao & Rop, 2001).

Knowledge-building Community

A Knowledge-building Community (KBC) is a group of learners committed to advancing the group's knowledge of some shared problems through collaboration (Hewitt, 2001). It resembles knowledge creation teams such as research and development teams in scientific community or the commercial world. Supported by an asynchronous communication platform known as Knowledge Forum™ (KF™), the KBC is a social-constructivist oriented pedagogical model developed by Scardamalia and Bereiter (1996). It builds on social-cultural theories of learning that view learning as a process of participating and interacting in a community of practice (Vygotsky, 1978; Greeno, 1998; Lave & Wenger, 1999). Given this general orientation, the KBC emphasizes situated learning in a collaborative social environment where the learners struggle to solve authentic problems. This emphasis is common among reformed pedagogies that are labeled as constructivist (Kirschner, Martens, & Strijbos, 2004). Within this broad framework, interaction among members is the key mediator for the co-construction of shared perspectives and the appropriation of cognitive strategies employed by expert within the community.

异步通信

Although the KBC model draws on the constructivist-oriented theories, researchers directly involved in developing KBC argued that the KBC has moved social-cultural framework beyond the acquisition of knowledge and appropriation of practices to that of creation of knowledge. For example, Scardamalia, Bereiter, and Lamon (1994) have criticized the current Vygotskian's view as overly focused on the internal cognitive structures of the learners while neglecting the social structures that facilitate knowledge advancement. The key element that distinguishes the KBC from the social-cultural framework is its emphasis on critical and creative work on ideas. This focus shifts the attention of a learning situation from internalization of existing practices and knowledge to the co-construction of new knowledge. Learning about the practice and knowledge becomes a by-product of being a knowledge worker. Despite the shift, the vital role of discourse in a KBC is not undermined

because it is through discourse that knowledge or ideas are constructed, negotiated and improved (Lamon, Reeve, Scardamalia, 2001).

To direct the focus of discourse towards knowledge creation rather then knowledge telling in a KBC, learners are encouraged to produce cognitive artifacts such as explanations of phenomena they have encountered. These cognitive artifacts are then subjected to the community scrutiny for improvement. In practice, the knowledge building process is thus a process whereby participants create knowledge objects such as an explanation or a design document that represent their understanding. These knowledge objects are shared in the form of notes (i.e. an online message) through the KF™ platforms. The community then assumes the collective cognitive responsibilities to improve the objects through various activities such as gathering information through multiple sources; debating about the ideas and conducting empirical research (Scardamalia, 2002). Bereiter (1997) argued that engaging students in the improvement of knowledge object would lead students to the examination of existing theories, which would lead to learning. At the same time, the contexts created help the participants in learning about how to work with knowledge. Engaging learners in a KBC is in essence empowering learners to work constructively and creatively with ideas, i.e. to treat learners as knowledge producers (Bereiter, 2002).

The above review highlighted that the KBC model focuses on the co-construction and improvement of knowledge objects. Lipponen, Hakkarainen, and Paavola (2004) classified CSCL models that are similar to the KBC model within the knowledge creation framework, as contrasted with CSCL models that are founded on the acquisition framework or the participation framework of learning. Although differences in underlying framework usually lead to different practices and research foci, it seems reasonable to accept that participation and interactions are the enablers of learning and knowledge co-construction in CSCL environments. In other words, the success of a CSCL environments such as the KBC is under girded by participants' active participation in a socially acceptable and yet cognitively challenging manner. The recognition of the importance of the participation, social and cognitive dimensions are reflected in the analysis models that has been developed recently.

Analysis models of CSCL

Online interaction, as a form of discourse, is a complex and discursive phenomenon. Researchers in this field generally agree that mixed method multidimensional analysis is necessary to provide in-depth understanding (for example, Wegerif & Mercer, 1997; Hmelo-Silver, 2003). To date, several researchers had attempted to develop coding schemes to account for the different aspects of online interactions. One of the earlier attempts to analyze content is the model proposed by Henri (1992) that includes five dimensions and their categories as shown in Table 1.

Henri believed that her model would help educators to understand the learning processes that occur online comprehensively. Although the model is lacking in clear criteria and detailed descriptions (Howell-Richardson & Mellar, 1996), it is a useful tool in terms of laying the groundwork. Hara, Bonk and Angeli (2000) adapted the model for a study of 20 graduate students' online discussions. The results indicated that although students' participation was limited to one posting per week, the postings were cognitively deep. For the dimension on interactivity, they devised message maps that depicted students' interaction clearly. The study also revealed the difficulty in achieving high inter-rater reliability for the metacognitive dimension.

Table 1: Henri's (1992) Model of Content Analysis

Dimension	Categories
Participation	Levels of participation; Types of participation
Social	Statement or part of statement not related to subject matter
Interactivity	Explicit interaction: Direct response, Direct commentary Implicit interaction: Indirect response, Indirect commentary Independent statement
Cognitive Skills	Elementary clarification; In-depth clarification; Inference; Judgment; Application of strategies
Metacognitive Knowledge and Skills	Personal; Task; Strategies; Evaluation; Planning; Regulation; Self awareness

Another model proposed by Newman, Webb and Cochrane (1996) was designed to measure critical thinking (see Table 2). They used indicators of critical thinking through approximately 40 codes in categories such as

relevance, justification, novelty, and ambiguities, each with a plus or minus appended to show whether the coded message contributes or detracts from critical thinking development (Marra, Moore & Klimczak, 2004).

Table 2: Newman, Webb and Cochrane's (1996) Model *

Category	Indicator
Relevance	Relevant states or diversions
Importance	Important points and issues or unimportant points and trivial issues
Novelty, new info, ideas, solutions	New problem related information or repeating what has been said
Bringing outside knowledge or experience to bear on problem	Drawing on personal experience or sticking to prejudice or assumptions
Ambiguities; clarified or confused	Clear statements or confused statements
Linking ideas, interpretation	Linking facts, ideas and notions or repeating information without making inferences or offering an interpretation
Justification	Providing proof or examples or irrelevant or obscuring questions or examples
Critical assessment	Critical assessment or evaluation of own or others' contribution or uncritical acceptance or unreasoned rejection
Practical utility (grounding)	Relate possible solutions to familiar situation or discuss in a vacuum
Width of understanding (complete picture)	Widen discussion or narrow discussion

* Adapted from Marra, Moore & Klimczak (2004)

Gunawradena, Lowe and Anderson (1997) developed an interaction analysis model (see Table 3) to examine meaning negotiation and co-construction of knowledge. The model describes co-construction of knowledge as five progressive phases. They are sharing, comparing of information; discovery of dissonance; negotiation of meaning/ co-construction of knowledge; testing and modification of proposed synthesis; agreement/ application of newly constructed meaning. Each phase consists of a number of operations such as stating an observation or asking questions. As it was developed in the context of a debate, how useful is the model in explicating the knowledge building processes that are not in the format of debate needs further research For example, it is not difficult to imagine a facilitator of an online discussion starting a knowledge building discourse by identifying an area of disagreement (Phase 2) or even with a negotiation of the meanings of terms (Phase 3). In such cases, the participants may move back to Phase 1 or proceed to the later phases.

该模型描述了知识模型共同建构的五个步骤：信息的分享与比较——发现失调——意义协商或知识的共同建构——对于提出的综合进行测试和修改；达成和应用新的建构意义。

Recent studies of online interactions roughly fall within the dimensions described above with adaptations to the specific contexts and purposes of the study. The common dimensions employed are participation, cognitive processing and social interactions. For example, Guzdial and Turns (2000) assessed over 1000 undergraduates used of online forum mainly from the participation dimension. Average number of postings, average length of threads, proportion of participants/ non-participants and on/off task notes were the indicators they employed to assess learning. Lipponen, Rahikainen, Lallimo and Hakkarainen (2003) categorised the students' postings of as on/off task, and further classified the functions of the postings as providing information, asking research/ clarification questions, and something else. They also measured the mean size of notes and the depth of notes and mapped out the social relations through case-by-case matrix. In the participation dimension, other than notes creation and responses/comments, they also made use of log files to study who-read-whose notes.

Table 3: Gunawardena, Lowe & Anderson's (1997) Interaction Analysis Model

Phase		Operation
1	Sharing / comparing of information	Statement of observation or opinion; statement of agreement between participants
2	Discovery and exploration of dissonance or inconsistency among participants	Identifying areas of disagreement, asking and answering questions to clarify disagreement
3	Negotiation of meaning/co-construction of knowledge	Negotiating meaning of terms and negotiation of the relative weight to be used for various agreement
4	Testing and modification of proposed synthesis or co-construction	Testing the proposed new knowledge against existing cognitive schema, personal experience or other sources
5	Agreement statement(s)/application of newly constructed meaning	Summarizing agreement and metacognitive statements that show new knowledge construction

Schellens and Valcke's (2005) also employed similar dimensions. For the cognitive dimension, their scheme of classification is geared towards knowledge building rather than learning. They claimed that the scheme is parallel to Gunawardena et al.'s scheme. They have also differentiated between the use of theoretical and experiential information in the online messages for knowledge building. Analysis in this aspect is important, as one concern in CSCL is superficial exchange.

Background of the Study and Methodology

This study is a post-hoc analysis of the online interactions that were produced by a group of 11 in-service teachers and the tutor. The study is naturalistic in the sense that the researchers had no control over the selection of participants. They were teachers who had enrolled themselves in a program that leads to the award of Advanced Diploma in Information Technology. These teachers have diverse background in terms of the subjects and levels they taught. Years of service ranges from 2 to 33 years and 8 of them are primary and the remaining are secondary teachers. Their teaching subjects include Malay and Chinese languages, Design and technology, Computer applications, English, Mathematics, Science and Art.

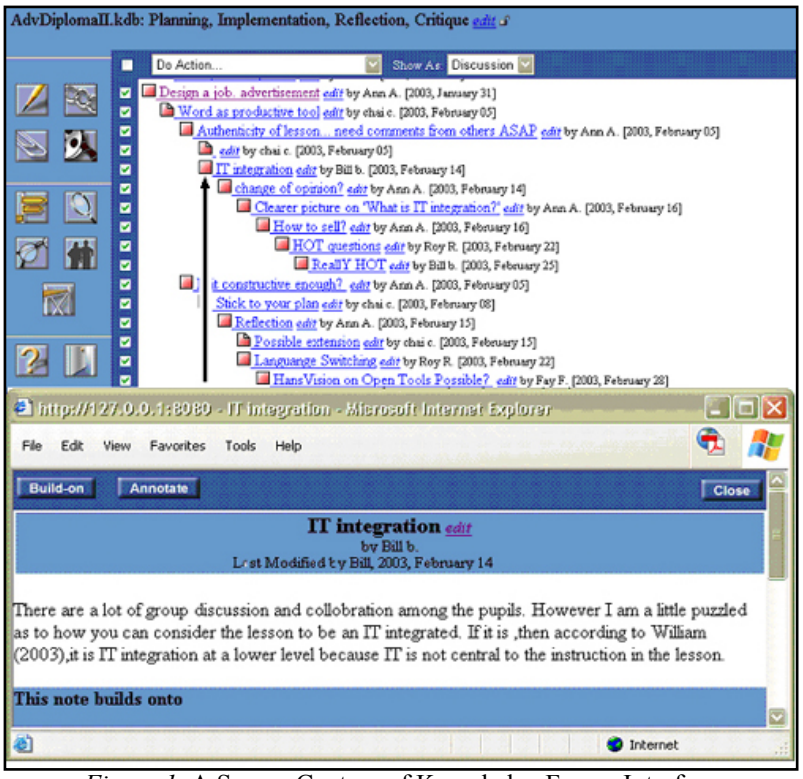

Figure 1: A Screen Capture of Knowledge Forum Interface

The in-service module was entitled "Integrating Information Technology into School Curriculum". The course was conducted from January to March 2003 and it lasted eight weeks. Half of the lessons were conducted face-to-face while the other half were online. At the beginning of the course, the KBC model was introduced to the participants. The learning activities can be roughly divided into three phases. In the first three weeks, teachers were tasked to discuss theoretical issues. Subsequently, they planned and implemented IT-based lessons for four weeks. All lesson plans and implementation records were shared through KF™. These were treated as data generated in practice for teachers to built-on each other's ideas and connect to their readings. In the last week, they wrote reflection notes about their experience of learning in a KBC and constructed mind-maps on the content learnt. The goal of the course was to allow teachers to construct collaboratively a comprehensive understanding about IT integration in classrooms. A brief example of how the researchers conceptualized the KBC for this study is given in the next paragraph.

3 讨论理论——
4 计划和应用基于IT的课堂——
1 反思，构建概念图

明确有力地表达

Generally, within each phase, the teachers were encouraged to articulate their initial ideas and shared it through KF. These ideas were treated as cognitive artifacts created by the teachers based on their prior knowledge and they are subjected to peers' critiques for improvement. For example, Figure 1 shows a screen capture of a series

of connected notes that were initiated by a teacher named Ann on the KF™ interface. The first note was a detailed lesson plan that Ann believed to be an IT integrated lesson. It tasked the students to interview a family member and create a job advertisement using the Word program. Treating the lesson plan as an improvable cognitive artifact, the instructor challenged Ann to improve on the authenticity of her lesson and commented that the use of Word did not appear to add value to students' learning. Another teacher, Bill, also raised questions on Ann's lesson plan as shown in the note at the lower half of figure 1. The challenges puzzled Ann and led her to reconsider what IT integration meant. For this instant, the puzzlement was resolved during the face-to-face session where Jonassen (2000) conceptualization of computers as mindtools was introduced by the instructor. Ann's final reflective note (see following quote), indicated that she had benefited from this process of knowledge co-construction.

> It (KBC) has helped me to understand better by reading and considering peoples' comments and ideas. Thus, resulting in a change and improvement of ideas. This can be seen clearly through the task on lesson planning. Ideas are drawn out at first. After comments and ideas, the task is developed better. (Ann)

Research Questions

The research question for this study is "how do teachers build knowledge collaboratively?" This is broken down into the following specific research questions:

1. What is the pattern of participation among the teachers?
2. What is the pattern of interaction among the teachers?
3. To what extent are the teachers building knowledge collaboratively?

Data Collection

Two main sources of data were collected for this study. They were the log files and the teachers' notes. The log files were generated by subjecting the database to the Analytic Toolkit® (Burtis, 1998) that analyses mainly the quantitative aspects of the knowledge building discourse. The files provide comprehensive quantitative indices that reveal the extent of knowledge-building activities (Chan & van Aalst, 2004). Reflective notes written by the researchers after the lessons supplemented the data.

Data Analysis

The data were analysed mainly through a combination of content analysis method as highlighted in the literature review. For this study, the participation, social and cognitive dimensions were chosen to provide a comprehensive answer to the research questions. Successful co-construction of knowledge requires active and broad participation. This implies that the messages posted should be substantial in term of quantity. It provides important background information against which the quality of interactions could be assessed. In the context of KBC that aims to promote deep understanding, the depth of discussion is crucial. The average length of threads was therefore computed. Analysis of the social dimension was conducted through computing the density of the social network. The Analytic Toolkit generated information on who interacted with whom in terms of both commenting/responding and reading of notes for this purpose. It will be presented in the form of a case-by-case matrix (Lipponen et al., 2003). Lastly, for the analysis of the cognitive dimension, Gunawardena's model was employed. The model was selected as it fits the purpose of this study and the underlying theoretical framework is compatible to the KBC. Notes that could not be classified within their model were given new codes and the model was modified slightly. Since notes that could be classified within Gunawardena's model were by default on task in nature, only notes that need new labels were examined for off task behaviour. The results were compared with results of other studies from different contexts. Although this comparison were loose in nature, it seemed that results obtained through different contexts exhibited some common problems about CSCL.

Results and Discussion

Participation Patterns

The numbers of notes created and the numbers of notes read were the two indicators selected for the examination of the extent of participation. Table 4 documents the data for these two areas. To provide a more comprehensive

view, data about the number of words used was also obtained from the Analytic Toolkit® and the average number of words per note was calculated.

On average, the database grew by 25.6 notes per week with each teacher contributing about 2.33 notes in a week. The number of words written by each teacher in a week is about 300. The results suggest that the participation rate is relatively high although it is difficult to make accurate comparison with other studies because of the different contexts involved. Hara et al. (2000) reported an average of one note per week per postgraduate student with a length of about 300 words. Guzdial and Turns's (2000) study of undergraduate online interactions yielded a result of about one note for every two weeks. Schellen and Valcke (2005) reported coding of 1428 messages for analysis for 80 students studying "Instructional Sciences" in a time span of 12 weeks. The average was about 1.48 messages per week per student (a posting can be separated into several messages). No data was provided for the length of posting. Based on these comparisons, the in-service teachers in this study should be considered as active participants.

The facilitator (tutor) posted 45 notes with an average of 85.7 words per note. He contributed the highest number of notes that were coded to be of higher phases of knowledge construction. In Hara's study, the facilitator's average posting is twice (2.1 notes/ week) that of the students. For the present study, the facilitator posting is 2.4 times (5.63 notes) that of the teachers' postings. This result may indicate that active participation by the facilitator is crucial in developing and sustaining discussion among teachers. To verify this result, further search was performed on the database using the Analytic Toolkit®. 43 out of the 45 notes from the facilitator were responding to the teachers and it resulted in 38 responses from the teachers, accounting for 19% of the teachers' notes.

Table 4: Participation Patterns of the Teachers

Teacher	Total number of notes posted	Number of notes per week	Percentage of note read	Total number of words written	Average number of words per notes
Ann	29	3.6	96%	5268	181.7
Bill	21	2.6	36%	2006	95.5
Clare	26	3.3	38%	5143	197.8
Fay	16	2.0	31%	2398	149.9
Grace	19	2.4	42%	2748	144.6
Ivy	11	1.4	51%	618	56.2
Lynn	22	2.8	63%	3628	164.9
Nancy	12	1.5	50%	3124	260.3
Roy	22	2.8	83%	2743	124.7
Susan	14	1.8	20%	2566	183.3
Sam	13	1.6	16%	872	67.1

The average percentage of notes read for this study is 48%. This should be an encouraging result given that teachers are generally busy people who have to deal with multiple demands on their time. To examine the relationship between the writing and reading of notes, a correlation coefficient of 0.44 was obtained through computing the correlation the ranked order of teachers for writing and reading of notes. The result suggests that there is a moderate correlation between these two forms of participation. However, the result also suggests that obtaining information about participation in terms of reading notes could be important since writing of notes could only predict the reading of notes with an accuracy of approximately 20%.

Dividing the total number of notes by the total number of clusters yields the average length of threads. This study made used of explicit links of notes created through the built-on functions of KF™ by the teachers and did not examined the possible implicit links between the notes or the note clusters. There are 42 unconnected notes in the database and 30 clusters of connected notes. The unconnected notes are considered as a note cluster each, giving the total number of note clusters to be 72. There are 250 notes in total (including the facilitator's notes) the mean note cluster size for this study is 3.47. The result implies that for every note posted, it received two to three responses. This result suggests that the discussions are not adequately sustained (Lipponen et al., 2003).
Achieving sustained online interactions has been a perpetual problem that needs further examination. Hewitt (1996) reported a maximum of 5.6 notes/cluster result achieved by a teacher with doctoral degree after 4 years of experimenting KBC in an elementary classroom. Guzdial and Turns (2000), on the other hand, reported a maximum of 56.3 notes/cluster when the discussions were anchored around examinations and homework assignments. While the anchoring strategy may work for undergraduate, it is unlikely to work in the context of in-service teacher development.

Social Dimension of Participation

矩阵

Table 5 and Table 6 below show the case-by-case matrix of "Who built-on whose" and "Who read whose" notes as generated by the Analytic Toolkit®. Reading off from the left to the right, the numbers shows how many times the teachers whose name appeared in the left column built-on or read the notes created by the teachers whose names appeared on the top row. For example, Ann had built-on to one of Bill's notes and three of Clare's notes. These tables provide information on who is/ is not interacting with whom, thereby allowing educators and researchers to have an overall understanding of how established the community is.

Based on the data in Table 5, the density of the network in term of participants building on each other's notes is computed using social network analysis. Scott (2000) defined social network density as "the extent to which all possible relations are actually present" (p. 32). The density is thus obtained by dividing the number of actual connections by the total number of possible connections. Since the computation is not directional, any connection that link two participants will be considered as an actual connection. Based on these premises, the density of Table 6 is computed to be 0.67. Lipponen et al. (2003) considered a density of 0.37 from his study as high. The density of the present study is therefore quite high.

Table 5: Who built-on whose notes?

	Ann	Bill	Clare	Fay	Grace	Ivy	Lynn	Nancy	Roy	Susan	Sam
Ann	--	1	3	0	1	0	3	2	1	0	0
Bill	1	--	1	1	1	2	0	0	1	0	3
Clare	2	0	--	0	0	0	4	0	2	1	0
Fay	2	0	0	--	1	0	2	1	2	1	0
Grace	2	0	1	1	--	0	2	1	2	1	0
Ivy	0	2	0	0	1	--	1	0	0	0	2
Lynn	3	0	3	1	1	0	--	0	0	0	0
Nancy	2	0	0	0	2	0	1	--	0	0	0
Roy	4	1	2	1	2	0	2	1	--	2	0
Susan	1	0	1	0	0	0	2	0	1	--	1
Sam	0	2	1	0	0	2	0	0	0	0	--

Table 6: Who read whose notes?

	Ann	Bill	Clare	Fay	Grace	Ivy	Lynn	Nancy	Roy	Susan	Sam
Ann	--	21	26	15	19	6	22	12	21	13	12
Bill	10	--	10	2	4	3	8	4	7	5	4
Clare	8	7	--	3	9	1	12	3	5	6	1
Fay	7	7	6	--	5	1	7	3	2	2	3
Grace	13	7	13	6	--	1	12	4	10	6	1
Ivy	13	13	13	6	9	--	9	8	10	4	6
Lynn	22	10	17	7	13	4	--	7	11	9	7
Nancy	13	10	9	7	12	1	10	--	9	7	5
Roy	29	13	23	11	18	2	21	11	--	8	7
Susan	5	2	3	1	4	0	4	2	7	--	4
Sam	2	7	5	2	1	1	2	1	1	3	--

Table 6 shows that the reading patterns of the participants are distributed in the sense that each participant read some notes from the rest of the participants. The only exception was Susan who did not read any note from Ivy. However, since Ivy read four of Susan's notes, a connection is still established. The social network density for reading is therefore a perfect 1.

Based on these findings, it seems that the teachers are well connected with each other, indicating that the community is fairly well established. This is a relatively conducive environment for collaborative knowledge building since the teachers are more likely to feel supported. There are three possible reasons for achieving this dense network. First, prior to this module, the teachers had attended another 8 weeks module and they therefore have a history of working together. Second, 50% of the course was conducted through face-to-face setting. The researchers observed that during break times, the teachers frequently shared their stories from their respective

schools and talked about their problems. Informal sharing and having a shared history are both believed to be essential for fostering community (Kreijns, Kirschner, & Jochems, 2003). They help to establish trust among participants since they need to share and comment on each other personal knowledge, practices and beliefs. Third, the number of participants is small and this helps in promoting mutual connections (Lipponen, et al., 2003). It is also worth noting at this point that there were only two notes that were off task in the whole database. One note was requesting for sale information of certain IT product brought up during discussion and the other was an unfinished note. This shows that the teachers were highly task-oriented when they were interacting online. Given that 50% of the course was conducted through face-to-face setting, the highly task-oriented nature of the online interactions should not be surprising given the face-to-face sessions and the teachers shared history of working together.

Knowledge Building Dimension

Gunawardena's model of interaction analysis was applied for the coding of the online interactions. The steps of coding followed that suggested by Chi (1997). The codes were largely applicable to this study although there were times when the researchers have to make modified the code descriptions. For instance, the teachers shared their lesson plans and invited critiques from their peers. A lesson plan is in a sense a cognitive artifact that is derived and synthesized from the teacher's knowledge, beliefs and experience. It is a proposed synthesis (Phase 4) but it is not entirely a result of co-construction. The teachers constructed their lesson plans individually and they were shared as the first note for the initiation of idea refinement process. The researchers therefore decided that the notes should belong to Phase 1 and stage 1a. Following such decision, the code descriptions were modified. Only one additional code was created in Phase 3, i.e., proposing possible solutions for identified problems. It was placed in Phase 3 as defined by Gunawardena et al.(1997) as the phase in which idea co-construction occurs through proposals of ideas.

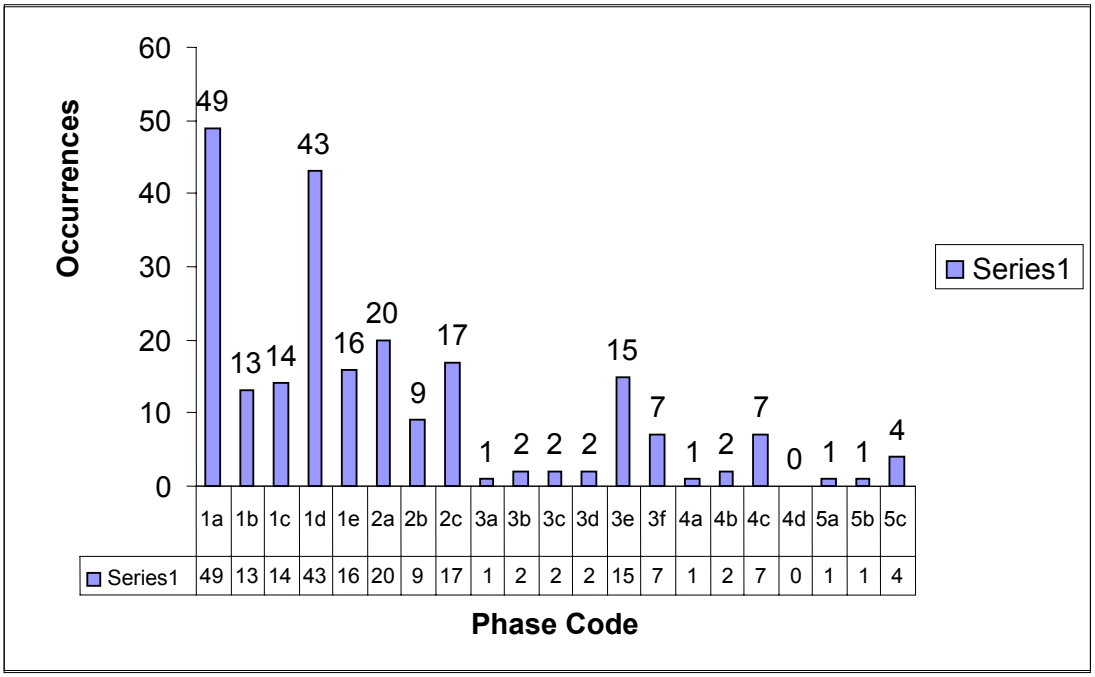

Figure2: Bar Chart of Occurrences Based on Coding Categories

The basic unit of analysis is a note. However, within a note, there were usually several paragraphs. For this study, the researchers did not go into segmenting the notes. Each note is examined for indications of presence of a phase and the results were recorded in a spreadsheet Notes that contain several paragraphs usually had more then one phases within it. The occurrences of the different phases were recorded but repeated occurrences of a phase were not treated as another occurrence within a note. The facilitator's notes were coded but not included for the computation in the following analysis because it would bias the results. During the course, the facilitator had consciously modeled the acts that would stimulate co-construction of knowledge.

The result of the coding is presented through a bar chart in Figure 2. Overall, there are a total of 226 coded incidents. Other then statements that are within Phase 1a, the rest of the codes represent some forms of co-

construction of knowledge. The proportion of Phase 1a occurrences (49) to the rest of the coded occurrences (179) is approximately 1:4. The result indicates that the teachers were able to built-on to each other's ideas. However, as illustrated by the bar chart and the pie chart in figure 3, most knowledge building activities were limited within Phase 1, i.e., sharing and comparing information. Within Phase 1, asking/ answering clarification questions and suggesting ideas for improvement occurred most often. However, the questions or ideas suggested did not challenge the fundamentals of the notes they were responding and thus did not result in further negotiation. Stahl (2002a) stated that in collaborating, people typically establish conventional dialogic patterns of proposing, questioning, augmenting, mutually completing, repairing, and confirming each other's expressions of knowledge.

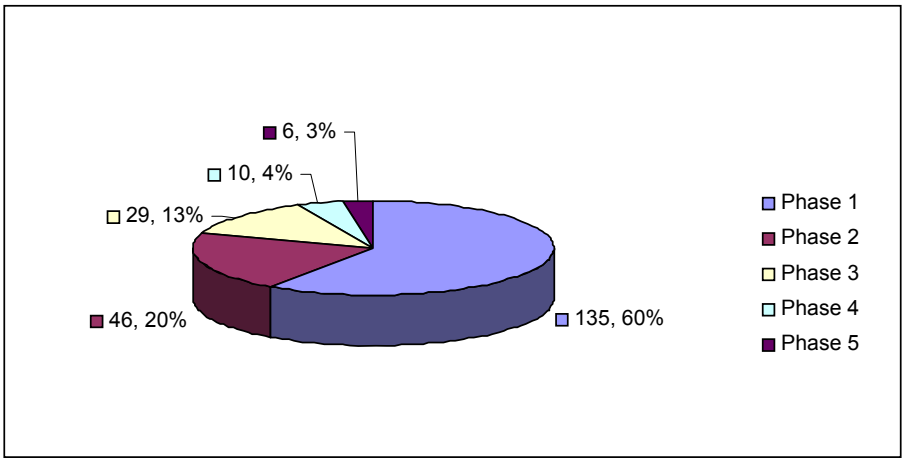

Figure 3: The Distribution of Knowledge Building Activities among the Five Phases

This is not an isolated phenomenon. Gunawardena et al.'s (1997) study obtained a result of 191; 5; 4; 2; 4 postings from Phase 1 to Phase 5 respectively. Her participants were practitioners of online education or graduate students. Schellens and Vackle (2005) used Gunawardena's model to analyze undergraduates' online postings and found 52%; 14%; 33%, 1.2% and 0.4 % from Phase 1 to Phase 5 respectively. The results seem to indicate that higher phases of co-construction of knowledge are difficult to achieve. Reviews of studies on teacher networked-based learning had also yielded similar results (see Zhao & Rop, 2001). While the technological affordances of networked environment seems to provide an avenue for collaborative learning, there seems to be a higher possibility for the participants to share information and perhaps request for elementary clarification. These results also seem to corroborate with the quantitative results obtained by most studies (and this study) in terms of the average thread length. It seems reasonable to assume that high level of knowledge construction did not happen when the typical structure of a forum is one first level note followed by two to three responses.

There are several possible reasons that could account for the results obtain is this study. First, detecting dissonance and building on ideas is a cognitively demanding task. It requires the teachers to think through the emerging issues and construct appropriate responses based on relevant experiences and literature. The multiple demands they had to answer to in their work life placed severe time constraint on their learning (Yamagata-Lynch, 2003). This study was conducted in a blended environment where the teachers were working full time without any offloading from school. A related study on teachers' perception of learning in this environment suggested that time constraint is a real issue for the teachers (Chai, Tan & Hung, 2003).

Second, criticizing each others' practices maybe culturally not an appropriate behaviour since it may be perceived as confrontational. The cultural norms of niceness among teachers may have discouraged the teachers from engaging in critical discussion (Lampert & Ball, 1999). Unless the participants have established trusting relation and are confident that they have indeed detected consistency or a gap in understanding, they are not likely to voice confrontational opinion. The researchers were enlightened to this by one of the participating teacher's remark that unless she was sure about what she had to say, she would not comment on others' classroom practices. She did not feel comfortable doing that because she did not know the students and was not responsible for what happen to the class. Her remarks had not only illustrated the cultural norms of respecting others but also highlighted the important but not easily accessible knowledge about students that teachers need to have in order to comment on practice.

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Third, teachers' friendship and collegiality may work in a way that instead of providing a trusting relationship for critical dialogue, it reduces teachers' willingness to engage in activities that could be questioning the validity of certain beliefs (Kelchtermans, 2004). In other words, teachers may treasure their collegiality more than the opportunities to create knowledge together.

Fourth, teachers were traditionally treated as implementers of education decisions made outside the classrooms. The shift of role from knowledge consumer to that of knowledge producer is not an easy one as most graduate students may testify. Much training and knowledge acquisition are needed. This study examined only the eight weeks of teachers interaction. It would be interesting to examine the teachers' interactions in more extended timeframe. Lastly, it is important to note that although the level of knowledge-building as measured using Gunawardena's scheme does not seem to be high, the course evaluation and studies from teachers' perspectives indicated that the teachers were very satisfied with their learning (Chai et al., 2003).

The results of this study have helped us to understand the complexity of knowledge co-construction in CSCL environments in more details and point to the needs of exploring strategies that would promote participants' ability and willingness to challenge each other's assumptions. In the concluding sections, we will dwell further on the implications of this study towards practice and research.

Summary

This study examined the pattern of participation and discourse analysis of the online interaction among the online interactions of a group of 11 teachers in the context of professional development. The results indicated that the community established through the combination of face-to-face and online interactions was rather cohesive. The teachers' participation in the online environment in terms of both reading and responding to each other's notes was also relatively high and their interactions were task-focused. Based on the results obtained, it seems fair to conclude that the teachers had managed to appropriate some practices of the KBC. However, the depth of interaction was still lacking even when the social conditions exist.

The results of this study suggests that cohesiveness at the level of distributed reading and built-on is a necessary but insufficient condition for in-depth knowledge building. For in-depth knowledge building discourse to happen within the context of teacher professional development, the teachers need to challenge the cultural/professional norm of niceness; be able to detect gaps in understanding; have adequate knowledge about the context of another teacher's classroom; have the necessary social skills in putting across the critical comments; and assumes a new identity of knowledge producer. None of these seem easy to achieve and all seem necessary. This implies although it is now technologically possible to provide ample opportunities for learners to participate in educational activities, educators have to carefully engineer the social, cultural, cognitive dimensions of the learning environment before they can reap the benefits afforded by technologies. In other words, the degree to which CSCL can enhance learning depends on how skillful the facilitator is. There also seem to be no prescription available on how to form the desired learning environment. It seems that teacher educators or the online facilitators need to constantly model the skills through written responses. Reiman's (1999) taxonomy of guided written reflections could serve as a good model. He emphasized on the techniques of matching and gradual mismatching for the creation of zone of proximal reflection. Presumably, when a participant has received enough exposure of being guided for knowledge construction, he/she may appropriate the practice. This further implies that courses employing the KBC or similar model need to stretch over a longer period of time for the critical and creative discourse practice to be appropriated by the learners.

Time is an important factor for knowledge building discourse to be shaped. Lack of time has been cited as a key factor that hindered reflective discourse from occurring in online environment (Zhao & Rop, 2001). There is no existing guideline or heuristic on how much time is required. It seems to be dependent on the historical, social and cultural context of the group of learners in the community. A group of learners who come from a discipline background where critical and creative discourse is valued could start the knowledge building discourse instantly once basic social cohesiveness is established. In the Singapore context and for teachers who are used to working in isolation, the researchers' intuitive assessment would be at least six months. However, few courses in higher education are beyond 15 weeks. The fragmented nature of professional development activities is ill-suited for the purpose of achieving deep understanding that is constituted through progressive discourse (Ball & Cohen, 1999). One way to beat the system is to employ a single pedagogical approach for several courses that cover different subject matter. This is the next step where the present researchers of this study are heading. As for research method in specific, one possible way to gain deeper understanding is to perform finer grain discourse analysis or microgenetic analysis of the online discourse (Stahl, 2004). The online discourse could be interpreted with

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reference to the course structures and the facilitator's forms of participation to tease out possible strategies to promote higher level of knowledge co-construction.

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