A Study of Peer Interactions between One-to-one and Shared display Collaborative Learning in a Technology-enriched classroom

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Abstract: Collaborative learning is widely used in classroom activities. The screens of handheld devices, designed for individual-user mobile application, which may constrain the interactions among group learners. The small size of screen may lead to fragmented and tête-à-tête communication pattern, and frequently obstacle the externalization of student learning process. This study proposes a shared display groupware with handheld devices in order to support the externalization and articulation of student thinking. The groupware is designed for exploring whether the shared display system in classrooms can augment the handheld devices to promote the student articulation process and communication among participants. This study involved 15 graduate students enrolled in a course. Students searched for relevant information from the Internet through handheld devices and tried to organize their own answers by using shared display groupware. This study analyzed the dialogue interactions in tablet-PC-only and shared-display settings by qualitative methodology. By a series of content analysis of dialogue interactions, experimental results showed that the shared display groupware could not only promote knowledge externalization and articulation of student’s thinking, but also enhance student engagement via better communication patterns to achieve effective collaboration.

Keywords: Interaction analysis; Handheld devices; CSCL; Shared display; Groupware design

1. Introduction

Peer discussion or peer interaction has been greatly noticed for facilitating collaborative learning. For instance, collaborative problem solving gained a lot of attentions among educators for the improvement of student learning [3] [6] [7] [12]. Instead of passively receiving knowledge simply from teachers, students can develop problem solving and knowledge construction activities in the processes of peer discussion and interaction [1] [8]. Therefore, the analysis of peer interaction plays an important role in understanding the critical learning process and effectiveness of peer collaboration under a certain environment [13] [16].

Collaborative learning activities encourage collaboration among members, sharing learning experience, collecting learning resources to help others, and share achievements of learning. Extensive collaborative learning systems have been developed on computers and the Internet to improve learning [7] [17]. Despite of the great advance of online collaboration, educators still emphasize the importance of face-to-face collaboration because promotive interaction is a key factor in the success of cooperative learning [5] [11]. In addition, face-to-face interaction is the most common interaction style in classroom. As technology is gradually coming into classrooms, it becomes important to investigate how students interact with peers in groups through different technological devices and how these devices affects the interaction among students. In the online collaborative learning scenarios, researchers have analyzed conversation between students to explore how students interact in online discussion forums [7] [14]. Nevertheless, in face-to-face collaboration there are many interaction cues such as visual focus and hand pointing behaviors which are not shown in online peer interactions, it requires an appropriate methodology to correctly reflect and explore the effect and atmosphere of face-to-face peer interaction. Consequently, this study attempts to explore the peer interactions involved in face-to-face collaborative learning with handheld devices.

The design of technological devices and the settings of using technological devices in human activities may affect the effect of the activities. For instance, a lack of shared displays may lead to loss of eye-contact and unawareness of visual focus when students were performing collaborative activities with individual tabletop computers [15]. The screens of handheld devices, designed for individual-user mobile application, may limit promotion of interaction among groups of learners. It becomes difficult to establish effective peer interaction during collaborative activities. Therefore, this study developed a technology-enriched classroom which integrates large LCD shared displays with handheld
devices to share the focus of group members and coordinate collaborative activities while students are using handhelds in collaborative activities. In this study, an analysis methodology is devised to explore how students interact with handhelds and how shared displays in classrooms affect peer interaction in face-to-face collaborative learning.

2. Technology-enriched collaborative classroom

Many collaborative learning models such as Think-Pair-Share and Jigsaw demonstrate the requirement of personal workspace and public workspace to enforce both personal accountability and shared group goals. The portability and communication capabilities of handheld devices enhance classroom dynamics [2] [9] and to promote face-to-face interactions [4] [6] [18]. However, handheld devices are designed for individual-user mobile application, rather than for collaborative applications, which may limit interactions of face-to-face collaborative learning. Because of the limit screen size of handheld devices, students need to browse information by using scroll bar or discuss with others by watching the screens of others. Students intuitively frequently interact with peers who locate right adjacent to them while neglecting other peers not sitting close to them. The lack of public workspace thus impedes communication among members and lead to tête-à-tête or fragmented communication patterns [10]. Therefore, this study developed a technology-enrich collaborative classroom (Figure 1) in which six LCD displays and shared display groupware is provided in a classroom for students as a public workspace while students perform their learning task in handheld devices. The groupware integrated handheld devices and shared LCD displays to support collaborative learning. It was expected to provide group member shared visual focus and help students to establish effective communication pattern and negotiate to achieve shared understanding.

3. Method

3.1 Participants and the course involved

The study attempts to investigate how students interact with each other when they are using handheld devices in collaborative learning activities. This study involved fifteen graduate students who enrolled in the course Statistics and data mining techniques at National Central University (Taiwan). During the class, the teacher fist outlined the learning content of the class. One of the students then presented the learning content related to the topics assigned. After students' presentation, students then began to collaborate solve problems given by the teacher. This study was to assess peer interactions when students use different equipment in the classroom and find the appropriate way of technical support for collaborative learning with handheld devices. Therefore, the experiments were carried out in two different environmental settings, which are Tablet-PC-Only and Shared-display. In the Tablet-PC-Only setting, students used only Tablet PC for both individual learning tasks and collaborative learning activities in the classroom, while they could utilize the shared display groupware in the Shared-Display setting.

3.2 Conversational analysis

During collaborative learning activities, students need to express their divergent suggestion, and discuss to achieve shared understanding in order to construct individual knowledge [13]. In a face-to-face collaborative learning scenario, all these communications occurs in the conversation among group members because each member in order to externalize their
ideas. This study analyzed the conversation of group members to understand how divergent ideas were proposed and resolved to achieve shared understanding and explore the negotiation between group members during collaborative learning activities.

3.3 Group dynamic analysis
According to the observation of collaborative learning between group members by Stahl [16], the degree of participation of group members was determined by the condition of the divergence conversation during questioning and answering. In order to observe the condition of participation of group members, we adopt the analytical method by Stahl in order to explore the differences in two settings.

3.4 Non-verbal interaction analysis
During the collaborative learning, non-verbal interpersonal interaction could aid understanding among group members. Scott et al. [15] utilized the observation of non-verbal interpersonal interactions of group members during discussion to assess whether the current collaborative learning environment setting is beneficial for discussion. Group members could point at the position of the answer on the shared display to others to improve the understanding of the discussion topic. Therefore, non-verbal interpersonal interactions of group members could assess the condition of the interaction during discussion.

4. Results

4.1 Conversational analysis

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Doubt</th>
<th>Articulation</th>
<th>Group development</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1</td>
<td>63(44%)</td>
<td>9(6%)</td>
<td>17(12%)</td>
<td>53(37%)</td>
<td>100%</td>
</tr>
<tr>
<td>Shared-display</td>
<td>43(32%)</td>
<td>15(11%)</td>
<td>23(17%)</td>
<td>53(39%)</td>
<td>100%</td>
</tr>
</tbody>
</table>

Analyzing the conversation in tablet-PC-only and shared-display settings (Table 1) found group members demonstrated more question interactions in 1:1 setting (44%) than in shared display setting (32%). On the contrary, group members presented more doubt and articulation interactions (11% and 17% respectively) when students discuss with a shared display than with only tablet PCs (6% and 12% respectively). Therefore, the shared display could help members articulate their ideas.

4.2 Group dynamic and non-verbal interaction analysis

The conversational relation of group members in shared-display setting was showed in Figure 2. We found the students engage the activity closely in shared-display setting (ex: dialogue 40→dialogue 52). Hence, the shared display could help group members engage the activity and discuss the topic coherently. On the other hand, the tablet-PC-only setting, which was showed in Figure 3, shared the most of understanding between 2 members due to fragmented communication patterns. Therefore, the shared display groupware could help group members to perform idea communication patterns and participate closely in collaborative activities. We also found that group members often pointed at and watched
shared display during discussion to achieve shared understanding. Such phenomenon reflects that the visualization of student non-verbal cues facilitated group participation and interaction.

5. Conclusion

Since there are difficulties of handheld devices in one-to-one collaborative learning, this study tries to design a shared display groupware in technology-enriched classroom and devised an analytical scheme for exploring face-to-face collaboration that incorporates important communication cues such as visual focus and hand pointing. By a series of content analysis of dialogue interactions, experiment results showed that the shared display groupware could not only promote knowledge externalization and articulation of student’s thinking, but also enhance student’s engagement via better communication patterns to achieve effective collaboration. By analyzing shared understanding in two different settings, the finding supported that besides personal learning devices, a group workspace is necessary to facilitate the establishment of shared understanding of problems during collaborative activities.

References

Biography
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