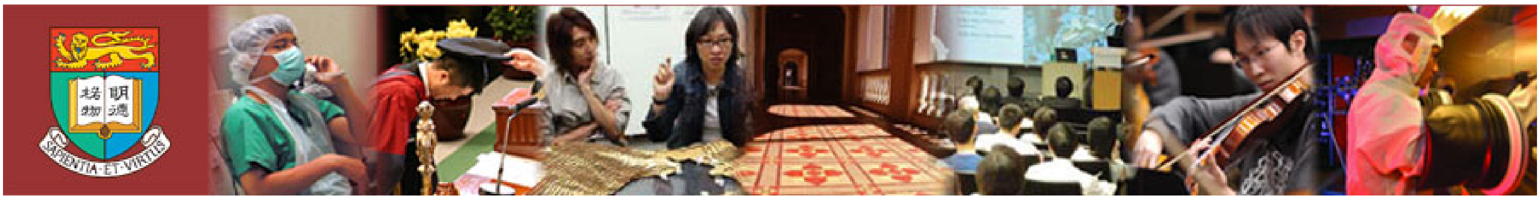

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Students' Participative Stances and Knowledge Construction in Small Group Collaborative Learning with Mobile Instant Messaging Facilitation

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Abstract: Mobile instant messaging (MIM) has become increasingly popular socially, but its educational impact on collaborative learning is still unclear. This study aims to understand how collaborative learning develops in small group discussions on a MIM platform. We collected interaction records from two groups of graduate students, who voluntarily set up private MIM groups to discuss collaborative projects. The records were analyzed with two set of codes to respectively examine levels of knowledge construction and learner participative stances. A processing mining technique was also applied to visualize how knowledge was built up on different tasks. Results suggested that MIM is probably most helpful with planning tasks and increasing interactivity with the facilitation of the pop-up notification. Informal leaders emerged in the discussions, who actively maintained group dynamics and also expressed ideas. Tasks requiring evaluation and creation might invite more higher-order knowledge co-construction.

Keywords: mobile instant message, knowledge construction, participative stance, collaborative learning

1. Introduction

Mobile devices such as smartphones have opened new possibilities for ubiquitous learning with increasing connectivity and communication. About 90% of users' smartphone time been spent on using apps (Chaffey, 2016). Social networking, particularly mobile instant messaging (MIM), is probably the most popular category, represented by applications such as WhatsApp, Facebook Messenger and WeChat. Unlike short message service (SMS) which transmits messages through a telecommunication carrier and thus incurs a fee for the sender, MIM transmits messages through the Internet, and is therefore free to use whenever a Wi-fi connection is available. It is accessible across various platforms. Users can synchronize chat records seamlessly across devices. In addition, it supports multimodal information transmission and easy private or group discussion management. In particular, MIM is functionalized with "pop-up" notifications, with which users will know immediately when messages arrive. People can initiate a real-time communication immediately as in a synchronous talk, or they can produce asynchronous dialogues with time lag. Therefore, MIM-enabled interaction is often referred as "quasi-synchronous" (Garcia & Jacobs, 1999).

Despite its popularity, MIM remains the least explored mobile service in educational research. In particular, one area worth exploration is its possible influence on small-group collaboration, when students interact and share resources and learning experience on the MIM-enabled platform. Educators have examined the use of other technologies and their impact on collaborative learning, such as Facebook, wiki, and Twitter, but little attention has been put on MIM. This study aims to examine how students collaborated to accomplish group projects in voluntarily established MIM groups. Specifically, we intend to seek the answers in twofold: a) how knowledge was co-constructed, and b) what roles were played by students in the MIM group discussions.

2. Literature Review

Learning happens with negotiation and internalization of meaningful resources. Therefore, students are encouraged to participate in active interaction and collaboration (e.g. Laurillard, 2002), which requires them to think, plan, express, converse, negotiate and ultimately, be able to critically think and reflect (Dillenbourg, 1999). One pedagogical strategy inspired by collaborative learning in higher education is group-based assignment. Students are usually divided into small groups with normally 3 to 5 people, and asked to work on a common project. Technologies, especially mobile services, have further advanced collaborative learning with flexibility and multi-modality. In recent years, researchers have just begun to examine the use of MIM for teaching and learning purposes. We will review extant research regarding the impact of using MIM on collaborative learning.

In Fattah's (2015) study, 15 students constructed a writing piece together based on peer feedback. The results of pre-post test revealed that students in the treatment group outperformed those in the control group in their writing skills, specifically about punctuation marks, sentence structure and idea generation. This study, however, mainly focused on terminal learning outcomes, i.e. the test results. No exploration was done on how students used MIM to collaboratively accomplish a task. Therefore, our understanding towards the dynamics of collaboration is limited. In another study, Kim, Lee, and Kim (2014) divided students into three discussion groups, using mobile IM, computer IM and discussion board, and assigned them with the same task. The results showed that even though MIM was conducive for communication, it yielded lower taskwork scores compared to the other two groups. Taskwork in this study was defined as how well students accomplished a problem-solving task in relation to elements such as novelty, importance, and relevance. However, the study merely analyzed students' posts in terms of cognitive/metacognitive, social/interactive, and other types of interactions. The specific roles students played during the MIM discussions were not explored.

Both studies above examined the use of MIM in groups with around 15 students, which is not representative considering group work usually involves only 4-5 members in higher educational settings. Therefore, the results lack transferability into other scenarios. Another limit is these two studies adopted the use of MIM as a mandatory task with a prescribed instructor-defined procedure. By far, only one study by Miller (2016) asked four students to form a group voluntarily and create a digital scientific documentary together. Students voluntarily set up WhatsApp groups to share images and provide feedback. However, the WhatsApp interactions was not the focus of this study, and no further analysis was provided regarding the collaborative process. `

To summarize, three major research and practice gaps have been identified. First, very limited number of studies examined using MIM for collaboration. Second, previous studies investigated the use of MIM in group collaboration in pre-determined research/instruction contexts. Therefore, the interaction is not initiated voluntarily by students. The groups were not assigned to the general small size of 4-5 people for group tasks either. Third, existing literature focused more on the final learning outcomes by assessment such as post-class tests. Less attention has been given on examining how students actually collaborated to complete their group task. This study tries to bridge these gaps, by examining the process of how students collaborated in voluntary MIM-enabled small groups to co-construct knowledge and complete tasks. The central research question of our study is: How is collaboration developed in self-initiated MIM-enabled small groups? Specifically, the following sub-questions have been proposed.

1. What activities were performed in self-initiated MIM-enabled small groups?
2. What participative roles emerged in self-initiated MIM-enabled small groups?
3. How was knowledge constructed in self-initiated MIM-enabled small groups?

3. Methodology

3.1 Research Context

Participants were two groups of first-year educational master students undertaking a disciplinary course in a university in Hong Kong. One required assignment was to give a group presentation on one key adult learning strategy and design a role-play scenario to enact the chosen strategy. Students formed five small groups on their own choices to cover five strategies respectively, and each group was randomly assigned with one strategy. The assignment included introduction to the main concept, role-play to enact the strategy, discussion on the pros and cons, and proposal of implementation guidelines. All groups were given six weeks to accomplish the task.

Table 1: Codebook for knowledge construction.

Code	Definition	Example
Non-task-oriented communication (Veerman & Veldhuis-Diermanse, 2001)		
Planning	Arranging operational details to accomplish the tasks collaboratively	“BTW, just would like to reconfirm that in coming few days we will collaboratively work online thru WeChat and Google drive to finish our preparation & PPT, right?”
Technical	Asking for help or discussing technical difficulties	“I don't have access to the folder, I don't know why.”
Social	Expressions for pure social purposes, to maintain the group cohesion and inter-personal relationship.	“Nice. Thank you!”
Irrelevant	Discussions that are irrelevant to the assignment	“I have a lot of reading need to be done for the other course.”
Levels of knowledge construction (task-oriented communication) (Gunawardena et al., 1997)		
Phase I: Sharing/comparing of information	1) statement of observation, 2) statement of agreement, 3) corroborating examples, 4) clarification of details of statements, 5) definition of description of a problem.	“A community of practice is a group of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly.”
Phase II: Dissonance or inconsistency among ideas	1) statement of disagreement, 2) clarification of the source and level of disagreement, 3) restating position with illustration	“Actually, I think the role setting can be decided later, maybe we need to decide all the key concepts related to our topic at first.”
Phase III: Negotiation of meaning/co-construction of knowledge	1) negotiation of meaning and importance, 2) identification of overlap among conflicting concepts, 3) compromise, 4) integration	“I think both scratch and paper folding lack a very realistic setting. Yet, with paper folding, everyone would be more confident during presentation.”
Phase IV: Testing and modification of co-construction	testing the co-constructed knowledge against existing fact, understanding, experience, data and literature.	“Edmodo is easier after testing out. You only need to register. Google classroom requires you to set up G suit first.”
Phase V: Agreement statement/application of newly constructed knowledge	summarizing and applying co-constructed knowledge, meta-cognitive statement on thinking and understanding.	“Up until now, let me summarize what we’ve already discussed: the professor wants us to have…”

The topic of group A (n = 5) was “Self-directed Learning”, and for group B (n = 6), it was “Workplace Learning”. These two groups were chosen because they both contained a mixture of full-time and part-time students. The part-time students were local school teachers with busy schedules, thus it was inconvenient for them to meet face-to-face with their full-time student peers. In order to facilitate collaboration, both groups voluntarily set up their own WeChat discussion groups for communication and sharing. Students chose WeChat probably because it is the most popular MIM app in the Asian market, especially in China, and they were using it daily for social purposes. Since students constructed the groups on their own, the instructor exerted no influence on the group interaction and collaboration.

3.2 Data Collection

Because students voluntarily set up the groups, neither the researcher nor the instructor was in their groups during the interaction and collaboration. Therefore, data collection was not carried out until the project was due. One technological affordance of WeChat is that it automatically saves interactive records unto user device or server, and makes the records easily retrievable. Therefore, we were able to collect students' group chat history after the course ended. The chatlog recorded the sender, time and content of each message, thus so we could observe participants' "behavior" in the computer-mediated communication usage (Mann & Stewart, 2000). As the externalization of thoughts, students' written communication reflected their cognitive thinking process, and thus helped us understand how they collaborated with one another to accomplish the given task.

Table 2：Codebook for participative roles in small group collaboration.

Roles	Definition	Possible behaviors	Actual examples
Captain	The member puts a lot of effort to manage discussion, refer to other's work and facilitate task accomplishment.	He/she usually sends messages characterized by positive tone, encouraging comments and with the aim to seek consensus.	"I'm sending an email to ask the instructor further on how we should select an object for training..."
Over-rider	A person who has strong self-oriented motivation, and stresses on his/her work and opinion.	He/she cares about the contributing to the groupwork by expressing ideas, yet focuses less on the group dynamics. Sometimes he/she re-stresses their points even though consensus has been reached.	"I know, but I don't agree with using programing for both."
Free-rider	The member who aims to get benefits from groupwork (such as grades), but invests limited effort.	He/she asks questions and expects answers. He/she is quick to agree "orally" with little constructive information, and sometimes slow to take actions.	"Thanks David (pseudonym)! Will check it tonight!"
Ghost	The member who is strongly self-oriented, but shows low participation.	The participation is unrelated to the discussion, or aims to demonstrate his/her interest.	Little participation and contribution.

3.3 Data Analysis

The unit of analysis was the individual idea communicated rather than the entire piece of posting. No posting contained more than one unit of analysis. 171 units were identified in the discussion of group A, while group B produced 703 units of analysis. Two coding schemes were applied to respectively evaluate knowledge construction and participative stances. 10% of the data was coded by an independent coder for reliability check, and the inter-rater reliability reached 90%. All disagreement was solved by discussion between coders. The purpose of the first coding framework (Table 1）was to examine the levels of knowledge co-construction. The codebook was developed based on Veerman and Veldhuis-Diermanse's (2001) and Gunawardena, Lowe and Anderson's (1997) works.

The second codebook (Table 2) was based on the conceptual framework of "participative stances" in a CSCL environment (Strijbos & De Laat, 2010). We adopted this codebook to see if any roles emerged in the small group discussion and how participants interact. "Ghost" was assigned to the participant if he/she contributed less than 10% of the communication with little constructive effort. It was possible one person demonstrated several individual stances in different situations.

4. Findings

4.1 What Activities were Performed in Self-initiated MIM-enabled Small Groups?

By calculation, we noticed that 80% of communication by group A was non-task-oriented, while only 24% of group B fell under this category. Within non-task-oriented communication, the top use was planning, such as progress management, division of labor and reminder of meetings. However, when it came to task-oriented communication, 83% communication of group A was information sharing (Phase I), while 53% of group B was on conflict statement and negotiation (Phase II to III). Phase II to Phase V communication is regarded as higher-level knowledge construction (Hew & Cheung, 2011). Therefore, group B demonstrated higher proportion of higher-level knowledge construction than group A. Figure 1 visualized the distribution of each category and showed differences between groups.

Between groups, group A mainly utilized MIM to conduct non-task-oriented activities (80%), while Group B used it for task-related purposes (76%), including sharing opinions and documents, expressing disagreement, and negotiating dissonancy. Between activities, planning was the top category in non-task-related communication for both groups, including sending reminders, confirming deadlines and setting up schedules. The most frequently demonstrated behavior in knowledge construction was sharing, including opinions, hyperlinks, and files of resources.

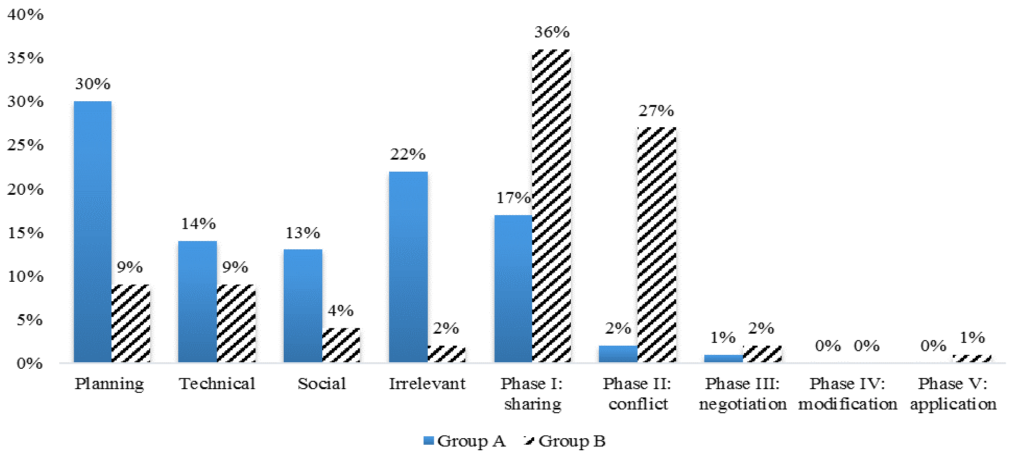

Figure 1. Distribution of Categories of Knowledge Construction

4.2 What Participative Roles Emerged in Self-initiated MIM-enabled Small Groups?

No participant was coded as ghost in either group based on the definition. The preliminary result showed that the most representative stance was over-rider in both groups, meaning participants actively expressed their opinions to construct knowledge, particularly more than free-riders, who invested insufficient effort into group work and tried to "ride" along with others.

However, group A had higher portion of captains and free-riders, while members in group B produced more information that characterized the members as over-riders. This result suggested that in group A, the work was more straightforwardly planned and divided with less disagreement and negotiation, while in group B, more participants were inclined to express opinions and handle the collaborative work. Further analysis of proportion of roles played in the non-task and task related communication also corroborated this postulation. The non-task captain, who coordinated group dynamics and proposed work plans, represented higher portion in group A. Similarly, free-riders who mainly expressed agreement, also has higher representation in group A. Figure 2 was presented to better visualize the participative stances distributed in two groups.

We then examined the participative roles demonstrated by each member respectively. Both groups had one outstanding member (A1 & B1) who played a major part in each role. This person not only showed concern over the group collaboration by shouldering the duty of a captain to help with reaching consensus, but also actively made personal contribution by providing ideas (Figure 3).

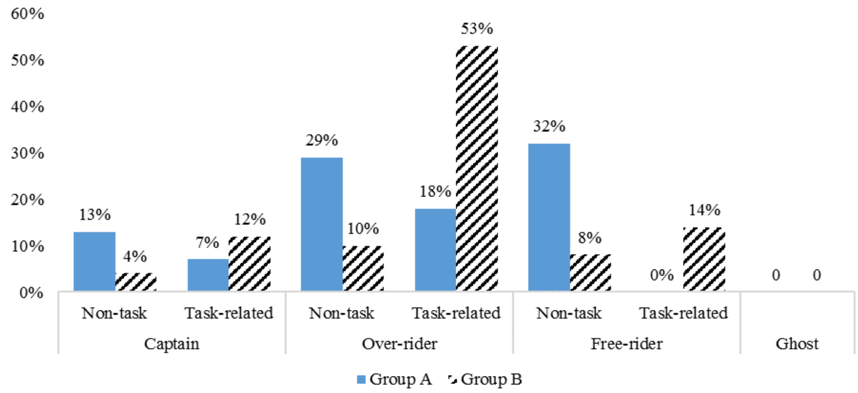

Figure 2. Distribution of Each Participative Role in Two Groups

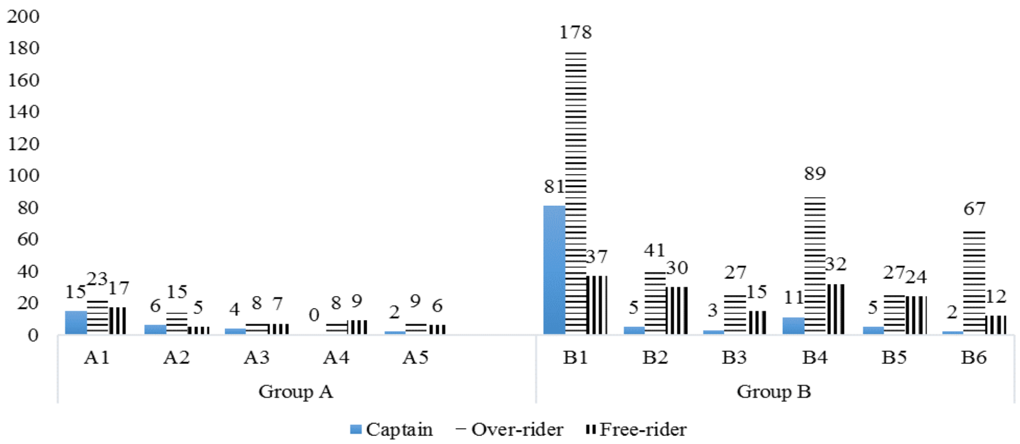

Figure 3. Distribution of Participative Roles of Each Member in Two Groups

4.3 How was Knowledge Constructed in Self-initiated MIM-enabled Small Groups?

To better understand how knowledge was co-constructed with the facilitation of MIM, we analyzed both groups' interaction with Disco, a process mining tool to make the knowledge construction process visible. This processing mining technique was generally used to identify, analyze and understand patterns of business processes using event logs. We identified three main topics of communication related to knowledge construction that emerged during group discussions, and simulated the conclusion of each topic as a conclusion of one business process. The discussion about planning was excluded because members did not construct any task-related knowledge together.

The three topics analyzed were: 1) decoding the logistical details of the task, 2) understanding the strategy, and 3) designing and evaluating the role-play scenario. Based on Bloom's Taxonomy (Krathwohl, 2002), the three topics represented different cognitive processes to work with knowledge and skills. Decoding the logistical details of the task was related to "remember"—recalling specific requirement of the task, which was pre-designed by the instructor. The second topic, understanding the strategy, called for skills to "understand". Both groups had to interpret and explain the learning strategy assigned to them. The third topic, designing and evaluating the role-play scenario, was related to "evaluate" and "create". Learners had to justify their own choices, and together create an authentic role-play scenario to enact the theory.

4.3.1 *Topic 1: Decoding the Logistical Details of the Task: What is Expected in the Presentation?*

Figure 4 shows the development process of how the two groups decoded the requirements of the project, such as what the required components of the project were, how long each component would last, and in what sequence should the components be presented. To illustrate the workflow, for example, in the workflow of group A, when A2 brought up the topic, immediately A4 and A5 commented. There were three cases of disagreement, one was followed up by immediate additional supporting evidence, one was presented with no conclusive solutions, but followed by information sharing, and the other was solved by active negotiation of seeking common understanding.

Another example from group B was presented below for illustrative purpose. This excerpt was started by B4 with a question, and followed by B1 with a Phase V summary. B1 then continued summarizing what had been discussed by the members in the previous communication with three more posts, and ended this piece of excerpt by sharing another requirement of the task.

B4: So what is our focus?
B1: Focus: displaying different kinds of workplace learning...?
B1: Maybe show some issues of workplace learning as well in the role-play…
B1: What issues of workplace learning are there............?
B1: Roles: teachers (and later on the presenters of this topic after the role-play), a mentor for interns, colleagues
B1: After the role-play, we still need to do a short presentation in the traditional way.

For group A, the discussion lasted for 8 days, with five peaks when group members were discussing at the same time. For group B, the discussion on this topic lasted for only 51 minutes. Despite the differences, the median time intervals for both groups were tagged as "instant" according to the Disco event log.

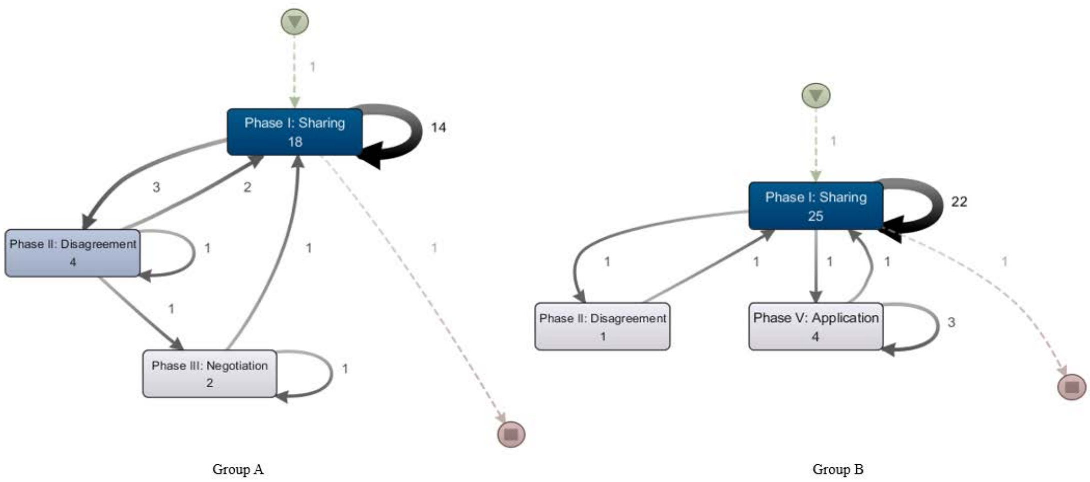

Figure 4. Workflow 1: Decoding the Logistical Details

4.3.2 *Topic 2: Understanding the Strategy: How to Define and Interpret this Learning Strategy?*

Figure 5 showed the workflow of how learners attempted to figure out the definition and meaning of the learning strategy assigned. The conversation was started by one member, and contributed by others cumulatively. Learners built on each other's contributions mainly by sharing resources found on internet and other course materials. No conflict or negotiation was identified in either group. The major way of contribution is "Phase I: Sharing", as shown in the excerpt below:

A3: Here are some example of SDL (self-directed learning) in primary school! I think it gives a framework for us to develop our SDL presentation
A1: Self-directed learning & andragogy [link]
A1: Don't worry, it's just the first chapter, NOT all 95 pages

A1: Also: [link]
A2: Key components and indicators of SDL- Directed Learning in Science [link]
A2: This is the website with the SDL material the teacher given us last night

For group A, the discussion sustained for just one day, while the time span of group B lasted over 3 days. However, the event log of group B showed five obvious peaks when group members gathered together online and clarified the concept of learning strategy to be presented. Although the longest interval between posts on this topic was longer (group A: 24hrs; group B: 25hrs), the majority of the interactions happened quickly online—the median interval between posting for both groups is "instant" according to the Disco event log.

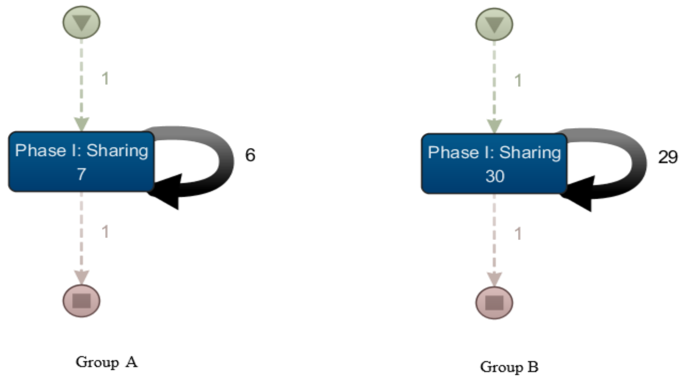

Figure 5. Workflow 2: Understanding the Strategy

4.3.3 Topic 3: Designing and Evaluating the Role-play Scenario

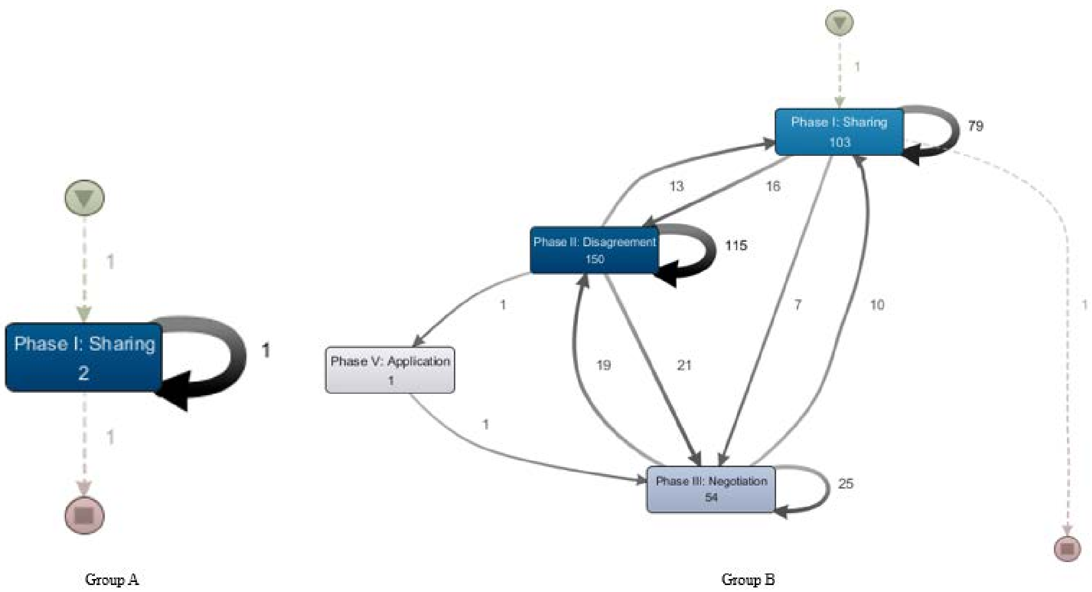

Figure 6. Workflow 3: Designing and Evaluating the Role-play Scenario

Figure 6 showed the process of how learners designed and created a scenario to implement the learning strategy in real class teaching. The task required each group to conduct a role-play to show an actual lesson with the learning theories being implemented. Two groups demonstrated sharply different communicative patterns on creating the role-play scenarios. For group A, only two records were identified on this topic, while group B conducted an intense discussion with substantially more higher-order knowledge co-construction being invoked. For group B, the most frequently represented pattern on this discussion was: (a) one learner presented his/her own thoughts; (b) some other participants disagreed with the initial ideas/comments, or asked for further clarification; (c) the disagreement was either solved by trying to reach a quick consensus, failing which a further round of criticism and justification came into play. Despite the fact that this topic took longer than the other topics, the median time interval between two posts is still short, ranging from instant to 3 minutes.

In the excerpt below, B4 started the communication by expressing disagreement. Rather than simply refuting, B1 summarized the task requirement details to persuade other members to accept her proposal.

B4: You have said that Scratch is very simple is it practical that a company would ask all employees to switch to something of lower standard.
B1: Flash and Powtoon are lower than scratch in some sense.
B1: And becuz scratch is newer.
B1: So let me summarize, the instructor wants us to have 1) ideally a realistic workplace issue and 2) a topic that some of the groupmates have real experience.
B1: I think both scratch and paper folding lack a very realistic setting. Yet, with paper folding, everyone would be more confident during presentation.
B4: Everyone would be confident? U mean us or our audience? I don't think group mates here are comfortable with paper folding…

5. Discussion

The conflict of schedule and limitation of physical distance are often regarded as the barriers to facilitate collaborative learning, but it seems MIM has provided possible solutions to overcoming these barriers. The cases in this study were groups set up voluntarily by students with no teacher interference. Collaborative work is nothing new in higher education, but traditionally it is only visible through the final artifact presented. By reviewing the interactive records on the MIM platform, this study hopes to reveal an otherwise neglected picture of how students collaborated to accomplish a given group task.

Based on the results of our study, both groups used MIM for planning for non-task related purposes, which required immediate decision making. The push notification of MIM has probably facilitated the planning process. Whenever a new message comes, a notification will pop up on the smartphone screen to remind the user about the arrival of new message (Barhoumi, 2015). It will remain visible as a stimulus for immediate response. This functionality has supplement the pitfall of asynchronous communication, which is scolded as it leads to lengthier time to response, and not helpful for tasks that require quick group decision making (Trentin, 2010). Besides, it may also serve as an accelerant to participation and interactivity. As nobody was found “lurking” in either group, using MIM may be helpful to build a sense of community (Wang, Fang, Han, & Chen, 2016) and encourage users to participate and interact.

As to how students performed the collaboration on the MIM platform, we examined the process of work completion, the roles of participants and knowledge construction process. Both groups had a “kernel” person (A1 & B1), who could be identified as the top figure in all participative stances. Participants got involved with no presumed roles, but these two members gradually shouldered the role of “leader” in the group communication, who would summarize previous discussion content, ask for everybody’s idea and also propose solutions to existing problems. These two students were to some degree similar to the student facilitators (Hew & Cheung, 2012), who were assigned the duty of facilitating asynchronous online discussions. Informal leaders or facilitators are considered helpful in groupwork completion. Therefore, teachers may make suggestions accordingly for student voluntary grouping, such as include someone who demonstrate such proactivity and leadership.

Besides, more higher-order knowledge construction was conducted for more demanding tasks, such as “to evaluate” or “to create”. As Schellens and Valcke (2005) discussed, the nature of task matters when teachers try to encourage students to have higher phases of knowledge construction. This information might be inspirational for task design. Teachers may take the task nature into consideration to help students benefit more from higher-order thinking.

6. Limitation

There are several limitations in this study. First, the two groups demonstrated major differences in regard to data size and data features, yet we were not able to conduct follow-up interviews with the participants to seek explanations to the disparity, for some objective reasons. Second, the current study only examined learner collaboration using interactive records. Future study may triangulate the data, such as students' self-reported data and group work artifacts and scores. Third, we only collected data from two groups from the same post-graduate class. The transferability is therefore limited. Fourth, the current study did not have comparison groups to confirm the effect of using MIM for collaborative learning. Future study may compare face-to-face learning, MIM, and online forum, and comprehensively understand the impact of different communicative mode on students' interaction and learning.

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