THE EFFECTS OF RATIONALE AWARENESS IN HYBRID COLLABORATIVE LEARNING ACTIVITIES

A Dissertation in Information Sciences and Technology

by

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ABSTRACT

This study is motivated by the interest of understanding the role of computer-supported rationale sharing in hybrid collaborative learning activities in higher education. A hybrid collaborative learning activity refers to a learning activity that includes both face-to-face collaboration and distributed collaboration. The activities that this study investigates require students to document and share with the group members their decision-making rationales of the shared tasks.

Prior studies have shown that previous rationales play a role in present activities and others’ rationales affect one’s decision-making. As one way of understanding the effects of rationale sharing in a hybrid collaborative learning activity, this study investigates the effects of computer-supported rationale awareness in the activity. Logically speaking, sharing rationales among the group members supports one’s awareness of other group members’ rationales, i.e., rationale awareness. Thus, one aspect of the effects of rationale sharing in the activity is reflected from the effects of rationale awareness. More specifically, the focus of the study is to examine the effects of rationale sharing on the awareness of group members’ expertise and contribution with respect to the activity and on the development of group practice in a hybrid collaborative learning activity.

Through an iterative design process, a group workspace tool was designed and implemented that supports both real time and asynchronous remote collaboration and provides a document-based group space for group members to share their rationales. A naturalistic study was conducted to understand the effects of computer-supported
rationale awareness mediated by the group workspace.

The findings of this dissertation study suggest that: being more aware of one’s collaborators’ rationales enhances awareness of collaborators’ contributions and expertise, impacts the group’s decision-making process, and facilitates the collective management of rationales. The results of the study show that the process of documenting rationales helped one in studying the course subjects. This study contributes to the study of designing meta-cognitive support in terms of providing awareness in group work or group learning setting by eliciting several design implications based on the students’ experience with the group workspace. This study contributes to the curriculum design by presenting evidence on the positive impacts of documenting the rationales in one’s learning process.
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Chapter 1

Problem Statement

This study is motivated by the interest of understanding the role of computer-supported rationale sharing in hybrid collaborative learning activities in higher education. A *hybrid collaborative learning activity* refers to a learning activity that includes both face-to-face collaboration and distributed collaboration. In another word, the student group in the activity may meet face-to-face working together on the shared tasks of the activity like traditional student groups, or work on the tasks at remote in a virtual collaborative space provided by software programs such as Google Doc and Groove. In such a learning activity, when a shared rationale space is provided in the virtual collaborative space for group members to document and share their rationales, how does this computer-supported rationale sharing affect the activity? A rationale is an explanation of the reasons underlying decisions, conclusions, and interpretations. In this study, *rationale sharing* is defined as *the sharing of group members’ decision-making rationales of the shared tasks*. But why do we care about studying this?

First of all, documenting rationales is expected to have positive impact on one’s learning experience from studies on reflective thinking. Reflective thinking is the process of being aware of one's own thinking and learning processes (Cunningham, 1987). Constructivist learning theorists believe that it is important to encourage reflexivity, helping learners to think about how they approach problems, and how they look for and find solutions. These theorists argue that when learners are aware of their own thinking process, they engage in higher order learning experiences, such that they form more
meaningful links within their knowledge structures and develop a more elaborate understanding of new concepts. The documented rationale is at once evidence and an outcome of a student’s reflective thinking process. Requiring students to document their rationale encourages them to reflect on their reasoning and may help them to discover flaws in this reasoning. Therefore, the requirement to articulate the rationale in a written format should promote the students’ reflective thinking processes.

Second, studies in collaborative learning have shown that collaborative learning is an appropriate model for higher education (Lipponen et al., 2004). The cognitive processes making up collaborative learning include explanation, internalization, conflict, appropriation, shared cognitive load, mutual regulation and social grounding (Goodyear, 2002). Employers expect the institutions of higher education to attend closely to the skills they consider to be essential in the graduates they recruit as employees. These demands increasingly refer to general-purpose skills like communication, leadership, teamwork, and IT skills (e.g., Assiter, 1995; Harvey & Mason, 1996). Correspondingly, the collaborative activities included as part of higher education often include components aimed at helping students to develop these skills.

Third, it is expected that computer-supported sharing rationales is beneficial to the collaborative learning experience according to the literature in computer-supported collaborative learning. Computer-supported collaborative learning (CSCL) is an interdisciplinary research field with the focus on how computer technology can enhance peer interaction and group work in collaborative learning, and how collaboration and technology facilitate knowledge creation, knowledge sharing and knowledge distribution among community members (Scardamalia & Bereiter, 1994). One’s rationale is expected
to reflect his/her perspective and knowledge on the issue, therefore, providing a group space for sharing rationales is consistent with the focus of CSCL research.

Given that documenting and sharing rationales in a collaborative learning activity are expected to have positive effects on the learning experience, it is of research interest to understand the effects of sharing group members’ rationales in the activity. Prior studies have shown that explicitly articulating one’s rationale, based on previous experience, may be beneficial to the performance of certain cognitive tasks (Kolodner and Simpson, 1989; Riesbeck and Schank, 1989; Schank, 1982, 1999). However, there is lack of understanding the effects of rationale sharing in a group activity.

Many variables may affect a group activity: the standing group structure defined in terms of compositions of members, division of labor on tasks, the communication structures, power structures, and interpersonal relations structures; the group interaction process including the level and rate of interaction, distribution of participation, extent of member involvement, the flow of work, the flow of information or communications, the flow of influence, and the flow of personal affect; and the environment of the group process, etc (McGrath, 1984).

In this study, the requirement of documenting and sharing group members’ rationale in a group activity is a cost in the group interaction process – more communication cost on sharing group members’ rationale, and more individual effort on documenting rationale. On the other hand, sharing rationale within the group may help the members to be better aware of others’ knowledge base with respect to the task by knowing the reasoning of others decisions. Also, the way the rationale is shared within the group supported by the groupware tool affects the group activity, e.g., whether group
members have control as to when and how to present their rationales to the group or not, how the association between a rationale and its decision is represented in the group workspace, etc.

As one way to understand the effects of rationale sharing in a hybrid collaborative learning activity, this study investigates the effects of computer-supported rationale awareness in the activity. Logically speaking, sharing rationales among the group members supports one’s awareness of other group members’ rationales, i.e., rationale awareness. Thus, one aspect of the effects of rationale sharing in the activity is reflected from the effects of rationale awareness. Awareness is an understanding of what others are doing, which provides context for what one is doing him/herself (Dourish and Bellotti, 1992). Awareness studies from the research field of computer-supported cooperative work (CSCW) show that in a collective activity, the members’ awareness of the activity affects the group’s common ground and the development of group of practice during the activity (Carroll et al., 2003, 2006). This study is interested in exploring the answers of two research questions:

**Research Question 1:** How does rationale awareness affect common ground formation in hybrid collaborative learning activities?

**Research Question 2:** How does rationale awareness affect the group practice in hybrid collaborative learning activities?

To approach the answers of these questions, the investigator conducted a naturalistic study in an undergraduate class in spring 2007. More specifically, the investigator designed a collaborative learning activity for the class that required the students to document and share the rationale of their decision on the shared tasks, and
developed a collaborative tool that enabled the students to carry out the designed learning activity in a virtual collaborative environment. The class, the designed activity and the developed tool provided an environment that enabled the investigator to study the effects of rationale awareness. The investigator then collected and analyzed various kinds of data from this class to probe the effects of computer-supported rationale awareness in the learning activity.

This thesis is outlined as follows: this chapter, Chapter 1, summarizes the motivation of the study. It also introduces the research questions of the study. Chapter 2 further elaborates the research background and related literature of the study. Chapter 3 presents an overview of the naturalistic study that was conducted in the undergraduate course. Chapter 4 discusses the design of the collaborative learning activity. Chapter 5 discusses the development of the collaborative tool for supporting the activity. Chapter 6 discusses data collection and analysis methods and presents the results. Chapter 7 discusses the significant findings of the study. Chapter 8 summarizes what was learned from the study and how it can be applied. The possibilities for future research are discussed as well.
Chapter 2

Literature Review

This study applies knowledge from several fields including computer-supported cooperative work, computer-supported collaborative learning, and learning science. Related research topics are reviewed in this chapter, including collaborative technology, computer-supported cooperative work and awareness research, computer-supported collaborative learning, reflective thinking and reflection, and rationale and decision-making.

Collaborative Technology

Technology can be used to support and enhance group process. Groupware is a term used to refer to technology that supports group work in a common task and provides shared interfaces for groups to interact and coordinate their goals and actions (Johansen, 1988). Based on where and when people use the software, Ellis, Gibbs, and Rein offer an application-level time-space taxonomy of groupware (1991) (Figure 2-1). Collaboration can occur in the same location through co-located interaction, or from different locations through distributed interaction. It also occurs either at the same time synchronously, or across different times asynchronously.

The particularly interesting situations are those in which collaborators are in different locations. In these cases, the geographically dispersed team members need
Computer-Supported Cooperative Work and Awareness

Computer-Supported Cooperative Work (CSCW) is an interdisciplinary domain at the intersection between computer science, telecommunication, industrial, organizational and social psychology, and sociology. It is an interdisciplinary domain that is about the study of group collaboration and the development of innovative technological solutions to support teamwork. Grudin (1994) located the research in CSCW as an intermediate area of study between Human-Computer Interaction and Management Information Systems. Depending on which aspect of a group interaction is in focus (e.g., the team,
their communication and cooperation, or the activity itself), researchers may focus primarily on computers as a supporting medium, or on the cooperative work and its organization and support (Borghoff and Schlichter, 2000).

Awareness is “an understanding of the activities of others, which provides a context for your own activity” (Dourish and Bellotti, 1992). The context “is used to ensure that individual contributions are relevant to the group’s activity as a whole, and to evaluate individual actions with respect to group goals and progress. The information, then, allows groups to manage the process of collaborative working”. It has been well recognized that existing groupware technologies lack sufficient support for the overall collaboration process (Carroll et al., 2003; Hupfer et al., 2005; Mark and Abrams, 2003, 2004; Powell et al., 2004). In order to address this issue, collaboration researchers have begun to investigate how to design groupware systems to support the shared activity process, focusing on providing collaborators ongoing awareness information (e.g., Carroll et al., 2003, 2006; Geyer et al., 2006; Hill and Gutwin, 2993; Mertz and Benhacène, 2002; Muller et al., 2004; Sarma et al., 2003; Scupelli et al., 2005). Examples of awareness information are presence of the collaborators, collaborators’ actions, and creation or changes to the shared plans.

Awareness plays a central role in collaborative systems (Dourish and Bellotti, 1992; Carroll et al., 2003, 2006; Gutwin et al., 2004; Carstensen and Nielsen, 2001). Initially, ethnographic field studies in CSCW observed that people integrate their activities with those of their cooperators in a seemingly “seamless” manner, i.e., without interrupting each other (e.g., Harper et al., 1989a; Harper et al., 1989a; Heath and Luff, 1991). As a placeholder for these elusive practices, the term ‘awareness’ was adopted
Researchers studied various awareness issues, e.g., ‘collaboration awareness’ (Lauwers and Lantz, 1990), ‘peripheral awareness’ (Gaver, 1992; Benford et al., 1994), ‘background awareness’ (Bly et al., 1993), ‘reciprocal awareness’ (Fish et al., 1990; Schmidt, 1994), ‘mutual awareness’ (Benford et al., 1994; Schmidt, 1994), ‘workspace awareness’ (Gutwin, 1997; Gutwin and Greenberg, 1999), etc. Designers implemented different kinds of computer-based technologies to support specific aspects of awareness, e.g., the use of video conferencing to support peripheral social awareness (Bly et al., 1993); the use of wearable computational devices to offer new interaction possibilities (Gaver, 2002); the use of ‘chat circle’ to display participants in a chat room and visualize their contributions over time (Viegas and Donath, 1999), etc.

One focus in awareness research examines the awareness issues in situations where people construct shared products in real time through collaborations that extend across time. These studies investigate three kinds of awareness support: social awareness, action awareness, and activity awareness. Social awareness aims at providing information of the social context in which current remote collaborations embed. The use of video in virtual workspace is one example (Mantei et al., 1991; Olson and Bly, 1991). The videos provide information of co-presence, the facial expressions of collaborators, the gestures of people in the work place, and so on. Another example is the use of icons or other visual depictions to notify the individuals of their partners’ status at remote (Roseman and Greenberg, 1996; Cadiz et al., 2001). These notification mechanisms provide dynamic information that affects the collaborators’ interaction, such as the availability of the collaborator for involvement, the collaborators’ arrival and departure, etc.
Action awareness concerns about the question of what is happening, such as what actions are being taken to modify the shared documentation, which portion of the document or the map the collaborators at remote are looking at, and what has happened recently to an object and who is responsible. Radar view is an early and successful technique that supports action awareness. Radar view is a miniaturized workspace overview that indicates the part of the workspace in view for different collaborators at remote (Smith, 1992; Gutwin and Greenberg, 1996). Radar views support social awareness providing information about the presence and location of collaborators in the workspace as well as action awareness through information of collaborators’ interactions with shared objects in the workspace. Version control systems maintain a history of shared resources supporting an extended awareness of actions (Fussell et al., 1998).

A real world collaborative activity that extends over a period time situates in a rich context: organizational planning and business goals, job responsibilities and team roles, social relationships of team members, division of labor, variability of the work locations, etc. To be aware of the context, situation awareness is defined as “knowing what is going on around you” (Endsley, 2000). Researchers studying situation awareness mainly focus on support for one person’s decision-making process through the information that provides awareness of the complex situation.

Carroll et al. studied how to support awareness of planning, acting and task status (Carroll et al., 2003), looking at the aspects of the situation that have consequences on group process and group performance. In their approach of understanding team effectiveness and designing technology to enhance team effectiveness, Carroll et al. posit shared activity as a basis for awareness and coordination (Carroll et al., 2003; Carroll et
The term “activity” refers to “substantial and coherent collective endeavors directed at meaningful objectives” (Carroll et al., 2006, p.24), built upon the theoretical and empirical foundations of Activity Theory (Bertelsen and Bødker, 2003; Bødker, 1991). In such an activity, the task is often decomposed into subtasks, with each collaborator assigned one or several responsibilities. As time goes on, the shared goals may need to redefined or re-interpreted. Members’ role and responsibilities may change accordingly. To emphasize their focus on teamwork as activity, they refer to the sharing requirement as activity awareness (Carroll et al., 2003). Activity awareness is about awareness of an activity, i.e., people work together to reach a common goal. To support a “seamless” collaborative process, activity awareness implies an awareness of collaborators’ plans and understandings (Carroll et al., 2003). Also, collaborators’ awareness of how others perceive the situation should be supported as well (Endsley, 1995; Hutchins, 1995).

Later, Carroll et al. proposed an activity awareness framework “for how collaborators share and coordinate their efforts to work together effectively” (Carroll et al., 2006, p.25). The framework integrates several theory bases that focus on dynamic and constructive views of interpersonal interaction and development for understanding activity awareness through four facets of sharing and coordination – common ground, community of practice, social capital, and human development. The authors argue that “these facets can be seen as sub-processes supporting the general need for activity awareness; by analyzing the character, interrelationships, and implications of each sub-process, we hope to better envision tools and methods for studying and enhancing shared activity” (Carroll et al., 2006, p. 25).
As one way to understand the effects of computer-supported rationale sharing in hybrid collaborative learning activities, this study investigates the effects of computer-supported rationale awareness in the activities, drawing on the existing literature about awareness research in group work. More specifically, the effects of rationale awareness on common ground of the group and the development of group practice are examined.

**Computer-Supported Collaborative Learning**

Educators have argued that collaborative learning is appropriate in higher education (Lipponen et al., 2004). Employers expect the institutions of higher education to attend closely to the skills they consider to be essential in the graduates they recruit as employees. These demands increasingly refer to general-purpose skills like communication, leadership, teamwork, and IT skills (e.g., Assiter, 1995; Harvey & Mason, 1996). Correspondingly, the collaborative activities included as part of higher education often include components aimed at helping students to develop these skills.

People learn through collaboration. Computer-supported collaborative learning is an interdisciplinary research field with the focus on how computer technology can enhance peer interaction and group work in collaborative learning, and how collaboration and technology facilitate knowledge creation, knowledge sharing and knowledge distribution among community members. In collaborative learning model, students work together in small groups to achieve a common academic goal, such as a semester project, a homework assignment (Glass and Putnam, 1988). This is fundamentally different from the traditional "direct-transfer" or "one-way knowledge transmission" model in which the
instructor is the only source of knowledge or skills (Harasim, 1990). Collaborative learning emphasizes the learner-centered approach, in contrast to the teacher-centered approach in traditional teaching practices. In collaborative learning activities, students are viewed as active participants in the learning process in which they interact with peers and experts, which has the potential to produce greater learning than a student learning on their own. Research on collaborative learning has shown that working together for a common task outperforms individuals working alone by producing higher achievement and greater productivity (Johnson and Johnson, 1994; Slavin, 1990). In collaborative learning activities, the cognitive processes include explanation, internalization, conflict, appropriation, shared cognitive load, mutual regulation and social grounding (Goodyear, 2002).

Lipponen et al. discussed several perspectives of learning that CSCL researchers and practitioners rely on through three frameworks of learning: acquisition, participation and knowledge creation (Lipponen et al., 2004). In acquisition framework, human thinking is seen as akin to a computer performing formal operations on symbols. The metaphor of learning is filling a container with water. Learning is a matter of construction, acquisition, and outcomes. Knowledge is seen as a property and possession of an individual mind and learning is a process of transfer knowledge and apply it in new situations (Anderson, Reder, & Simon, 1996, 1997; Anderson, Greeno, Reder, & Simon, 2000; Cobb & Bowers, 1999). Research that adopts participation framework focuses on interaction, discourse, and participation processes between and among community members or communities that are in particular social and physical contexts (Lave, 1988; Lave and Wenger, 1991). Knowledge is an aspect of participation in cultural practices
Participation framework has attracted considerable attention in CSCL research (e.g., Stahl, 2002; Dillenbourg, Eurelings, & Hakkarainen, 2001). Situated learning (Brown et al., 1989), cognitive apprenticeship (Collins et al., 1991), and community of practice (Lave & Wenger, 1991) are example concepts in participation framework. Participation framework emphasizes on how learning happens in participation, and the related studies focus on the process of mastering skills and gaining knowledge of a field, and/or becoming a professional in a practice. Interested in how higher level learning occurs, such as development and articulation of theories, models, and ideas, knowledge building is about the collective work for development and articulation of conceptual artifacts. At this level, the research focus is on the learning process towards concept changes in individual knowledge structures. Both the participation and the knowledge creation frameworks acknowledge the impact of socio-cultural context on learning process and learning outcome.

Participation and knowledge creation framework lay on the perspective of social constructivism. Social constructivists view learning as a process that happens when individual interacts with his/her environment including social environment and physical environment. Social constructivism emphasizes the importance of the socio-contextual situation in which learning process embeds. Knowledge is an aspect of participation in cultural practices (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). About how learning occurs, constructivists assume that “knowledge is constructed by learners as they attempt to make sense of their experiences. Learners therefore are not empty vessels waiting to be filled, but rather active organisms seeking meaning" (Driscoll, 1994, p 360).
This study adopts the perspective of social constructivism, acknowledging the effects of the social interactions on the learning experience and learning outcome.

A CSCL is that it supports shared knowledge building by the learners (Scardamalia & Bereiter, 1994). There are many CSCL systems. For example, Lee and Lee reported the design and use of a Blackboard Virtual Learning Environment (VLE) that supports problem-based collaborative learning activities in a nursing course (Lee and Lee, 2004). The Blackboard VLE provides digital material storage and distribution/presentation, interactivity, and synchronous and asynchronous communication.

Developed by Marlene Scardamalia and Carl Bereiter, CSILE (Computer Supported Intentional Learning Environment) is a networked multimedia environment that functions as a communal database with both text and graphics capabilities for students to generate and share “nodes” (Scardamalia et al., 1989). In CSILE, every “node” contains an idea or piece of information relevant to the topic under study, and is labeled with description written by the student who created the node. Other students can comment on the information or the idea contained in the node. In a way, CSILE can be considered as a discussion space that organizes the discussion around the topics. CSILE has been integrated with the curriculum across a range of subject areas, e.g., CSILE was used for collaborative problem solving in math and for collaborative work in social studies. CSILE provides an environment for students to collaborate and communicate. Teachers of the courses into which CSILE is integrated also found traces of the kinds of support that the students provide for each other’s thinking skill and communication skill.
Also, a linking functionality is provided in CSILE so students can explain the connection between topics when connecting one node to another.

CaMILE (Collaborative and Multimedia Interactive Learning Environment) is a Web-based collaboration tool for use by students to encourage learning (Guzdial et al., 1995). Similar to a web discussion forum, CaMILE enables the students to post messages/notes to the web. In CaMILE, students are prompted to identify the kind of notes they are contributing to the collaboration (e.g., whether the note is a new idea, rebuttal, or an alternative to someone’s idea). There is a URL link associated with each note, so links to a particular thread of CaMILE discussion can be added to any Web document. Students can also upload document as attachment to their notes.

Later, Guzdial and his colleagues developed another CSCL system, CoWeb (Swiki). They described their experience with the long term, widespread use of CoWeb in course activities at Georgia Tech (Guzdial, et al., 2000). CoWeb is an asynchronous collaborative tool that is conceptually based on the Wiki by Ward Cunningham (http://c2.com/cgi-bin/wiki). With Wiki infrastructure, CoWeb users are able to edit any page within the website, and add new pages using only a regular web browser. The CoWeb is implemented in a cross-platform freeware – Squeak (Ingalls et al., 1997), which enables the CoWeb users to use the tool on virtually any server platform available. The authors investigated the use of the CoWeb during 1998 and 2000, and found out that the use of the CoWeb falls into four general categories: collaborate with others to create artifact; review others’ activities; create case library for future students of the same course; and distribute information. They reported that the growth of the CoWeb (Swiki) at Georgia Tech has been enormous such that over 120 CoWebs were in use during the
investigation period with the majority of these being used to support course activities. The authors also found that CoWeb was used as a complement to face-to-face interactions and the overall interaction was changed by the affordances of the on-line environment, similar to the findings in the study by Karsten and Jones on the use of Lotus Notes (Karsten and Jones, 1998). The CoWeb is a successful example of a CSCL system used in higher education.

Collaboratory Notebook is a shared hypermedia database that provides a scaffold for students to conduct collaborative open-ended inquiry. A primary function of Collaboratory Notebook is to allow teacher to monitor and guide students' process of learning. It emphasizes learning process instead of learning outcomes. Edelson, et al., (1995) studied the usage of Collaborative Notebook and found that students took better advantage of the features of the environment if they had more positive attitudes about science and had more experience using on-line communications media (Edelson, et al, 1995).

The developed collaborative tool in the study provides a virtual collaborative space for the student group. The space supports both real time and asynchronous collaboration enabling student group to carry out the learning activity without time and location constraint. The unique feature of this tool from pre-existing CSCL systems is the shared rationale space provided in the tool for each group document. The students document and share their rationales related to the document in this space.
Reflection, Reflective Thinking, Learning

There are many dimensions and definitions of reflection and reflective practice. Dewey defines reflective thought as “active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends… it is a conscious and voluntary effort to establish belief upon a firm basis of reasons” (Dewey, 1910). Schön extends this to a view of reflection as the process of professionals creatively responding to the problems of practice in a manner that is both experiential and social (Schön, 1983). He distinguishes the two kinds of reflection: reflection-in-action and reflection-on-action. Reflection-in-action is the thinking process that happens when the action is taking place. In this mode, the practitioner reflects on the phenomenon before him/her and makes a decision for the current problematic situation based on his/her prior understandings which have been implicit in his/her behavior. The action based on the decision is an experiment “which serves to generate both a new understanding of the phenomenon and a change in the situation” (Schön, 1983, p. 68). Reflection-on-action happens after the experience (e.g., a problem solving process). The act of reflecting-on-action is to explore why the practitioner acted as he/she did, what happened in group work and in the situation, and so on.

Van Manen (1977) suggests three levels of reflectivity: 1) technical reflection – the reflection on the skills, methods, and strategies used to reach predetermined goals; 2) practical reflection – the reflection on the methods to reach goals as well as the goals
themselves; 3) critical reflection – the reflection on the broader scope that the goals are embedded in including the ethical, social, and moral assumptions underlying the goals.

Boud et al. defined reflection as the “intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations” (Boud et al., 1985; p. 19). The definition emphasizes the role of affect in reflection. According to this definition, the reflection process consists of three stages: 1) returning to experience; 2) attending to feelings; and 3) reevaluating experience.

Building on Boud et al.’s (1985) definition of reflection, Yukawa proposed the definition of co-reflection – “a collaborative critical thinking process involving cognitive and affective interactions between two or more individuals who explore their experiences in order to reach new intersubjective understandings and appreciations.” (Yukawa, 2006)

Yukawa presented findings on co-reflection from a comparative case study of the learning experiences of two graduate students in an online action research course. She proposed two types of co-reflection: tacit and active. Tacit co-reflection refers to the situation that the reflective self engages in inquiry without directly seeking feedback during the process. Active co-reflection refers to the situation that the reflective self engages inquiry through explicitly seeking feedback in an overtly interactional and discursive manner. She found out that co-reflection involves cognitive and affective interactions in synergy with relationship building.

Reflective thinking process is the process of being aware of one's own thinking and learning processes. Reflexivity is "the ability of students to be aware of their own role in the knowledge construction process" (Cunningham, 1987). It involves the reflective thinking process. Driscoll (1994) explains that reflexivity is a critical attribute
in learners that allows them to be aware of how and what structures create meaning. Constructivists believe that it is important to encourage reflexivity, helping learners to think about how they approach problems, and how they look for and find solutions. Being aware of their own thinking process learners engage in higher order learning experience and may form more meaningful links between knowledge and develop more elaborate understanding. Houssman (1991) identified learners who are aware of their meta-cognitive processes are more proficient learners. Biggs and Moore (1993) pointed out that they are more likely to plan, to use strategies for learning, to monitor progress and to evaluate. Noblitt and Pochis showed that requiring students to write reflective journal along the course activities is a valuable method of engaging students with deep learning of a subject (Noblitt and Pochis, 1997). George reported the study of using reflective journal in a computer programming class to support students’ development of lifelong learning skills and to stimulate reflective practice (George, 2001).

In this study, students are required to document the rationale of their decisions in producing the deliverables. The documented rationale is evidence and an outcome of a student’s reflective thinking process. Requiring students to document their rationale encourages students to reflect on their reasoning and may discover the flaws of their reasoning. Piaget (1972) and Iozzi (1978) theorized that individuals tend to reason at more sophisticated levels in areas which they have more knowledge. The requirement of articulating the rationale in written format promotes student’s reflective thinking process and contributes to the development of student’s reflexivity.
**Rationale, Decision Making**

By definition, rationale is the fundamental reasoning. In examining the use of reasoning in learning context, case-based reasoning (CBR) is a kind of analogical reasoning that focuses on reasoning based on previous experience (Hammond, 1989; Kolodner, 1993, 2004; Kolodner & Simpson, 1989; Riesbeck & Schank, 1989; Schank, 1982, 1999). From the view of CBR, the ability of analogical reasoning is essential to function as human beings. In the CBR paradigm, learning is viewed as extending one’s knowledge by interpreting and incorporating new experiences into memory, by re-interpreting and re-indexing old experiences to make them more usable and accessible, and by abstracting out generalizations over a set of experiences (Kolodner, 2004). The key to promote learning is the ability and need to explain. Brown’s criterion of individual development is that development is the formation of general structured and context free skills (Brown, 1982). From Brown’s view, individual development in CBR process is the formation and development of the capabilities of indexing the new experiences in memory with “intelligent” labels for later retrieval, of retrieving useful and relevant old experiences from memory to apply to current situation through re-interpretation and re-indexing, and of abstracting out generalizations over a set of experiences. All these capabilities account for the ability to explain which develops over time through noticing the similarities and differences of the experiences (e.g., Kolodner, 1993; Holyoak, 1984, Redmond, 1992).

CBR suggests that software tools should support for reflection (Kolodner, 2004). Turns et al. developed Reflective Learner that helps undergraduate engineering students
write “learning essays” about their design experiences through guided instruction on what to include in the essays (e.g., describe the learning experience, anticipate the kinds of situations where a similar solution might be useful, etc) (Turns et al., 1997). Shabo’s JavaCap (Shabo et al., 1997), and its successor, Kolodner’s and Nagel’s Storyboard Author tool (Nagel & Kolodner, 1999) help middle-school students to summarize their project-base science experiences and write their learning experiences up as stories that are accessible by other students through a case library. With Nagel and Kolodner’s Design Discussion tool students can plan the activities, summarize their learning experiences, justify design decisions, and explain design experiences (Kolodner & Nagel, 1999).

Vygotsky distinguished “good learning” and “bad learning” in (school) learning. He maintains, “the only ‘good learning’ is what which is in advance of development” (Vygotsky, 1978, p. 89). Engeström used the experiment conducted by Karmiloff-Smith and Inhelder (1975) to illustrate the distinction between these two kinds of learning (Engeström, 1987). In Karmiloff-Smith and Inhelder’s experiment, they presented young children with a relatively difficult task: balancing given blocks. They observed and named two approaches: ‘action response’ and ‘theory-response’. In the approach of ‘action response’, children looked for solutions for balancing blocks through fail and trial. They were happy when they got the blocks balanced, unhappy when they failed. In the approach of ‘theory-response’, children did not measure the success with the immediate outcome (balanced or unbalanced). Instead, “they went on exploring the other dimensions of each block. It was as if their attention were momentarily diverted from their goal of balancing to what had started as a subgoal, i.e., the search for means. One
could see the children oscillating between seeking the goal and seeking to ‘question’ the block” (Karmiloff-Smith & Inhelder, 1975, pp. 201). In this approach, it seemed that children had hypotheses about balancing blocks in mind and were interested in testing their hypotheses. The children would rejoice even when the block did not in fact balance but testified their hypotheses. There is a fundamental difference between the two approaches: in the ‘action response’ approach, the means of achieving the outcomes is through trial and error, i.e., the mechanism of exhaustive search among a set of known means; in the ‘theory-response” approach, a candidate means is found or invented first following a hypothesis and then verified or falsified through experimentation. The distinction between ‘action response’ approach and ‘theory-response’ approach is the distinction between ‘bad learning’ and ‘good learning’. Logically, the reasoning of their hypotheses is the child’s rationale of why things happen in the way he/she predicts.

Require students to document their rationale as they work on the tasks is compatible with the flow of the good learning activity. Karmiloff-Smith and Inhelder found that when a child was engaged in the ‘theory-response’ approach, there were pauses in his/her action sequences as if the child detached himself/herself from the moment and entered into a stage of internal thinking to form the theory or hypothesis (Karmiloff-Smith and Inhelder, 1975). Schön also noted such moments in daily work practice of professionals in various fields (Schön, 1983). During that moment or the period of pause, the individual formalizes the theory or hypothesis which will be tested after he/she comes back from the withdrawn moment or the pause to the facing reality. Documenting rationale is to externalize the thinking process that happens in the already existed moment or pause, instead of adding this pause to the action sequence.
Decision-making is the cognitive process leading to the selection of a course of action among alternatives. In the process, people go through several stages: search for information and generate a list of alternatives, evaluate the alternatives, and choose an alternative. There are two main branches of research bodies in decision-making literature: studies on optimizing the decision made given the choices; studies on perceiving and processing the incoming information that affects the decision-making process. As an example from the first branch of the research literature, subjective expected utility (SEU) is a theory that models the decision making process mathematically, assuming that the decision makers know all the choices and related uncertainties. This is unrealistic in at least two aspects: not all choices and expected consequence of each choice is known when one needs to make a decision; and we do not always make rational decisions. Simon proposed the notion of Bounded Rationality to describe the decision making behavior in real world situation (Simon, 1957). Bounded rationality is used to designate rational choice that takes into account the cognitive limitations of both knowledge and cognitive capacity. Situation awareness study is related to obtaining useful information that affects the decision-making process. As discussed earlier, situation awareness is defined as the awareness of “knowing what is going on around you” (Endsley, 2000). These studies on decision-making and rationale show that rationale can play an important role in an individual’s decision-making process. In this study, the effects of knowing other group members’ rationales in a group’s decision-making process are investigated.
Chapter 3

Conceptual Framework

As discussed in the Chapter 1, the focus of this study is to understand the effects of rationale awareness in distributed team setting in a hybrid collaborative learning activity. Four research propositions are proposed as a way of approaching the answers of the study’s two research questions. For each research question, there are two propositions:

Research Question 1: How does computer-supported rationale awareness affect common ground in hybrid collaborative learning activities?

Common ground refers to about mutual understanding in communication (Clark and Marshall, 1981; Clark and Wilkes-Gibbs, 1986). If one is aware of why a colleague makes a decision, i.e., understands underlying assumptions, reasons, and beliefs associated with the colleague’s decision, then supposedly he/she understands more about the colleague’s perspectives. As is common knowledge, one’s perspectives are closely tied to past experiences and background. Over time, if group members are consistently made aware of each other’s rationales, then it is likely that this awareness helps the group better depict, and establish mental models of the group members’ knowledge bases in the knowledge domain of the activity. These concepts lead to the first research proposition of the study:
**Proposition 1:** Knowing group members’ rationale contributes to one’s awareness of their expertise.

Understanding another person’s rationale indicates the nature of his/her logic within the thinking process as well as the depth of his/her thinking process (e.g., thinking about the issue deeply, or in a shallow fashion). It makes one more aware of the intellectual effort other have investing in the issue knowing the nature of other people’s rationales as part of the decision-making process. This leads to the second research proposition:

**Proposition 2:** Knowing group members’ rationale contributes to one’s awareness of their contribution.

**Research Question 2:** How does computer-supported rationale awareness affect the group practice in hybrid collaborative learning activities?

The development of group practice is referred to how the group develops it way of coordinating and cooperating on the tasks. It is expected that the group will have a more comprehensive understanding of how each member makes his/her argument when rationale statements are made available in the group space, which helps the group to take into account various thinking styles and eventually develops its own way of making group decisions and arguments on particular issues and managing the rationale space among the group members. This leads to the third and fourth research proposition:

**Proposition 3:** Rationale awareness impacts the group’s way of making its decisions.
Proposition 4: The group develops its way of managing the shared rationale space.

To enable the investigator to explore the effects of rationale awareness in a hybrid collaborative learning activity and examine the propositions, there are several requirements for the research context: the group members collaborate through both face-to-face meetings and virtual collaborative environment; and in the virtual environment the members work together synchronously and asynchronously and share their rationales within the group. The investigator created such a context in an undergraduate class of spring 2007 and conducted a naturalistic study in the class. The investigator first designed a collaborative learning activity of the class that required the students to document and share the rationale of their decision on the shared tasks in distributed teamwork setting. This learning activity was part of the semester long group project that was assigned to the student groups before the intervention of the investigation. Then, the investigator designed and implemented a collaborative software program to support this collaborative learning activity. The class, the designed activity and the developed tool together provided an environment that enabled the investigator to study the effects of rationale awareness. The investigator then collected and analyzed various kinds of data from this class to probe the effects of computer-supported rationale awareness in the learning activity. Figure 3-1 presents a conceptual diagram of this study and shows the organization of the remaining chapters of the study. Note that the last chapter presents the summary of the study and discusses the future research plan.
The effects of computer-supported rationale awareness in the distributed teamwork

Chapter 4 – Activity Design: create a situation in which the students collaborate in a distributed setting and share their rationales

Chapter 5 - Software Development: Support Distributed Teamwork and Rationale Sharing

The effects on common ground formation

Chapter 6 - Data Collection, Data Analysis, and Results

Chapter 7 - Discussion on significant findings

The effects on group practice

Investigate the research proposition

Create an environment for studying the research interest

Figure 3-1 A conceptual diagram of the dissertation study
Chapter 4

Activity Design – A Challenges Assessment Activity

In the investigation, a collaborative learning activity was designed for the purpose of providing a context for the investigator to examine the effects of rationale awareness in learning activities. The learning activity required the students to work in distributed team setting and to document and share the rationale of their decisions on shared tasks. This chapter discusses in detail the design of this activity.

The Activity Context – a Traditional Class and a Predefined Group Project

This study was carried out in a project management course of the program of Information Sciences and Technology (IST) at the undergraduate level in spring 2007. This was a traditional class where the instructor held face-to-face lectures in a classroom weekly. All the students were co-located. There was a predefined semester-long group project in the class.

The project management course is a junior level undergraduate course taught at a major university. In this class, students usually work in groups focused on corporate-sponsored projects that aim to solve a real-world technology problem, even as they learn about managing IT projects. For the spring 2007 class, the project was to research solutions and best practices for the success of distributed teamwork with respect to five project phases for the consulting company Deloitte: project initiation, project planning,
project execution, project planning, and project closure. More specifically, for each project phase activity (e.g., a project initiation phase activity), a group needed to identify the top three challenges, barriers to success, or risks associated with each project management phase; select two to three technology tools and compare and contrast them; and identify at least three best practice recommendations for each project management phase, especially those associated with the relevant technology tools. Each group submitted a mini-report to the company and to the instructor about their work at the end of each project phase activity. After all of the project phase activities were completed, each group produced a final report and presented their work in front of the class.

There were two designated Deloitte employees assigned to each group serving as the group’s company contact to provide guidance and feedback during the semester-long project. Students were encouraged to set up conference calls and exchange emails with the employee as the way to communicate with the company.

Figure 4-1 shows the context for the activity design provided by the pre-defined group project and the class setting.
• A traditional undergraduate class: weekly face-to-face lectures, the instructor and the students were co-located

• Students worked in groups on a semester-long group project

• The group project was about the best practices for the management of distributed team projects

Figure 4-1 The activity context – a traditional class and a pre-defined group project

The Challenges Assessment Activity

Within the context described in the above section, the investigator designed a collaborative learning activity, the challenges assessment activity, as part of the group project for the investigation of the effects rationale awareness. The activity required the students to document the rationales of their decisions over the course of the project.

The activity followed the principles for designing an educational activity (Newman, Griffin, & Cole, 1989):

1. Constructive

   The activity integrates students’ existing knowledge schemes with new information to support acquisition of new knowledge

2. Active
Each student is expected to participate in the activity actively in generating new knowledge and learning from peers.

3. Significant

Learning should be meaningful to each individual student.

4. Reflexive

The learning group in the activity acts as a mirror reflecting each student’s learning process.

5. Collaborative

The activity supports students to learn with their group members. Student group has the same pedagogical goal, and each member is a potential source of information.

For each project phase activity, there was a challenges assessment activity in which the group needed to answer two questions as a group:

1. What are the different types of challenges to successful distributed teamwork during this project phase?

2. What are the top three and bottom three challenges for the success of distributed teamwork?

To answer the first question, each group was asked to propose at least thirty challenges, and then group the challenges into at least three categories (types). For each challenge that a student proposed, he/she was required to provide the rationale that explains why he/she selected it. To answer the second question, each student in the group selected his or her top three and bottom three challenges from the challenges list developed for question one, and then provided the rationale for his/her decisions. Then
the group selected the top and bottom three challenges as a group, and provided the group rationale for that step.

During the challenges assessment, the groups were asked not to meet face-to-face, pretending to be working as a distributed team. The purpose of doing so is to offer the groups opportunity of experiencing the distributed teamwork model firsthand, which is beneficial for the students to carry out the group project: research the challenges for distributed teamwork, compare and contrast the collaborative tools effectively and efficiently, and suggest best practices for distributed teamwork. The groups used the developed collaborative software tool to perform the challenges assessment task. The workspace software tool provides a virtual collaborative environment for each group.

Table 4-1 shows the connection between the activity design and the principles it followed.

Table 4-1 The connection between the principles for design of educational activities and the design of the challenges assessment activity

<table>
<thead>
<tr>
<th>Principles for Designing an Educational Activity</th>
<th>The Challenges Assessment Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructive</td>
<td>Brainstorm the challenges based on the students’ knowledge about distributed teamwork and the class lectures’ on project management</td>
</tr>
<tr>
<td>Active</td>
<td>Each student is required to participate in brainstorming the challenges and in selecting and ranking the challenges</td>
</tr>
<tr>
<td>Significant</td>
<td>Identifying the challenges of distributed teamwork helps the students evaluate the collaborative tools and suggest best practices for managing distributed teamwork</td>
</tr>
<tr>
<td>Reflexive</td>
<td>The requirement of documenting and sharing the rationales in the group helps reflect the individual students’ learning process in the activity</td>
</tr>
</tbody>
</table>
Collaborative Students worked in groups in the class; each student had his/her perspective as to the challenges for distributed teamwork.

After the challenges assessment task, the students may choose how they wanted to communicate and collaborate for the remaining tasks involved in the project phase activity, including comparing and contrasting collaborative technology tools, researching best practices for the distributed teamwork at the project phase, and producing the mini-report for the project phase activity. The mini-report has to follow a report template provided by the instructor. A template includes five sections:
Table 4-2 presents an overview of the overall group project in this class.

**Table 4-2 Overview of the students’ group project in the project management course**

<table>
<thead>
<tr>
<th>Name of the students’ activities and the period</th>
<th>Students’ activities, setting, and the period of the activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Initiation (Feb. 13th – Feb. 22nd)</td>
<td>Challenges Assessment (virtual) (2 days)</td>
</tr>
<tr>
<td></td>
<td>Mini-Report (regular setting) (1 week)</td>
</tr>
<tr>
<td>Phase</td>
<td>Activity</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Project Planning (Feb. 27&lt;sup&gt;th&lt;/sup&gt; – March. 8&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Challenges Assessment (virtual) (2 days)</td>
</tr>
<tr>
<td></td>
<td>Mini-Report (regular setting) (1 week)</td>
</tr>
<tr>
<td>Project Execution (March. 20&lt;sup&gt;th&lt;/sup&gt; – March. 29&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Challenges Assessment (virtual) (2 days)</td>
</tr>
<tr>
<td></td>
<td>Mini-Report (regular setting) (1 week)</td>
</tr>
<tr>
<td>Project Controlling (Apr. 3&lt;sup&gt;rd&lt;/sup&gt; – Apr. 12&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Challenges Assessment (virtual) (2 days)</td>
</tr>
<tr>
<td></td>
<td>Mini-Report (regular setting) (1 week)</td>
</tr>
<tr>
<td>Project Closure (Apr. 17&lt;sup&gt;th&lt;/sup&gt; – Apr. 26&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Challenges Assessment (virtual) (2 days)</td>
</tr>
<tr>
<td></td>
<td>Mini-Report (regular setting) (1 week)</td>
</tr>
<tr>
<td>Final Report (Report due. May. 7&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Final report and presentation (one and a half week)</td>
</tr>
</tbody>
</table>
Chapter 5

Software Design and Implementation: A Challenges Assessment Workspace

To enable the investigator to study the effects of computer-supported rationale awareness in the group project, a challenges assessment workspace was designed and implemented for the purpose of creating a virtual collaborative environment that enables the students to collaborate and share their rationales with their group members in the challenges assessment activity. As the preliminary work to the study, the investigator carried out an exploratory study to explore the basic requirements of the software design. This chapter first discusses the preliminary work that provided design suggestions on the challenges assessment workspace, and then discusses in detail the design of the workspace.

Preliminary Work – A Collaborative Case Building Workspace

The exploratory study was carried out in an undergraduate course – Usability Engineering in the term of fall 2006. This was also in the program of Information Sciences and Technology.

In this class, the students learned about the techniques and tools for design projects from the usability perspective, and learned about the general process of a design project following the scenario-based framework (Rosson and Carroll, 2002). To get hands-on experience on the course subject, the students worked in groups on a term
project to develop prototypes for a local small community group. In the project, the
students took several field trips to the site and had conversations its representative for
collecting the requirements from the organization. The students then worked in groups on
web interface design. The instructor invited the representative to the class to evaluate the
interface. Based on her evaluative feedback, students revised their interface design. The
students then developed usability testing scripts to test the searching functionalities of the
web for different types of web users of the organization. At the end of the project each
student group gave a presentation on what they accomplished to the representative, their
instructor and students in the class.

During the last two weeks of the project, the instructor required the students to
carry out a collaborative case building activity in which they worked together with the
group members to reflect on the project process and document the group project into a
design case with the case format from an existing case library. During this activity, the
students were also required to document the rationales of their decisions and share them
with the group members. The instruction on documenting the rationales was given to the
students (Appendix A).

Design Requirements of the Workspace

A workspace was designed and implemented to support the collaborative case
building activity. The design of the workspace centered on the activity, and the
requirements of software design are gathered from the activity. The characteristics of the
collaborative case building activity posed several basic requirements on the information design and interaction design of the workspace for supporting the activity:

- **Basic Requirements for Information Design**

  With respect to the activity itself, the workspace should provide the mechanism for sharing the design documentations among the members and the corresponding rationale documents.

  The teamwork could be in distributed setting and could be asynchronous as the activity lasted two weeks. Compared to the face-to-face collaboration, the members did not automatically know who were working with them as well and which part of the work was done by whom. Therefore, the workspace should have a mechanism to provide the information of who are present in the virtual collaborative space.

- **Basic Requirements for Interaction Design**

  The workspace should enable each group member to freely add/edit/delete his/her work and communicate with others. Because the members may or may not be present at the same time in the workspace, the workspace should support both synchronous and asynchronous interactions and collaborations among the members.

**The Design of the Collaborative Case Building Workspace**

The design of the workspace took the above basic requirements into consideration and presented a user interface shown in Figure 5-1. In the workspace, the students could
work together on the design project and organize their project documents in the case format required by the instructor. The interface of the software has five areas:

- **User panel:** This area displays the list of usernames who are currently logged into the workspace.

- **Organization panel:** This panel presents a tree view of the project documents organized according to the case format. The red plus icon indicated that there was new content in the document’s rationale space that has not been read. The envelope icon indicated that there were content in the document’s rationale space and the student had visited the space. The default icon indicated that there was no content in the rationale space of the document.

![Figure 5-1](image)

**Figure 5-1** A screenshot of the case builder tool used by a students group for the design project of usability engineering course in fall 2006
• **Document panel**: This panel displays the document that is currently open. The tool allows the following types of documents to be opened: a text document, a HTML document, and an image.

• **Rationale panel**: This panel provides a freeform collaborative text editor for the student to write down any comments related to the open document and share their comments with others.

• **Group chat panel**: This panel provides a group chat that automatically saves and displays all the chat messages exchanged within the group, i.e., a persistent group chat. Also, as it shows in the figure, a message ended with a question mark was displayed in red.

**The Implementation of the Workspace**

The workspace was developed using CORK (Content Object Replication Kit), an architecture supporting the synchronous sharing of Java objects as replicas across multiple distributed clients (Isenhour et al., 2000, 2001). CORK is a toolkit for constructing Java-based synchronous and asynchronous collaborative systems suitable for delivery over the web. To support a broad range of collaborative applications, CORK has mechanisms that support replication and collaboration awareness at different architectural layers. CORK has a central database that maintains latest version of data objects. These data objects are master copy in the central and can be replicated when there is a request from the client for data retrieval. Changes of the objects in client side will be sent to the server and broadcast to all clients to update the local copy. There are various
collaborative components developed based on CORK architecture, such as a shared
drawing tool, a synchronous text editor, a persistent chat, a collaborative data table, and
the challenges assessment workspace. Figure 5-2 shows the CORK architecture.

![CORK Architecture Diagram]

**Figure 5-2 CORK architecture**

Built on top of CORK architecture, BRIDGE system (Basic Resources for
Integrated Distributed Group Environments) provides standard structures for organizing
CORK objects, mechanisms for awareness, and facilities for multiple user interfaces
(web, Java client, etc.) for the same object (Ganoe et al., 2004). The workspace
implemented BRIDGE structure for the representation of the workspace in the virtual
environment.
The focus on the design process helped the students realize that early design concepts are important artifacts in a design project and the tool allowed them to share and organize the various kinds of design documentations within their groups and create their design cases. For example, a group took photos during their project process and put the photos taken during their brainstorming meetings into the case using the tool (Figure 5-3).

Figure 5-3 A screenshot of one student group’s case builder workspace (the photo was taken during their brainstorming meeting on the design)

There were three student groups in this class. Two groups had three members each and one had four members. Nine out of the ten students filled out a questionnaire.
regarding the group project at the end of the semester. The questionnaire consisted of eight essay questions and five 5-Likert scale items (Appendix B). The questions asked about the students’ learning experience of the group project and their experiences of collaborating online with the case builder tool. Students mentioned several features they liked about the virtual group workspace: the real time collaboration in virtual environment, the connectivity that allows for communication at remote, the group chat in the workspace, the availability of the previous messages in the group chat, the unified space for storing and sharing the group documents, and the file organization that the tool provides.

The students generally liked the feature of having a shared place for rationale in the workspace. They liked the design of associating the rationale space with the corresponding document. Five out of nine students said that they read other students’ rationale. Four of the five students acknowledged some level of learning. One student said, “I learned how other people react to what a person says also how design ideas differ from team to team and the way they see how the project should be.”

The whole result of the survey is available in Appendix B. Note that because there were only three groups and nine participants, we consider the survey results only indicators of the users’ preference in this context instead of being statistically meaningful.

**Development of the Challenges Assessment Workspace**

The preliminary work in the fall 2006’s class offered the experience of designing and implementing software programs for supporting collaborative learning activities. The
design and implementation process of the challenges assessment workspace was similar to that of the collaborative case building workspace.

**Design Requirements of the Workspace**

The characteristics of the challenges assessment activity posed several basic requirements on the information design and interaction design of the workspace. Some of the characteristics are similar to that of the collaborative case building activity:

- **Basic Requirements for Information Design**

  Similar to the collaborative case building activity, the challenges assessment activity required that the students document and share their rationales. Therefore, the workspace should provide the mechanism for sharing the challenges among the members and the corresponding rationale statements, and sharing the individual choices of the challenges and the rationales.

  However, there is a fundamental difference on information sharing and representation in the group space. In the case building activity, the members worked on a group document that was expected to present a coherent look, i.e., a single document representation instead of disjoint paragraphs put together. But in the challenges assessment activity, each challenge posted by a member could be independently from others and all the proposed challenges in the activity do not have to be represented in one format. The challenges
assessment workspace should therefore provide a mechanism that supports the different kinds of representation of the challenges.

In the challenges assessment activity, the teamwork was in distributed setting and could be asynchronous. Compared to the face-to-face collaboration, the members in distributed teamwork did not automatically know who were working with them at present and which part of the work was done by whom. Therefore, the workspace should have a mechanism to provide the information of who are present in the virtual collaborative space and of distinguishing group members’ challenge notes and ranking decisions and the corresponding rationales from each other.

- **Basic Requirements for Interaction Design**

Similar to the collaborative case building activity, the workspace should enable each group member to freely add/edit/delete his/her work and communicate with others. Because the members may or may not be present at the same time in the workspace, the workspace should support both synchronous and asynchronous interactions and collaborations among the members. Additionally, as the challenges of the activity did not have to be in one format, the students should be able to choose different representation styles for presenting the challenges.
The Design of the Collaborative Case Building Workspace

Workspace Version I – A Parallel and Structured View of the Document and Rationale Spaces

As shown in the above, the requirements of the challenges assessment workspace were similar to those of the collaborative case building workspace. Therefore, the first version of the challenges assessment workspace adapted the basic design of the case building workspace. From the user experience of the preliminary work, the features kept in the challenges workspace include a shared group environment that supports both real time and asynchronous collaboration, a persistent chat in the environment, a document-based rationale space and a file organization that fits with the activity structure.

In designing the relative location of the document space, rationale space, and group chat space, a claims analysis regarding the features of the case building workspace was performed (refer to Figure 5-1 for the analysis):

Claims Analysis

- **Design Feature:** The document and its rationale space are divided as top and down spaces

  **Pros/Cons:**

  + In a fixed space, both the document and rationale space will have more horizontal space than if they are divided by a vertical divider

  - The change in the rationale space of the document by the other group members’ may be more difficult to detect than if they are divided by a vertical divider, as
a change in a space located below the user’s focused space may be more
difficult to get attention than that in a space parallel to the user’s focused space
- The switch between the document space and the rationale space is more costly
  than if the spaces are presented in parallel (the distance between the top panel
  and the lower is longer than that between the left panel and the right panel)
  (Fitts’ law)

- **Design Feature:** When a user opens the rationale space of a document, the
document is opened automatically as well, and vice versa

  **Pros/Cons:**
  + It is convenient for the user to associate rationale with the document
  - It takes the space in the window

- **Design Feature:** Group chat messages are presented in parallel to the document
  and rationale panel

  **Pros/Cons:**
  + It is spacious to display a number of messages to support awareness of previous
    communication record. As when a user sends a message, it starts from a new
    line, potentially vertical space is favored for the chat messages space
  + It is relatively easy for a user to be aware of the exchanges of chat messages
    while working on the document
  + It is relatively easy for the users to discuss the document or rationale related
    issues in the group chat
- It takes up a significant amount of vertical space in the window so it becomes difficult for the document space and the rationale space to be displayed in parallel.

The claims analysis of the case building workspace shows that the design of separating the document space and its rationale space by a horizontal divider thus presenting a top-down view may affect the research study negatively because of the following reasons:

a). the top-down view of the document and rationale space is not convenient for users to switch between the document and the rationale, which is a behavior that a user may be doing – interleaving between working on the document and reflecting and documenting their rationale;

b). the content change in the rationale space is more difficult for the user to notice compared to a parallel view.

**Figure 5-4** shows the UI design of the workspace that addressed this issue. In this designed interface, the document space and the rationale space were displayed in parallel, and the group chat component was displayed below them. As shown in the figure, the group chat was below the document and rationale panels. One drawback of this design was that the chat tool took up a significant space of the document and rationale.
Before adopting this as the final prototype to be used in the class, there were also several modifications need to be made because of the differences of the characteristics of the two activities. In the case building activity, the group worked together to produce case documents. The mental model of a shared word processing tool was to support collaborative writing for producing a group document. So it was appropriate to use the tool in the case building activity. In the challenges assessment activity, the student group worked together in a brainstorming process instead of collaborative writing, and the group may not present all the challenges together as one document. Therefore, the shared word processing tool was not appropriate to use in the challenges assessment activity. Instead, a shared whiteboard tool was adopted in the workspace for the students to propose and share the challenges. The mental model of a whiteboard was to enable users...
to post and share things. This interaction affordance made the process of brainstorming and sharing the challenges in the workspace analogous to an affinity diagram process using a physical wall. The shared whiteboard provided the features of coloring, shaping, and resizing the challenge notes, which made it possible for the students to distinguish who posted which note on the whiteboard. There was a shared whiteboard for each challenges assessment activity.

A shared data spreadsheet was provided for each activity allowing the group members to write down their choices of top three and bottom three challenges and the group’s choice. The student group used one challenges assessment workspace for all the five activities, so there were five whiteboards and data spreadsheets in total.

Because the students needed to be able to move the challenge notes around on the whiteboard to form at least three categories of the challenges, having the space for the whiteboard so that the students could view all the challenge notes together was important in this activity. The previous design of having the group chat under the document space was therefore not desired as it took up the vertical space of the whiteboard. The chat tool was put below the organization panel to address this issue.

In the case building activity, all the rationales about a shared document were in one space, and this feature was favored by the students. In the challenges assessment activity, the students’ rationales were associated with their challenge notes which were just part of the whole whiteboard’s challenge notes. Should a rationale space provided for each challenge note, or should a rationale space provided for a shared whiteboard in a challenges assessment activity? In this study, the rationale space was designed to be
associated with a shared whiteboard or data spreadsheet. Figure 5-5 shows the UI design of the workspace.

![Figure 5-5](image)

**Figure 5-5** A screenshot of the challenges assessment workspace (version I)

Operationally it would help the students to choose the challenges from those on the whiteboard and put them in the shared data spreadsheet if both the whiteboard and the data spreadsheet windows were open in the workspace. To support this activity scenario, the workspace UI was structured to present the four panels (two for the whiteboard and the data spreadsheet, and the other two for their associated rationale space) in one workspace window (Figure 5-6). It was expected that this structured view of the four panels would make the work more efficient than an unstructured view, as it saved the
time of switching between the windows for reviewing the content.

Figure 5-6 A screenshot of the workspace with two documents and their rationale spaces open (version I)

A claims analysis of the workspace with this version (Figure 5-5 and Figure 5-6) was performed:

Claims Analysis

- Design Feature: Group chat messages are presented below the tree view, instead of below the document and rationale panel

Pros/Cons:
+ It does not take up the horizontal or vertical space of both the document and rationale space

- Students see less chat history because of limited chat display window

- **Design Feature:** The rationale document contains the rationale of all the challenge notes on the shared whiteboard

**Pros/Cons:**

+ It helps the students review each other’s rationale and comment on each others’ rationale while trying to propose challenges

+ It helps the students to build on each other’s idea when proposing the challenges

+ It provided a comprehensive view of the rationale statements for an activity making it relatively easy to compare the challenges and rationale statements.

+ It supports the awareness of the group members’ contribution in the activity by being able to see all their work in one place

- The students may be affected by others’ rationale and be confined when thinking of challenges

- It was not intuitive to relate one challenge note to its rationale statement.

- **Design Feature:** The structured and fixed view of the documents and their rationale spaces when two documents are opened

**Pros/Cons:**

+ There is no overlap among the four windows with pre-organized layout

+ Students can refer to the rationale documents when making the decision on which challenges to choose
- Each panel has limited screen space

**Workspace Version II – A Conventional Design of Parallel Windows for the Document and Rationale Space**

The students used the workspace version I in the first challenges assessment activity. Although it was expected that with the fixed spaces for the rationale documents in the structured view the students could refer to the rationale documents relatively easily when making the decision on which challenges to choose, students complained to the investigator verbally about not being able to move the windows around after the first challenges assessment activity. The workspace version II was then designed and implemented to address this issue. In this workspace, there were no fixed panels for the document and its rationale document any more. Instead, when one clicked on a document’s name from the tree, the document and its rationale document are opened as two parallel windows (*Figure 5-7*). The students used this version for the rest challenges assessment activities.
The Implementation of the Workspace

Like the collaborative case building workspace, the challenges assessment workspace was also implemented using CORK architecture and BRIDGE system. Please refer to the earlier section about CORK and BRIDGE for details.
Chapter 6
Data Collection, Data Analysis, and Results

The participants in the project management class worked on the challenges assessment activities using the developed workspace. There were five challenges assessment activities in total in the group project. For the first activity, the investigator demoed the workspace and presented examples of good and bad rationale statements to illustrate the requirement of writing a meaningful rationale statement. Additionally, participants were given half an hour class time to work on the challenges assessment in the class. The first challenges assessment task was counted as the pilot study in the investigation.

Following a triangulation research method, several approaches were used to collect, compare, and analyze the data for this study. Various kinds of data were collected in the study, including survey, the artifacts, the class observation notes, semi-structured interviews, and the grades of the participant groups’ activities. This chapter discusses the data collection and analysis methods, and presents the results of the analysis. In this chapter, the term “participant” was used instead of “student” since technically only the student who chose to participate in the study was considered in data collection process. So the analysis and the results were based on the participants’ data, not all the students’ data.
Survey

Survey can be a powerful and useful tool for collecting data on human characteristics, attitudes, thoughts, and behavior. Alternatives to survey method include available data, focus group interviews, key informant interviews, observational studies, and experiments. In this study, survey was used for collecting the participants’ background information (background survey, Appendix C), for collecting the participants’ perception on the effects of rationale awareness in the group activities (survey A, Appendix D), and on their collaboration experiences and the effects of documenting the rationales on their learning experience in this class (survey B, Appendix E). There are several reasons of choosing survey method for collecting such information:

a). It would be time consuming to interview each participant for his/her background information, so survey was the alternative option of collecting such data.

b). There have been efforts on studying the activity awareness using survey. For example, Convertino et al. (2004) used a questionnaire in their study of activity awareness. This study examines the effects of rationale awareness on the two aspects of the activity awareness, therefore, collecting “self-reported” survey data as one way of understanding the rationale awareness is reasonable.

c). The participants’ experience of collaborating and learning with others in the class indicates the impact of this study and provides feedback on the design of the collaborative learning activity and the collaborative tool. It is therefore important to collect these subjective data.
This study was conducted in a naturalistic environment, not a lab. The participants could collaborate at different times and at different places. Because of the nature of this study, it would be impossible to observe all the participant groups to collect these subjective data. Also, it would also be time consuming to interview each participant in order to collect this information. Survey was the alternative option to collect these data for obtaining an overall picture of the participants’ experiences on collaboration and learning and on the use of the tool.

Survey Design

The background survey used in a lab study for collaborative activity (Convertino et al., 2007) was adopted and customized in this study. It is appropriate to do so because both studies recruited college participants for carrying out the activities, and the types of the activities were similar in both studies: the participants worked together in a virtual collaborative environment using a collection of the tools developed in CORK and BRIDGE (see Chapter 5 for details about CORK and BRIDGE).

There were 19 items in the Survey. All were seven level Likert-scale ranging from 1 “strongly disagree” to 7 “strongly agree”). The survey was designed based on the research propositions of this study as follows:

a). 1-5 items were designed for understanding the participants’ perceived effects of rationale awareness on their awareness of others’ contribution: the first two items were about one’s awareness of others’ contribution in the group project including the challenges assessment activities and the mini-report activities; and the next three items
were about one’s perception of the effects of rationale awareness on his/her awareness of others’ contribution.

b). 6-10 items were designed for understanding the participants’ perceived effects of rationale awareness on their awareness of others’ expertise. The wording and the organization of the items in this group (6-10 items) were designed to be similar to the first group of items (1-5 items) so as to introduce less cognitive processing load for understanding the items when the participant was filling out the survey: the first two items were about one’s awareness of others’ expertise in the group project including the challenges assessment activities and the mini-report activities; and next three items were about one’s perception of the effects of rationale awareness on his/her awareness of others’ expertise

c). 11 – 13 items were designed for examining whether the groups reused the previous rationales, as the reuse of the rationales is another way of supporting the awareness of others’ rationales

d). Item 14 was also designed for examining whether the participant purposefully used the rationales as a way to help him/her to be aware of others’ work. Awareness of one’s work could imply one’s contribution and/or expertise.

e). Item 15 – 17 were designed for examining whether the group had developed the practice of sharing the rationale space

f). Item 18 and 19 were designed for examining whether the group had developed the practice on generating the group rationale
The wording of the items on the group practice (item 15 – 19) was based on that of the questionnaire used in studying the activity awareness on shared practice (the questionnaire is available at http://cscl.ist.psu.edu/public/projects/awareness/q.html).

The survey B was also seven level Likert-scale ranging from 1 “strongly disagree” to 7 “strongly agree”. The survey included items about the participants’ group work experience (class I items, 12 items), the participants’ feedbacks on the design of the rationale space (class II items, 6 items), and the participants’ learning experience by documenting the rationales (class III items, 16 items). The items were designed as follows:

a). There were 12 class I items. Item 1 was from the scaled used in Roberson’s study (2006). Item 2 and 3 were created to examine the participant’s satisfaction on the teamwork. Item 4-12 were customized from the existing scale used in the study of partially distributed teams (Plotnick et al., 2008).

b). There were 6 class II items. The design of these items were based on the workspace features: the workspace supported real time rationale sharing (checked in item 1); provided no access control on rationale editing (checked in item 2); provided a feature of automatically opening the rationale space when the document was opened (checked in item 3); and provided a document-based rationale space (checked in item 4, 5, and 6). The purpose of collecting this information was to collect the participants’ feedbacks on these design features.

c). There were 16 class III items. Item 1 was designed to understand the perceived usefulness of documenting rationales on helping the participants to externalize their thinking. Item 2 – 16 were designed to understand the perceived usefulness of the
challenges assessment activity on the participants’ experiences of learning the course subjective. The course subjective of this class was written in the description of the course (available online at the university’s web site:
http://bulletins.psu.edu/bulletins/bluebook/university_course_descriptions.cfm?letter=I&courselong=IST|302|200203S1) – “This course is designed to introduce and explore the basic concepts and practices of project management and help students understand how to plan and manage IT projects successfully”. Item 3-9 were designed to examine the usefulness of different tasks on helping the participants to “explore the basic concepts”, and item 10 – 16 were designed to examine the usefulness of different tasks on helping the participants to “understand how to manage IT projects successfully”.

**Data Collection**

All the surveys were administered as web-based online surveys, and filled out anonymously to reduce the result bias due to the participants’ concern that the survey result would affect their course grades. Because the survey data were also analyzed at the group level, the participants were asked to indicate which group they belonged to in the surveys.

.33 participants signed IRB participation forms in the class and received extra course credit for the participation. 31 participants filled out the background survey (Appendix C) at the beginning of the first challenges assessment activity. The survey collected the participants’ demographic information, such as their experience of using
collaborative tools, their knowledge on project management, and their teamwork experience.

25 participants filled out survey A (Appendix D) after all the five project phase activities were completed. The survey A was about the perceived effects of rationale awareness in the group activities. 30 participants filled out survey B (Appendix E) two days after survey A was administered. The survey B was about the participants’ group work experience, the experience of using the shared rationale space in the workspace, and the impact of the challenges assessment activity on the learning experience.

Data Analysis and Results

Background Survey

The background survey was analyzed by calculating the mean value of the survey items. The results of this analysis provide an overview of the participants’ background in this class. Because there were four out of thirty seven participants who chose not to participate in the study, their perception and experiences were not available in the analysis. Also, some participants missed some survey items and their experiences were not available in the analysis.

Experience and preference of working in groups

According to the background survey, the participants in this class mainly majored in IST (27 out 30 participants, one participant did not fill out this information). Majority
of the participants were sophomore or junior (Figure 6-1). A few participants were senior or had been in college for over five years. As most of the IST courses offer group work assignments, the survey result suggests that it is reasonable to assume that the participants had practically same level experience of working in groups. The survey data also show that 16 out of the 31 participants preferred working alone and 22 out of the 31 participants enjoyed team work.

![Bar chart showing the number of years in college for each participant.](chart.png)

**Figure 6-1** The number of years that participant had been studying the major

**Experience and Preference of Computer Use in Work**

25 out of 30 participants have been using computers for over ten years, and the rest five participants have been using computers for at least six years. 29 out of 31 participants enjoyed working on computer. 23 out of 31 participants preferred working on
computer than on paper. The participants used the computer daily: 20 participants used the computer for over four hours and no more than 10 hours a day, 9 used the computer for two or three hours per day, and 1 participant spent 20 hours on computer use per day (Figure 6-2). The average number of hours on computer usage in the class is 5.87 hours. Overall, the participants’ background on computer use and preference indicates that the participants had practically the same level of experience of using the computer tools and the same attitude for using the computer tools for group tasks.

![Figure 6-2](image)

Figure 6-2 The number of hours per day that a participant spent on computer usage

**Experience of Using Collaborative Tools**

Participants were very experienced using instant messaging tool either for work or other purposes, fairly experienced with using data spreadsheet, and not very experienced
with concept mapping tools (Table 6-1). Overall, the participants’ previous experiences of using these tools were practically at the same level. Note that in the challenges assessment workspace, the whiteboard was used for the students to propose challenges and rearrange the challenges to group them into different categories. In this sense, the use of the whiteboard was similar to that of a concept mapping tool.

Table 6-1 The background survey result on the participants’ experience with the tools

<table>
<thead>
<tr>
<th></th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant Messaging</td>
<td>3.2% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>3.2% (1)</td>
<td>93.5% (29)</td>
</tr>
<tr>
<td>Data spreadsheet</td>
<td>6.3% (2)</td>
<td>9.4% (3)</td>
<td>40.6% (13)</td>
<td>21.9% (7)</td>
<td>21.9% (7)</td>
</tr>
<tr>
<td>Concept mapping tools (e.g., SmartDraw, CmapTools)</td>
<td>40.6% (13)</td>
<td>43.8% (14)</td>
<td>15.6% (5)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Play online game with others</td>
<td>3.1% (1)</td>
<td>12.5% (4)</td>
<td>21.9% (7)</td>
<td>12.5% (4)</td>
<td>50.0% (16)</td>
</tr>
</tbody>
</table>

*Experience related to the challenges assessment activity*

26 out of 31 participants have worked on exercises that required them to write down their explanations. Most participants felt comfortable with writing and posting notes on a wall or on a computer screen space that is shared by others (Table 6-2). Overall, the participants’ had practically same level of experience of working in activities that are similar to the challenges assessment activity and may have assumed same comfort level of working in the activity.
Table 6-2 The survey results on the participants’ comfortable level of using the shared space

<table>
<thead>
<tr>
<th>How comfortable are you with writing and posting notes on a wall that is shared by others?</th>
<th>Not at all comfortable</th>
<th>Not very comfortable</th>
<th>Somewhat comfortable</th>
<th>Fairly comfortable</th>
<th>Very comfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2% (1)</td>
<td>0.0% (0)</td>
<td>16.1% (5)</td>
<td>38.7% (12)</td>
<td>41.9% (13)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How comfortable are you with writing and posting notes on a computer screen space that is shared by others?</th>
<th>Not at all comfortable</th>
<th>Not very comfortable</th>
<th>Somewhat comfortable</th>
<th>Fairly comfortable</th>
<th>Very comfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>25.8% (8)</td>
<td>35.5% (11)</td>
<td>38.7% (12)</td>
<td></td>
</tr>
</tbody>
</table>

Prior domain knowledge – knowledge on project management

Table 6-3 shows the participants’ knowledge on project management prior to this class. As it shows in the data, most participants had experience on managing an individual project, and many had experience on managing a team project, and majority of the participants had some experiences of working in distributed team environment, but few experience of not on managing a distributed team project. The results show that the level of domain knowledge is practically the same for the participants regarding managing individual project and co-located team project. There are some variations in terms of the knowledge on managing a distributed team project.

Table 6-3 The participants’ knowledge on project management prior to the class

<table>
<thead>
<tr>
<th>How would you rate your experience on managing an individual project?</th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2% (1)</td>
<td>6.5% (2)</td>
<td>12.9% (4)</td>
<td>48.4% (15)</td>
<td>29.0% (9)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How would you rate your experience on managing a team project?</th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0% (0)</td>
<td>6.5% (2)</td>
<td>35.5% (11)</td>
<td>48.4% (15)</td>
<td>9.7% (3)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How would you rate your experience on working in distributed team environment?</th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2% (1)</td>
<td>29.0% (9)</td>
<td>35.5% (11)</td>
<td>25.8% (8)</td>
<td>6.5% (2)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How would you rate your experience on managing a distributed team project?</th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.7% (3)</td>
<td>35.5% (11)</td>
<td>32.3% (10)</td>
<td>19.4% (6)</td>
<td>3.2% (1)</td>
<td></td>
</tr>
</tbody>
</table>
An item of survey A and B is 7 level Likert scale ranges from 1 “strongly disagree”) to 7 “strongly agree”. The higher the item value, the participant’s attitude was more towards the “agree” side. With the scaling ranging from 1 to 7, 4 was considered a neutral value meaning “neither disagree nor agree”.

A two-tailed one sample t test was performed to test the statistical significance of the survey items’ mean values. A one-sample t-test is performed when a researcher needs to determine if the mean value of a target variable is different from a hypothesized value. The two-tailed test is performed when there is no assumption of which side the mean value should be. In this study, the mean value of a survey item was tested against value 4 in the two-tailed one sample test to examine whether the mean value was statistically different from 4. If the mean value of an item was less than 4 and the difference was statistically different from the test, this indicated that the participants’ opinion on the survey item was indeed leaning towards disagreement (note that 1 meaning “strongly disagree” and 7 meaning “strongly agree”), and the lower the mean value, the stronger the participants’ opinion on the disagreement. Vice versa, if the difference between the mean value of an item and 4 was statistically significant and the value was higher than 4, this indicated that the participants’ opinion on the item was indeed leaning towards agreement, and the higher the mean value, the stronger the participants’ opinion on the agreement. Table 6-4 shows the results of survey A items using the two tailed one-sample t test.
Table 6-4 Two-tailed one sample t test of the survey A items

<table>
<thead>
<tr>
<th>Survey Item (N = 25)</th>
<th>Mean value Two tailed One-Sample t Test (Test Value = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was aware of each member's contribution in challenges assessment activities</td>
<td>6.04 (t = 9.62, P &lt; 0.001)</td>
</tr>
<tr>
<td>I was aware of each member's contribution in mini-report activities</td>
<td>6.04 (t = 8.98, P &lt; 0.001)</td>
</tr>
<tr>
<td>Knowing my group members' explanations contributed to my awareness of their contribution in challenges assessment activities</td>
<td>5.12 (t = 3.52, P = 0.002)</td>
</tr>
<tr>
<td>Knowing my group members' explanations contributed to my awareness of their contribution in mini-report activities</td>
<td>5 (t = 2.97, P = 0.007)</td>
</tr>
<tr>
<td>If we had worked on the challenges assessment without sharing the explanations, I would have been less aware of my group members' contributions</td>
<td>4.84 (t = 2.13, P = 0.044)</td>
</tr>
<tr>
<td>I was aware of my group members' expertise as we were working on challenges assessment activities</td>
<td>5.04 (t = 3.98, P = 0.001)</td>
</tr>
<tr>
<td>I was aware of my group members' expertise as we were working on mini-report activities</td>
<td>5.36 (t = 5.28, P &lt; 0.001)</td>
</tr>
<tr>
<td>Knowing my group members' explanations contributed to my awareness of their expertise in challenges assessment activities</td>
<td>4.92 (t = 3.33, P = 0.003)</td>
</tr>
<tr>
<td>Knowing my group members' explanations contributed to my awareness of their expertise in mini-report activities</td>
<td>5.16 (t = 3.89, P = 0.001)</td>
</tr>
<tr>
<td>Our group found it useful for this project that we were able to access to the explanations of the challenges assessment from previous assignments</td>
<td>4.84 T = 2.77, P = 0.011</td>
</tr>
<tr>
<td>We developed our own way of sharing the given rationale space now</td>
<td>5.16 T = 3.96, P = 0.001</td>
</tr>
<tr>
<td>We developed our own way of allocating the rationale space to the group members now</td>
<td>4.96 T = 2.96, P = 0.007</td>
</tr>
<tr>
<td>We developed our own way of generating the group rationale now.</td>
<td>5.48 t = 5.58, P &lt; 0.001</td>
</tr>
<tr>
<td>We developed our own way on deciding who writes the group rationale during the challenges assessment</td>
<td>5.84 t = 9.75, P &lt; 0.001</td>
</tr>
<tr>
<td>Although we could access to the explanations of the challenges assessment, we did not find it necessary in producing mini-reports</td>
<td>4 T = 0, P = 1</td>
</tr>
<tr>
<td>We referred to the explanations of the challenges assessment from the previous assignments when we were working on present group activities</td>
<td>4.6 T = 2, P = 0.057</td>
</tr>
<tr>
<td>Statement</td>
<td>T</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>We did not develop our strategy on how to share the rationale space</td>
<td>3.52</td>
</tr>
<tr>
<td>In the challenges assessment assignments, I read my members' explanations to monitor their work progress</td>
<td>4.44</td>
</tr>
<tr>
<td>I would have been less aware of my group members' expertise with respect to this project if I did not know their explanations.</td>
<td>4.56</td>
</tr>
</tbody>
</table>

**Reliability of the Survey A Items**

The reliability of the survey A items (N = 25) were tested using Cronbach’s Alpha. A Cronbach’s Alpha value tells the internal consistency reliability of the test. Internal consistency is a measure based on the correlations between different items on the same test (or the same subscale on a larger test). It measures whether several items that propose to measure the same general construct produce similar scores. A common rule of thumb is that cronbach’s value should be .70 or above to ensure acceptabl reliability (Nunnally and Bernstein, 1994). Very high reliabilities (0.95 or higher) are not necessarily desirable, as this indicates that the items may be not just consistent, but redundant.

The calculation of the cronbach’s alpha value was done using Minitab statistical software version 15). All negatively worded items were reversed prior to calculating scale scores.

**Rationale awareness and contribution awareness**

In the survey A design, item 1-5 were for understanding the participants’ perceived effects of rationale awareness on their awareness of others’ contribution. Item 1 and 2 were about one’s awareness of others’ contribution and the cronbach’s alpha of
these items was 0.8397. Item 3 to 5 were about one’s perception of the effects of rationale awareness on his/her awareness of others’ contribution and the cronbach’s alpha of these items was 0.6305. The low alpha value indicates that the three survey items were actually not about a general construct. The cronbach’s alpha value for item 3 and 4 was 0.8444. The cronbach’s alpha value for item 3 and 5 was 0.4825, and for item 4 and 5 was 0.2007. These results show that item 3 and 4 were about a general construct, while item 5 was measuring something else. These items were:

3. Knowing my group members' explanations contributed to my awareness of their contribution in challenges assessment activities

4. Knowing my group members' explanations contributed to my awareness of their contribution in mini-report activities

5. If we had worked on the challenges assessment without sharing the explanations, I would have been less aware of my group members' contributions

Here is one interpretation of the result: it is possible that when the participant was scaling item 3 and 4, he/she was considering the contribution that was indicated through knowing others explanations. But when the participant was scaling item 5, he/she was reflecting on the whole project and considering either other kinds of contribution or a broader sense of contribution in the project (e.g., leadership contribution) than the contribution meant in the first two items. Because of the different concepts or types of “contribution” involved in these items, the item 5 was not correlated with item 3 and 4.

Rationale awareness and expertise awareness
Item 6-10 were for understanding the participants’ perceived effects of rationale awareness on their awareness of others’ expertise. Item 6 and 7 were about one’s awareness of others’ expertise and the cronbach’s alpha of these items was 0.7952. These values suggest acceptable reliability of these items, i.e., the items measured the same general construct. Item 8 to 10 were about one’s perception of the effects of rationale awareness on his/her awareness of others’ expertise and the cronbach’s alpha of these items was 0.4039. The low alpha value indicates that the three survey items were actually not about a general construct. The cronbach’s alpha value for item 8 and 9 was 0.7430. The cronbach’s alpha value for item 8 and 10 was 0.1622, and for item 9 and 10 was -0.1107. These results show that item 8 and 9 were about a general construct, while item 10 was measuring something else. These items were:

8. Knowing my group members' explanations contributed to my awareness of their expertise in challenges assessment activities

9. Knowing my group members' explanations contributed to my awareness of their expertise in mini-report activities

10. I would have been less aware of my group members' expertise with respect to this project if I did not know their explanations.

An interpretation for these results similar to that for item 3, 4, and 5 is that the concept or the type of “expertise” could one thing in item 8 and 9 and another in item 10, so the result of item 10 was not correlated with the results of item 8 and 9.

Reuse of the rationales
11-13 items were designed for examining whether the groups reused the rationales. The survey A is about the perceived effects of rationale awareness during the group activity. The cronbach’s alpha value for item 11, 12, and 13 was 0.3970, for item 11 and 13 was 0.7584, for item 11 and 12 was -0.16, and for item 12 and 13 was 0. The results indicate that item 11 and 13 measured the same general construct, while item 12 was measuring something different. These items were:

11. We referred to the explanations of the challenges assessment from the previous assignments when we were working on present group activities
12. Although we could access to the explanations of the challenges assessment, we did not find it necessary in producing mini-reports
13. Our group found it useful for this project that we were able to access to the explanations of the challenges assessment from previous assignments

One interpretation of the results was that because item 12 was worded negatively, the acquiescence bias (i.e., survey participants in general tend to agree with the statements as presented) affected how the participants scaled the item.

Practice of sharing the rationale space

Item 15 to 17 were designed for examining whether the group had developed the practice of sharing the rationale space. The cronbach’s alpha value of the items was 0.8018 indicating good reliability of the results and they measured one general construct.

Generation of the group rationales
Item 18 and 19 were designed for examining whether the group had developed the practice on generating the group rationale. The cronbach’s alpha value of the items was 0.7936 indicating good reliability of the results and they measured one general construct.

In summary, the cronbach’s alpha values of the survey A items showed acceptable reliability according to the design of the survey, except item 10 and 12. The values of the accepted items that were about one construct were then averaged and the average value was used for the construct and the results were in Table 6-5.

Table 6-5 The results of the constructs based on the results of the survey A items

<table>
<thead>
<tr>
<th>CA</th>
<th>RA on CA</th>
<th>EA</th>
<th>RA on EA</th>
<th>RR</th>
<th>RSP</th>
<th>GRP</th>
<th>Item 14</th>
</tr>
</thead>
<tbody>
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<td>5.5</td>
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<td>6.5</td>
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<td>6</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

CA: Awareness of the others’ contribution in the group activity – contribution awareness
RA on CA: Perceived usefulness of rationale awareness on one’s contribution awareness
EA: Awareness of the others’ expertise in the group activity – expertise awareness
RA on EA: Perceived usefulness of rationale awareness to one’s expertise awareness
RR: Perceived reuse of rationales
RSP: Perceived development of the group practice on sharing rationale space
A two-tailed one sample t test was performed on the constructed survey results in Table 6-5 to test the statistical significance of the survey items’ mean values. Table 6-6 shows the results. All the mean values were higher than 4, meaning that the participant’s responses about all the constructs were leaning towards agreement. All the mean values were statistically significant for 95% confidence interval except item 14. This means that although the response on item 14 was 4.44 leaning towards agreement, it was not statistically different from the neutral value – “neither agree nor disagree”. Therefore, one could not claim that the participants agreed that they read the rationale statements to monitor others’ work. This could be that the item value was not necessarily leaning towards either disagree or agree side. It could also suggest that the item was not properly designed. In fact, there could be several interpretations of the item. For example, one could disagree with item 14 because he/she did not read others’ rationales, or because he/she read others’ rationales for purposes other than monitoring others’ work.

Table 6-6 Two-tailed one sample t test of the constructs from the survey A items

<table>
<thead>
<tr>
<th>Constructs from the Survey A (N = 25)</th>
<th>Mean value Two tailed One-Sample t Test (Test Value = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contribution Awareness:</strong></td>
<td></td>
</tr>
<tr>
<td>• I was aware of each member's contribution in challenges assessment activities</td>
<td></td>
</tr>
<tr>
<td>• I was aware of each member's contribution in mini-report activities</td>
<td>6.04</td>
</tr>
<tr>
<td></td>
<td>t = 10, P &lt; 0.001</td>
</tr>
</tbody>
</table>
**Perceived Usefulness of Rationale Awareness to One’s Contribution Awareness**

- Knowing my group members' explanations contributed to my awareness of their contribution in challenges assessment activities
- Knowing my group members' explanations contributed to my awareness of their contribution in mini-report activities

<table>
<thead>
<tr>
<th></th>
<th><strong>t</strong> = 3.48, <strong>P</strong> = 0.002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>5.06</strong></td>
</tr>
</tbody>
</table>

**Expertise Awareness:**

- I was aware of my group members' expertise as we were working on challenges assessment activities
- I was aware of my group members' expertise as we were working on mini-report activities

<table>
<thead>
<tr>
<th></th>
<th><strong>t</strong> = 5.08, <strong>P</strong> &lt; 0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>5.2</strong></td>
</tr>
</tbody>
</table>

**Perceived Usefulness of Rationale Awareness to One’s Expertise Awareness**

- Knowing my group members' explanations contributed to my awareness of their expertise in challenges assessment activities
- Knowing my group members' explanations contributed to my awareness of their expertise in mini-report activities

<table>
<thead>
<tr>
<th></th>
<th><strong>t</strong> = 4.06, <strong>P</strong> &lt; 0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>5.04</strong></td>
</tr>
</tbody>
</table>

**Perceived Reuse of Rationales**

- Our group found it useful for this project that we were able to access to the explanations of the challenges assessment from previous assignments
- We referred to the explanations of the challenges assessment from the previous assignments when we were working on present group activities

<table>
<thead>
<tr>
<th></th>
<th><strong>t</strong> = 2.66, <strong>P</strong> = 0.014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>4.72</strong></td>
</tr>
</tbody>
</table>

**Perceived Development of the Group Practice on Sharing Rationale Space**

- We developed our own way of sharing the given rationale space now
- We developed our own way of allocating the rationale space to the group members now
- We did not develop our strategy on how to share the rationale space

<table>
<thead>
<tr>
<th></th>
<th><strong>t</strong> = 3.12, <strong>P</strong> = 0.005</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>4.867</strong></td>
</tr>
</tbody>
</table>
**Perceived Development of the Group Practice on Generating Group Rationales**

- We developed our own way of generating the group rationale now.
- We developed our own way on deciding who writes the group rationale during the challenges assessment

<table>
<thead>
<tr>
<th>Item 14</th>
<th>Description</th>
<th>Mean Value</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the challenges assessment assignments, I read my members' explanations to monitor their work progress</td>
<td>4.44</td>
<td>t = 1.14</td>
<td>P = 0.268</td>
<td></td>
</tr>
</tbody>
</table>

5.66 \[ t = 7.92, \ P < 0.001 \]

The results of the survey A show that overall the participants acknowledged the effects of rationale awareness on their awareness of group members’ contribution and expertise in the project activities, and the groups developed their way of managing the shared rationale space and generating the group rationales.

**Survey B**

An item of survey A and B is 7 level Likert scale ranges from 1 “strongly disagree”) to 7 “strongly agree”. The higher the item value, the participant’s attitude was more towards the “agree” side. With the scaling ranging from 1 to 7, 4 was considered a neutral value meaning “neither disagree nor agree”.

**The Participant’s Group Work Experience**

A two-tailed one sample t test was performed to test the statistical significance of the survey items’ mean values against the neutral value 4. Table 6-7 shows the test results for the perceived group work experience. All the mean values were statistically significant. The results show that participants perceived the shared identity (item 1). They
were satisfied and confident with the group performance, and had little conflict or disagreement with the group members.

**Table 6-7** Two-tailed one sample t test of the survey B items on the participant’s group work experience

<table>
<thead>
<tr>
<th>Survey Item (N = 30)</th>
<th>Mean value Two tailed One-Sample t Test (Test Value = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I see myself as a member of my group</td>
<td>t= 7.75, P &lt; 0.001</td>
</tr>
<tr>
<td>2. I felt satisfied about our group work in challenges assessment activities</td>
<td>t= 4.29, P &lt; 0.001</td>
</tr>
<tr>
<td>3. I felt satisfied about our group work in mini-report activities</td>
<td>t=4.21, P &lt; 0.001</td>
</tr>
<tr>
<td>4. My group members were competent in terms of generating a diverse set of explanations</td>
<td>t=5.18 , P &lt; 0.001</td>
</tr>
<tr>
<td>5. My group members were competent in terms of generating good quality of explanations</td>
<td>t=5.17 , P &lt; 0.001</td>
</tr>
<tr>
<td>6. My group members were quite competent in terms of generating good quality of mini-reports</td>
<td>t=5.92 , P &lt; 0.001</td>
</tr>
<tr>
<td>7. Much disagreement on performing the tasks existed in challenges assessment activities</td>
<td>t=-6.6 , P &lt; 0.001</td>
</tr>
<tr>
<td>8. Much disagreement on performing the tasks existed in mini-report activities</td>
<td>t=-10.57 , P &lt; 0.001</td>
</tr>
<tr>
<td>9. A great deal of disagreement regarding the tasks existed in challenges assessment activities</td>
<td>t=-9.51 , P &lt; 0.001</td>
</tr>
<tr>
<td>10. A great deal of disagreement regarding the tasks existed in mini-report activities</td>
<td>t=-8.52 , P &lt; 0.001</td>
</tr>
<tr>
<td>11. Little tension existed in my group</td>
<td>t=5.267 , P &lt; 0.001</td>
</tr>
<tr>
<td>12. When I needed help I counted on my group</td>
<td>t=6.8 , P &lt; 0.001</td>
</tr>
</tbody>
</table>

**The Participant’s Feedbacks on the Design of Shared Rationale Space**

**Table 6-8** shows the two-tailed one sample t test results for the participant’s feedbacks on the design of the shared rationale space in the workspace. All the mean values were statistically significant. The result shows that the participants were
comfortable with rationales being shared in real time, and they liked the feature that the rationale space is document-based and opened automatically. The participants preferred their rationales being editable only by themselves. They did not have the preference of having a centralized rationale space for all the group documents (item 5), nor did they prefer to have a rationale space for each challenge note (item 6).

Table 6-8 Two-tailed one sample t test of the survey B items on the participant’s feedbacks on the design of the shared rationale space in the workspace

<table>
<thead>
<tr>
<th>Survey Items (N = 30)</th>
<th>Mean value Two tailed One-Sample t Test (Test Value = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am comfortable with my explanations being shared with my group members as I was writing them</td>
<td>5.233 t = 5.656, P &lt; 0.001</td>
</tr>
<tr>
<td>2. I prefer that my group members give me comments on the explanations instead of changing my explanations</td>
<td>4.867 t = 4.419, P &lt; 0.001</td>
</tr>
<tr>
<td>3. I like the fact that when I open a document (e.g., a challenges map), the rationale space of the document is opened as well</td>
<td>4.8 t = 2.978, P = 0.006</td>
</tr>
<tr>
<td>4. I like the BRIDGE feature that each rationale space is associated with its document</td>
<td>5.1 t = 4.097, P &lt; 0.001</td>
</tr>
<tr>
<td>5. I prefer to have one rationale space for all the group documents</td>
<td>3.233 t = -2.447, P = 0.018</td>
</tr>
<tr>
<td>6. I prefer to have a rationale space for each challenge note</td>
<td>3.233 t = -2.507, P = 0.018</td>
</tr>
</tbody>
</table>

The Impact of Challenges Assessment Activities in the Participant's Learning Experience

Table 6-9 shows the two-tailed one sample t test results of the items on the participant’s learning experience of conducting the challenges assessment activities. The
Table 6-9 Two-tailed one sample t test of the survey B items on the participant’s learning experience of conducting the challenges assessment activities

<table>
<thead>
<tr>
<th>Survey Items (N = 30)</th>
<th>Mean</th>
<th>Two tailed One-Sample t Test (Test Value = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The process of generating my explanations helped me better articulate my thoughts</td>
<td>4.567</td>
<td>$t = 2.332, p = 0.027$</td>
</tr>
<tr>
<td>2. The process of generating my explanations helped me in understanding the project management subject</td>
<td>4.633</td>
<td>$t = 2.52, p = 0.018$</td>
</tr>
<tr>
<td>3. I found it helped me to explore the basic concepts of project management by generating the challenges during the challenges assessment</td>
<td>4.867</td>
<td>$t = 3.635, p = 0.001$</td>
</tr>
<tr>
<td>4. I found it helped me to explore the basic concepts of project management by generating my explanations of the challenges during the challenges assessment</td>
<td>4.767</td>
<td>$t = 3.096, p = 0.004$</td>
</tr>
<tr>
<td>5. I found it helped me to explore the basic concepts of project management by ranking the challenges during the challenges assessment</td>
<td>4.4</td>
<td>$t = 1.508, p = 0.142$</td>
</tr>
<tr>
<td>6. I found it helped me to explore the basic concepts of project management by generating my explanations of the ranking during the challenges assessment</td>
<td>4.5</td>
<td>$t = 1.851, p = 0.074$</td>
</tr>
<tr>
<td>7. I found it helped me to explore the basic concepts of project management by reading my group members' explanations</td>
<td>4.267</td>
<td>$t = 1.072, p = 0.293$</td>
</tr>
<tr>
<td>8. I found it helped me to explore the basic concepts of project management by writing mini-report</td>
<td>5.2</td>
<td>$t = 5.288, p &lt; 0.001$</td>
</tr>
<tr>
<td>9. I found it helped me to explore the basic concepts of project management by attending the class</td>
<td>4.933</td>
<td>$t = 2.676, p = 0.012$</td>
</tr>
<tr>
<td>10. I found it helped me to understand how to manage IT projects successfully by generating the challenges during the challenges assessment</td>
<td>4.233</td>
<td>$t = 0.793, p = 0.434$</td>
</tr>
<tr>
<td>11. I found it helped me to understand how to manage IT projects successfully by generating my explanations of the challenges during the challenges assessment</td>
<td>4.6</td>
<td>$t = 2.127, p = 0.042$</td>
</tr>
<tr>
<td>12. I found it helped me to understand how to manage IT projects successfully by ranking the challenges during the challenges assessment</td>
<td>4.367</td>
<td>$t = 1.302, p = 0.203$</td>
</tr>
<tr>
<td>13. I found it helped me to understand how to manage IT projects successfully by generating my explanations of the ranking during the challenges assessment</td>
<td>4.5</td>
<td>$t = 1.945, p = 0.062$</td>
</tr>
<tr>
<td>14. I found it helped me to understand how to manage IT projects successfully by reading my group members' explanations</td>
<td>4.133</td>
<td>$t = 0.465, p = 0.645$</td>
</tr>
<tr>
<td>15. I found it helped me to understand how to manage IT</td>
<td>5.1</td>
<td></td>
</tr>
</tbody>
</table>
projects successfully by writing mini-report $t = 4.235$, $p < 0.001$

16. I found it helped me to understand how to manage IT projects successfully by attending the class $t = 3.907$, $p = 0.001$

results show that the process of generating the rationales helped them externalize their thinking process (item 1) and understand the project management topics (item 2).

The impact on exploring the basic concepts of project management

The difference between item 3’s mean value and 4 was statistically significant, and so was item 4’s mean value. Both the survey results were leaning towards agreement side (mean values were close to 5). These indicate that statistically there were perceived benefits on exploring the basic concepts of project management by brainstorming the ideas (item 3) and documenting the rationales (item 4).

The difference between item 5’s mean value and 4 was not statistically significant, and so was item 6’s mean value. This means that statistically these two items’ responses were not different from “neither disagree nor agree”. This indicates that statistically there was no perceived benefit on exploring the basic concepts of project management by ranking the challenges (item 5) and generating the ranking rationales (item 6).

The results of item 3 – 6 suggest that for exploring the basic concepts of project management, a brainstorming activity for the ideas along with the requirement of documenting the rationales of the ideas would be more beneficial to the participants than an evaluation activity of the ideas along with the rationale documenting.

The impact on understanding how to manage IT projects successfully
The difference between item 11’s mean value and 4 was statistically significant, and so was item 13’s mean value. Both the results were leaning towards agreement side (mean values were close to 5). These indicate that statistically there were perceived benefits on understanding how to manage IT projects successfully by documenting the rationales of the brainstormed ideas (item 11) and by documenting the rationales of the choices (item 13).

The difference between item 10’s mean value and 4 was not statistically significant, and so was item 12’s mean value. This means that statistically these two items’ responses were not different from “neither disagree nor agree”. This indicates that statistically there was no perceived benefit on understanding how to manage IT projects successfully by generating the challenges (item 10) and ranking the challenges (item 12).

The results of item 10 - 13 suggest that for understanding how to manage IT projects successfully, the process of documenting the rationales for the brainstormed ideas and for the evaluation decision would be more beneficial to the participants than the brainstorming and evaluation activity.

**Summary**

In summary, the survey data suggest that rationale awareness contributes to one’s awareness of others contribution and expertise, and the groups developed the shared practice of managing the shared rationale space and generating the group rationales. Also, the participants had positive feedbacks on the current design of the shared rationale
space, and the challenges assessment activities had positive impact on the participants’ learning process in this class.

However, there were several potential biases on the results of the likert scales:

a). central tendency bias – participants may avoid using extreme response categories (e.g., “strongly disagree”);

b). acquiescence bias – participants may tend to agree with statements as presented; as shown in the discussion of the data analysis, this bias may affect the results of the negative items;

c). social desirability bias – participants may try to portray themselves or their organization in a more favorable light. Although the surveys were administered anonymously, the participants were asked to provide the group number in the surveys. Because of this, the participant may be concerned that the result would affect the group’s grade thus rated some items with the social desirability bias.

**Interview**

The data collection methods of a study should closely relate to the research questions of a study and reflect its theoretical orientation. In the two research questions of this study, the investigator is interested in how the rationale awareness affects the group activities. The investigator viewed the world as socially constructed through individual perceptions, and intends to use the interpretative lens to articulate the social dynamics of the activities through the subjective meanings that the participants experienced. There are a lot of uncertainties associated with interpreting the sense-making of the participants.
Thus survey method, which surrogate data into statistic indicators, can not provide a deep understanding of the process of the collaborative activities and how the rationale awareness played a role in the process.

Interview data help the investigator obtain a richer and contextual understanding on the group process and the effects of the rationale awareness in the process from the participants’ perspectives. Semi-structured interviews were conducted to understand the participants’ experiences of working with the group members in the project, using the collaborative software, and learning in this class.

**Design of Interview Questions**

The structured interview is based on the detailed preset interview guides and predetermined categories of interest, and focuses on the data consistency across informants (Trauth, 2004). The unstructured or semi-structured interview is based on the open-ended questions and emphasizes on the exploratory understanding of the experience and social world of the informants (Trauth, 2004). Therefore, for the purpose of this study, i.e., to explore the effects of rationale awareness and to understand the interviewee’s experience in the activities, semi-structured interview is appropriate method for data collection.

The investigator used a semi-structured interview guide to guide the discussion by asking specific questions (Rubin and Rubin, 1995). The questions were designed to elicit the members’ responses on how they perceive their collaboration experience, the effects of the rationale awareness, the design of the rationale space, and the experience of
documenting the rationales. Following the procedure recommended by Mason (2002), the investigator decomposed these three “big” questions into “small” questions. For example, to examine the interviewee’s group work experience, the following “small” questions may be asked: How do you think of your group, compared to other groups? Is there any critical incident or event happened? Did each member contribute to the project equally?

The investigator organized the interview questions by grouping the questions about a big question together.

The investigator consulted the dissertation advisor and co-advisor when designing the interview guide. The investigator practiced the interview procedure and conducted three interviews based on it. The interviewees were leaders of three groups in the class (Note: these groups were not chosen in data collection. It was the purpose not to interview the members of the selected groups in the testing stage of the interview questions). The investigator sent out request for interview to these interviewees on March 12th and interviewed them in March.

The initial interviews helped the investigator modified the interview guide.

Table 6-10 lists the interview questions.

**Table 6-10** Interview introduction script, questions, follow-ups, and probes

---

Thank you for your time. Your answers to all the interview questions are only accessible by me, my advisor Prof. Carroll and Prof. Rosson. They are not part of your course work and will not be used to evaluate your course performance.

It is really important that I try to understand what you are saying and that I don’t reword or change anything you say. So this means I will often ask you to tell me more about something you’ve said or to give me an example of what you mean.

We first talk about your group in general and your role of the leader

1. Have you been a group leader before? (if so) How many projects have you been a group leader for? (<3, 3-6, >6)
2. What do you think are the duties for a group leader?
3. Have you worked with anyone from the group before? Who are they?
4. Do you know if some of your group members have worked with each other before?
5. How do you think of your group, compared to other groups that you have worked with? Examples of the aspects include cooperation, communication, meetings, member involvement, and conflict management?
6. Is there any critical incident or event happened in your group that you want to talk about?
7. Did each member contribute to the project equally? (Follow up: How? Why not?)
8. Which one of your group members do you think contributed to the group project most in this project? Why?
9. Is there any conflict in the group? Working style conflict? Personality conflict? Etc. (follow up: How did the group manage the conflict? Do you think sharing the explanations to each other helped on managing the conflict that is related to the task?)
10. Are you willing to work with your group again?

**Now we talk about this group project**

11. Please summarize what you understood the group project in this course to be about
12. Please reflect on your approach to working on the document and writing down your explanations, e.g., did you complete your work on the document first and then write in the rationale space? Or did you interleave your work on the document and your explanation? Or did you work on the document exclusively and then come back at another time to write the explanations? Or else? Please be sure to include any thoughts you have as to why you approached the task in this way.
13. What did you like most about sharing the explanations with your group members in this project?
14. What did you like least about sharing the explanations with your group members in this project?
15. Which one of your group members do you think are most knowledgeable at technology, at project management? Why?
16. How did your group come up with the group decision on which are the top 3 and bottom 3 challenges? (Follow up: who wrote down the group explanations?)
17. How did your group decide on the mini-report content?
18. What would you say that when your group needs to come up with the group selection on the top 3 and bottom 3 challenges, your group usually reads each others’ explanations before making the group decision on the challenges ranking?
19. How much do you know about the content of other’s sections?
20. How much do you know about the reason that others included the content in their sections?
21. Based on your experience of this project, would you say if members share their reasons of why they constructed their sections in the way it is, it would help or would not help to combine the individual sections together?
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>22. Overall, are you satisfied with your group’s performance?</td>
<td></td>
</tr>
<tr>
<td>23. Overall, did you enjoy this group project?</td>
<td></td>
</tr>
</tbody>
</table>

**Now let’s talk about the collaborative tool:**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>24. What did you like most about the BRIDGE workspace?</td>
<td></td>
</tr>
<tr>
<td>25. What did you like least about the BRIDGE workspace?</td>
<td></td>
</tr>
<tr>
<td>26. Did you find out that this tool is difficult or easy to use?</td>
<td></td>
</tr>
<tr>
<td>27. Based on your experience of working with others in BRIDGE workspace, how would you comment on the feature of having a common place for members to share their rationale in virtual collaborative environment?</td>
<td></td>
</tr>
<tr>
<td>28. Based on your experience of working with others in BRIDGE workspace, how would you comment on the feature of having the shared rationale space associated with its document?</td>
<td></td>
</tr>
<tr>
<td>29. Based on your experience of working with others in BRIDGE workspace, how would you comment on the feature of others being able to edit your rationale?</td>
<td></td>
</tr>
<tr>
<td>30. Based on your experience of working with others in BRIDGE workspace, how would you comment on the feature of your rationale shared with others right after you write down the rationale?</td>
<td></td>
</tr>
<tr>
<td>31. Based on your experience of working with others in BRIDGE workspace, how would you comment on the feature of being able to review the rationales from previous group work?</td>
<td></td>
</tr>
<tr>
<td>32. Any suggestion on the tool?</td>
<td></td>
</tr>
</tbody>
</table>

**Data Collection**

Because the purpose of collecting the interview data was to help better understand the group process in conducting the activities in the semester, the interviewees were selected by first selecting the groups and then interviewing the group members, rather than selecting individuals from the class.

**Group Selection**

There were seven groups in the class formed in class during the third lecture period and organized into groups by the instructor using the co-location of participants in
rows as grouping criterion. It was felt that the participants were, for the most part, randomly distributed since there was no assigned seating and it was early in the semester.

Three out of seven groups were chosen for implementing the interview method. The three groups were selected based on the groups’ grade of the first mini-report and the groups’ participation status. Table 6-11 shows the groups’ grade of the first mini-report and their participation status. The maximum grade of a mini-report would be 85. Because Grape and Pear groups had participants who chose not to participate in the study, these two groups were not considered in selection process. Among the remaining groups, Apple had the highest grade and Peach had the lowest grade. Therefore, these two groups were selected. Out of the rest three groups, Orange and Kiwi had the closer number of participants to Apple and Peach. Kiwi’s group leader missed the first challenges assessment activity because of a personal reason. Thus, Orange was chosen as the third group for the study.

Table 6-11 the participant groups’ composition, participation status and first activity’s grade

<table>
<thead>
<tr>
<th>Group</th>
<th>Composition</th>
<th>Research Participation</th>
<th>Mini-report’s Grade (1st activity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>6 (all male)</td>
<td>All participate</td>
<td>79</td>
</tr>
<tr>
<td>Kiwi</td>
<td>5 (all male)</td>
<td>All participate</td>
<td>78</td>
</tr>
<tr>
<td>Pineapple</td>
<td>4 (all male)</td>
<td>All participate</td>
<td>78</td>
</tr>
<tr>
<td>Orange</td>
<td>6 (5 male, 1 female)</td>
<td>All participate</td>
<td>77</td>
</tr>
<tr>
<td>Peach</td>
<td>5 (all male)</td>
<td>All participate</td>
<td>76</td>
</tr>
<tr>
<td>Grape</td>
<td>6 (5 male, 1 female)</td>
<td>5 out of 6 participate</td>
<td>82</td>
</tr>
<tr>
<td>Pear</td>
<td>5 (all male)</td>
<td>2 out of 5 participate</td>
<td>78</td>
</tr>
</tbody>
</table>
**Interview Process**

All members of the three groups were interviewed with the total number of 17 interviewees: six members each from two groups and five members from the third group. All interviews were face to face in a meeting room of a building on campus. Because scheduling face-to-face interviews was challenging given the busy schedules of some participants, the investigator interviewed the members at various times corresponding to the project activities (**Table 6-12**).

As shown in the table, all the interviews were conducted after the third challenges assessment activity and mini-report activity, and all but two interviews were conducted after the fourth challenges assessment activity. It is expected that after working on three challenges assessment activities and mini-report activities, the participants group should have established their norms in collaboration and their practice on coordinating and managing the work. Thus, the interview data about group process should relatively reflect on the real group process and the group practice. Also, the effects of the computer-supported rationale awareness on the activities were expected to be noticed by the participants by that time.

**Table 6-12** the interview timeline of all three groups with respect to the project timeline

<table>
<thead>
<tr>
<th>Group</th>
<th>Members</th>
<th>Interview time</th>
<th>Project stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Chris</td>
<td>May 3rd</td>
<td>after the final presentation</td>
</tr>
<tr>
<td></td>
<td>JJ</td>
<td>April 11th</td>
<td>after the 4th challenges assessment activity</td>
</tr>
<tr>
<td></td>
<td>Andy</td>
<td>April 29th</td>
<td>before the final presentation</td>
</tr>
<tr>
<td></td>
<td>Jeff</td>
<td>April 13th</td>
<td>After the 4th mini-report activity</td>
</tr>
<tr>
<td></td>
<td>Eric</td>
<td>April 17th</td>
<td>during the 5th challenges assessment activity</td>
</tr>
<tr>
<td></td>
<td>Taylor</td>
<td>April 17th</td>
<td>during the 5th activity</td>
</tr>
</tbody>
</table>
The investigator conducted the interviews, which lasted from 20 to 90 minutes. 9 interviews were recorded by a digital recorder. All the recorded interviews were transcribed and used as the data source in analysis. In the cases where the interview was not recorded (because the digital recorder was a shared lab resource, there were times where the recorder was not available for the interview), the investigator took the interview notes and repeated the notes to the interviewee to ensure the notes were taken literally. In these cases, the notes were the used as the data source in analysis.

**Data Analysis and Results**

There are three ways to study the interview data (Trauth, 2004): *literal reading*, which focuses on the literal form of content and structure; *interpretive reading*, which aims at constructing a version (or develop a code schema) to represent the meaning of the data; and *reflexive reading*, which requires the researchers locate themselves as part of...
the data generated from their own perspectives. In this study, the epistemological lens is interpretative and the focus is to understand how the rationale awareness played a role in the group process. Therefore, interpretive reading was applied with the purpose of generating a code schema. Because there was no prior coding scheme available for the effects of rationale awareness in the group process, the impact of the designed group activity on the participant’s learning experience, and the participant’s experience of using the developed tool, an open-coding method was applied in analyzing the interview data.

ATLAS.ti software was used for coding the data. In coding the first document, the investigator created seventy-six codes. The investigator added two more codes in coding the second document. Before coding the third document, the investigator generated the coding scheme based on the existing codes. The coding scheme had four coding families and sixty-four codes. Some codes were merged. For example, originally there were three codes about the interviewee’s attitude on the software design – “attitude on software”, “dislike about the software”, and “like about the software”. In the generated coding scheme, these codes were merged into one code – “attitude about the software”. The investigator then coded the rest of the documents using the coding scheme. After coding all the documents, the code list was reviewed and the corresponding quotations were reexamined. The final coding scheme had 54 codes, and 712 quotations were coded.

Table 6-13 presents the coding scheme.

Table 6-13 the coding scheme of the interview data

<table>
<thead>
<tr>
<th>Coding family</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function of rationale awareness</td>
<td>This family refers to a list of codes about the perceived effects of rationale awareness</td>
<td>rationale awareness-awareness of minority opinions, rationale awareness - collaboration, rationale awareness - quality control</td>
</tr>
<tr>
<td><strong>Group work experience</strong></td>
<td>This family refers to a list of codes about the participant’s experience of working in the group</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| 26 codes, 435 quotations  | attitude to group's division of labor  
                                 awareness of others' contribution  
                                 awareness of others rationales  
                                 awareness of why others came up with their sections of the mini-report  
                                 collaboration experience with the group  
                                 critical incident  
                                 enjoyment with project  
                                 group coordination norm  
                                 group meeting style  
                                 group rationale generation  
                                 group work history  
                                 group's decision making on project content  
                                 group's way of working on the assignment  
                                 group's way of working on the mini-report  
                                 members' expectation on performance  
                                 members' work attitude  
                                 members' relationship  
                                 process of choosing challenges  
                                 project management person  
                                 Rationale space management  
                                 read others' mini report section  
                                 satisfaction on the group work  
                                 technology knowledge person  
                                 the establishment of group leader  
                                 the rationale of the group's division of labor  
                                 trust |

<table>
<thead>
<tr>
<th><strong>Software feedback</strong></th>
<th>This family refers to a list of codes about the participant’s feedback on the design of the rationale space based on his/her experience</th>
</tr>
</thead>
</table>
| 7 codes, 109 quotations | attitude on the design of document-based rationale space  
                                 attitude about software  
                                 learning curve of the software  
                                 real time rationale sharing  
                                 one's rationale editable by his/her group members  
                                 rationales organized in one shared space  
                                 suggestion on tool |

<table>
<thead>
<tr>
<th><strong>Individual Learning experience</strong></th>
<th>This family refers to a list of codes about the participant’s learning experience besides working with the group</th>
</tr>
</thead>
</table>
|                                   | appearance of rationale in the interviewee's narrative  
                                 understanding of the project  
                                 style of writing rationale statements  
                                 reflective thinking  
                                 domain knowledge before the project |
The Effects of Rationale Awareness in the Group Activities

There were 12 codes about the perceived effects of rationale awareness in the activity and 72 quotations. Table 6-14 presents the description of each code, the number of quotations a code has, and a sample quotation of the code. The interviewees perceived that rationale awareness could have the following functions in the group activity:

- helps one to be aware of others’ contribution and expertise in the task
- supports the collaborative effort in the activity such as integrate the ideas together

Table 6-14 A list of codes about the functions of rationale awareness in the group activities (for each code, the number of quotations and a sample quotation are included)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description (Number of Quotations)</th>
<th>Sample Quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>rationale awareness (RA)-</td>
<td>Rationale awareness (RA) helps one be aware of minority opinions (1)</td>
<td>“I looked at their explanations … to see if maybe their thinking is minority thinking… sometimes I think the group becomes very automated and they can miss something very important and original”.</td>
</tr>
<tr>
<td>awareness of minority</td>
<td></td>
<td></td>
</tr>
<tr>
<td>opinions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA - collaborative</td>
<td>RA supports the collaborative effort in the activity (e.g., combine the individual sections together) (11)</td>
<td>“If I was using my own intellect, coming up with best practice, that would be only my point of view, but if I went back and read the explanations, I would get the rest of five opinions”</td>
</tr>
<tr>
<td>RA - quality control</td>
<td>RA helps control the quality of the work (1)</td>
<td>“By requiring the explanations, you prevent people from making things up that aren't useful or irrelevant, cause they have to rationalize what they’ve said”</td>
</tr>
<tr>
<td>RA_contribution awareness</td>
<td>Perceived effects of RA on the awareness of others’ contribution (2)</td>
<td>“By reading the explanations, I can tell whether they actually spend time to think about explanations.”</td>
</tr>
<tr>
<td>RA_criticism on grammar</td>
<td>RA can make one’s grammar criticized (1)</td>
<td>“I guess the thing i was most afraid of is maybe i was picked up on an awkward grammar”</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>RA_decision making</td>
<td>Perceived effects of RA in decision making process (15)</td>
<td>“Knowing how they explain certain ideas, you can make much better decisions, than reading what they wrote without going to the specifics”</td>
</tr>
<tr>
<td>RA_expand idea</td>
<td>RA helps one expand ideas based on others (3)</td>
<td>“It helps if you struggle with an idea, you can not necessarily copy the idea, but go with a different aspect of it. so help to expand upon any ideas you have.”</td>
</tr>
<tr>
<td>RA_grounding</td>
<td>RA helps one understand others, contributing to the grounding process (16)</td>
<td>“I think by explaining things it helps cut down miscommunications and things like that.”</td>
</tr>
<tr>
<td>RA_group think</td>
<td>RA may make one difficult to think of other ideas, potentially leading to groupthink (2)</td>
<td>“If I read other ones before i put the six challenges down. I'll be blank”</td>
</tr>
<tr>
<td>RA_reduce process cost</td>
<td>RA reduces the process cost by saving time of explaining the same thing to different group members (2)</td>
<td>“It helps whenever I am not clear, I just go there and read that instead of asking them, so they don't have five people asking them”</td>
</tr>
<tr>
<td>RA_expertise awareness</td>
<td>Perceived effects of RA on the awareness of others’ expertise (9)</td>
<td>“Justin wrote “communication” as the challenge for several times. It is easy to distinguish Andy’s explanations from Tom’s or Jack’s because theirs are more in depth, and better thought out, and elaborated.”</td>
</tr>
<tr>
<td>RA_monitor members' work</td>
<td>RA helps one to monitor others’ work (quality of the work, status of the work) (6)</td>
<td>“I actually go and read everyone's explanations or rationale to make sure that they are doing the right thing”</td>
</tr>
</tbody>
</table>

- helps the members to better understand each other. An interviewee conceived the benefits of sharing the rationales in real virtual team setting to be “cut down miscommunications”

- helps control the quality of the work. One interviewee said, “By requiring the explanations, you prevent people from making things up that aren't useful or irrelevant, cause they have to rationalize what they've said”
• affects the decision-making process. For example, an interviewee said, “
Knowing how they explain certain ideas, you can make much better
decision, than reading what they wrote without going to the specifics”
• reduces the process cost by making the explanation available to the group
thus saving time on explaining the same thing to different group members
at different times
• helps monitor other members’ work. One interviewee said always read his
group members’ rationales to monitor the quality of others work and to
make sure they were in the right direction – “I actually go and read
everyone's explanations or rationale to make sure that they are doing the right
thing”

Some potential downsides of awareness rationales were noticed from the study.
The members may run into groupthink situation if they know about others’ ideas and
rationales too soon in the brainstorming process. For example, an interviewee said he
could not read others’ rationales before generating his own challenges during the
categorization task – “I will have the problem if I read other ones before i put the six
challenges down. I'll be blank...if I read them, i just freeze up, just can't write anything”.
Another potential downside is the rhetorical bias. None of them talked about using
textbook or other official resources to evaluate and rank the challenges. Instead, they
mentioned that reading others rationales may affect their decisions. One said, “usually we
will use the rationale mainly to explain, to hierarchy like based on your rationale, you
may make a good point that this is actually more challenging than that one”. Therefore,
one who is good at arguing and writing may get his/her challenge selected not because of
the challenge itself but because the rationale statement is convincing, hence, the rhetorical bias in the decision-making process.

The Participant’s Experience Regarding the Design of the Rationale Space

Research suggests that when tools are hard to navigate and "frustrating" to the user, they have a neutral or negative impact on the learning process (Storey et al., 2002). Therefore, the satisfaction of the tool’s user interface may impact the group activity which confounds with the effect of the awareness design. As a result, the participants’ experience regarding the workspace design was collected.

The survey data show that the participants’ feedback was positive in general (Table 6-8). The participants were comfortable with real time awareness of rationales, and positive on the design of associating the rationale space with its document. Also,

The interview data support the survey results. For example, the survey data show that participants preferred their rationales being editable only by themselves. During the interview, some students showed their strong opinion about this. Jordan (peach group member) said, “I don’t see why someone wants to change the rationale. It's my rationale. I would not want someone to change. If someone asks me to clarify it or something, I would change it, I wouldn't want everyone else to mess with it.”

The rationale statements from the previous activities were always available in the group workspace. The participants mentioned that they have reused them in later activities. Some used them for writing the challenges section of the mini-report, some used them to make sure that they were not giving the same rationale again, and some
used them to help them get started on brainstorming the new challenges. For example, Thomas (apple group member) said once when he was writing the overview section for the mini-report he used a previous rationale, “My explanations helped me to incorporate into the overview section. (Give an example?) ‘Execution is a long phase, longevity.’ I took the attributes of the explanations to the overview”. He also used the rationale statements from the previous activities to help him think of the possible challenges – “Initially when I had the trouble of coming up challenges, I looked at previous phases to guide me get started”. Bob (apple group member) checked the previous rationales to “avoid repeating myself and make sure it's still valid”.

Unfortunately, there were no other data sources to validate or invalidate these interview data. However, the students’ feedbacks on this issue at least suggest that making previous rationale statements available to the group members has the potential of helping the members in later activities.

The Participant’s Learning Experience in the Activities

The Impact of Documenting Rationales

As one intervention to the learning activities in the class, the process of documenting rationales during group activities is expected to have effects on students’ learning experience and learning outcome. As discussed earlier, the survey data show that the participants perceived learning benefits by generating and documenting the rationales (Table 6-9).
The interview data support the survey results and show that the process of documenting the rationales helped the participants reflect on their previous thought and revise their previous decisions. For example, one interviewee explained why he changed his challenge after writing down its rationale, “as you are writing the explanations, you are seeing that your explanation is in a different direction from the challenge note, and since the explanation is in a better direction, so change the challenge”. Although there isn’t enough evidence to show that the process of documenting the rationales during the activities helps a student to develop the habit and skill of reflection, one interviewee’s comment indicates that it has the potential of contributing to this development – “I would say the first three phases I pretty much came up the challenges all six of them, and then I did the explanations all six of them. Not necessarily I did in one session. For the last phase, I found myself writing a challenge and then its explanation. I prefer that way, because as I came up with the challenges, I am already thinking about why it is a challenge. Since it is already on my mind, I figure I might just as well write it down”.

Writing the rationales was a difficult task and some participants felt it unnecessary as well. The apple group leader Justin was against the method of writing the rationale and did not see the benefit of doing it. He said, “I am not the type of person to explain every thought I have. I wrote the paper. Here is the paper. I don't want to write why I wrote the paper. I wrote the paper because I had to write the paper. I hate it but I need a grade”.

The interview data also show that some members may feel uncomfortable with the requirement of choosing the bottom challenges. One interviewee said, “I don’t think anyone is loosing any sleep over, but it's like oh man why that is a bottom challenge, that
is a good one, but everyone else thinks it's a bottom challenge. So that's the only thing I don't like about it. It's just that little negative aspect”.

The Participant’s Group Work Experience

There were 25 codes and 435 quotations in the coding family of “group work experience”. The purpose of having this coding family is to enable the investigator to elicit information about the interviewee’s group work experience from the interview thus helping depict the group process. Therefore, if make this elicitation process analogous to a search process, the focus was not on the precision of the results but the relevance. Three groups all had different ways of working together such as the different styles and attitudes about the group meetings and different strategies of distributing the assignments among the group members. The results will be discussed in details in the next chapter.

Summary

In summary, the interview data support the survey findings. The interview results show that the interviewees perceived positive effects of rationale awareness in the group activities and acknowledged the benefits of documenting the rationales in their learning process. The interviewees’ feedback on the design of the shared rationale space was also consistent with the survey results.

The reliability of the interview data to great extend depends on the subjectivity and bias of the interviewee’s responses. There are problems with memory recall and
distortion. Also the interviewees may have some personal agenda that could cause them deliberately to cover or deceive on certain issues.

Artifacts

Artifacts were collected as the supplemental data of the interview and survey data source. Artifacts were used for several purposes: a). to provide additional research evidence in the study. For example, the screenshots of the groups’ shared rationale spaces were collected for the investigation of the group’s practice on managing the rationale space. b). to provide additional information about the research context. A photo about the classroom shows the physical environment that the class met. This tells much information such as whether the place allowed computer use, supported face-to-face interactions, and enhanced collaborative activities, etc. c).to address the authenticity issue of the study. Authenticity is concerned with the relation between the researcher and the research study, e.g., whether the researcher did carry out the research or not. The collected artifacts during the study could be served as evidence to ensure authenticity;

The collected artifacts include photos taken during the group meeting, photo of the classroom, the group’s emails, and the group’s shared artifacts in the workspace. The shared artifacts in the workspace include the shared whiteboards containing the challenges, the shared data spreadsheets that have the participants’ decisions on challenges, the group chat, shared rationale space, and the shared rationale documents.
Rationale Statements

The three groups’ rationale statements were collected and graded by two external evaluators. There were two purposes of evaluating the rationale statements: first, the evaluation results served as another data source for the investigation of the first two propositions:

Research Proposition 1: Knowing group members’ rationale contributes to one’s awareness of their expertise

Research Proposition 2: Knowing group members’ rationale contributes to one’s awareness of their contribution

If the propositions hold correct, then a rationale statement should provide information about one’s expertise and contribution. Therefore, by evaluating the rationale statements to examine whether they indeed provide such information, we would know whether the rationale statements had the potential of contributing to the awareness of expertise and contribution.

Second, the evaluation results served as a way of triangulating the interview and survey results. Both interviews and surveys relied on "self-reported” data which posed biases on the results. Additionally, in this study the interview data were only analyzed by the investigator and the coding reliability was not assessed. This poses additional bias on the interview data. Therefore, by having the rationale statements graded by external evaluators, the believability of the interview and survey would be stronger if the results were consistent.
Evaluator recruitment

The evaluators were recruited from the same class in the subsequent semester, i.e., fall 2007, to evaluate the three groups’ rationale statements. The rationale is that the evaluators should have knowledge on the subject, that is, the challenges of managing a project that is consisted of distributed team members, and participants who have taken the course were considered to have the required knowledge for evaluation purpose.

The investigator first sent an email to six students who scored high in the final grade of the class to ask for their willingness to evaluate the rationale statements. The students were told that they would be paid for $250 for doing the evaluation. All students replied. Four students were willing to do the evaluation. Two students were recruited as the evaluators. The recruitment was based on the investigator’s experience of working with them. The recruitment criteria were the quality of the rationale statements the student wrote; and the investigator’s trust on the student’s responsibility of working on the evaluation seriously.

The evaluators did not know who else was recruited so as to ensure that the evaluators would work on the task independent of each other.

Evaluation Criteria

The criteria were developed for the purpose of evaluating whether the rationale statements indeed provide information to support awareness of the members’ contribution and awareness of the members’ expertise. Therefore, the criteria were about the characteristics of a student’s rationale statement that would indicate his/her contribution
and expertise in the activities. In this study, the related contribution is the intellectual contribution to the task of brainstorming the challenges and ranking the challenges. And the related expertise is the knowledge on managing a distributed team project. Because this study was interested in these contribution and expertise that are context dependent, the investigator did not refer to the kinds of knowledge or the types of contribution discussed in the literature (e.g., procedural knowledge). Instead, the investigator developed the criteria based on the logical understanding about what the characteristics of a rationale statement should be for supporting the awareness of contribution and expertise in this study context. There were three criteria:

a). Relevance to the phase

This criterion probes the effect of knowing group members’ rationales on one’s awareness of their contribution in the activity by examining whether the rationale explains a challenge that is relevant to this particular project phase. As in a challenges assessment activity, the participants were required to generate challenges that were specific for a particular project phase, if that a participant’s challenge was not related to the phase, even if the rationale statement was well written, it was not graded well. Thus, the participant’s challenge and rationale statement were not considered to be contributing to that activity. The score of a rationale statement for this criterion ranges from 0 (useless, totally irrelevant) to 5 (very good challenging issue for the project phase)

b). Effort of the participant:

This criterion also probes the effect of rationale awareness on one’s awareness of their contribution in the activity by examining how much effort the participant has put in explaining his/her decision on choosing the challenges. The score of a rationale statement
for this criterion ranges from 0 (the participant did not seem to pick the challenges with serious thoughts) to 5 (the participant really thought about and explained well why the challenges were picked).

c). Knowledge of the participant

This criterion probes the effect of knowing group members’ rationales on one’s awareness of their expertise in the activity by examining whether the rationale shows the participant’s knowledge in this project and what kind of knowledge. The score of a rationale statement for this criterion ranges from 0 (the rationale does not show how much the participant knows about the project related knowledge at all) to 5 (the rationale statement shows that the participant is very knowledgeable). And the evaluators describe the kind of knowledge shown from the rationale statement.

**Evaluation Process**

Before the evaluation process started, the investigator met the two evaluators to discuss about the criteria and make sure that the evaluators understood what each criterion was meant. The meetings were separate such that the investigator met the evaluators at two different times. This was done purposefully so as to ensure that the evaluators would work on the task independent of each other.

After the meeting, the evaluators had four weeks to grade the rationale statements using the criteria developed by the investigator. When grading the rationale statements based on the criterion of “knowledge of the student”, the evaluators were asked to describe the kinds of knowledge on project management shown in the rationale.
statements. This was to ensure that the evaluators indeed graded the statements based on the knowledge for project management, not for other domains.

After the evaluation was done, each evaluator had a meeting with the investigator to discuss about the evaluation results and to give the investigator the grades. The evaluators did not meet to share their evaluation results.

**Analysis of Evaluation Results**

With the grades of the rationale statements from two evaluators, the investigator first conducted inter-coder reliability analysis. Inter-coder reliability refers to the extent to which two or more coders agree on the coding of content variables. As discussed above, the evaluation process was to code the content variable by giving numerical score to the rationale statements based on each criterion. Therefore, the inter-coder reliability needs to be checked first on the two grades before averaging them for further analysis.

**Inter-coder reliability analysis**

**Select a statistical method**

There are several ways of measuring the agreement to determine inter-coder reliability. Some of the common ways include

- Coefficient of reliability (Holsti, 1969, p. 140)
- Scott’s pi (Holsti, 1969, p. 140)
- Cohen’s kappa (Krippendorff, 1980, p. 138)
Coefficient of reliability was commonly used in analyzing the inter-coder reliability and was reported as the percentage of agreement between the coders. However, it does not take into account the fact that the coders would probably agree part of the time simply due to chance. Scott’s pi corrects the coefficient of reliability for agreement due to chance, but it was mainly used for nominal data. While Cohen’s kappa appears to be commonly used in research that involves the coding of behavior (Bakeman, 2000), others (notably Krippendorff, 1987) have argued that its characteristics make it inappropriate as a measure of inter-coder agreement.

In this study, the values of the rationale statements in this study were ordinal not nominal, and the analysis was to examine the inter-coder agreement. Also, because the codes in this study were in fact numerical scales indicating the levels of the variables, the evaluators were less likely to agree on the code only because it was due to chance. Therefore, the coefficient of reliability was used to report the inter-coder reliability.

**Process of Calculating Coefficient of Reliability**

Because there was no computer software available for computing the Scott’s pi, the analysis was done by hand. The coders’ codes on the criterion of “knowledge of the participant” were used in the inter-coder reliability analysis. First, the codes from two coders were arrayed into a contingency table. **Table 6-15** shows the table that was used for the creation of the contingency table. In this table, both the coder 1 and coder 2’s codes were in columns. In this view, the “appearance count” refers to the number of times when the coder 1 coded a statement with the code shown in the first column, and coder 2 coded the same statement with the code shown in the second column. For
example, the first row of the table means that there was no situation where both coder 1 and coder 2 coded a statement by 1. the “Apple” “Peach” “Orange” refers to the appearance count for the three groups’ rationale statements. The “sum of the counts” column shows the total counts adding the three group’s counts together.

Table 6-15 The two coders’ coding results for the contingency table

<table>
<thead>
<tr>
<th>Coder 1's codes</th>
<th>Coder 2's codes</th>
<th>appearance count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Apple</td>
<td>Peach</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
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<td>2</td>
<td>7</td>
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<tr>
<td>3</td>
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<td>4</td>
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<tr>
<td>3</td>
<td>5</td>
<td>0</td>
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<tr>
<td>4</td>
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<td>0</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
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<td>4</td>
<td>10</td>
</tr>
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<td>0</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
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<td>5</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

|               | 135   | 129   | 139   | 403 |

The contingency table was then constructed based on the above table. The contingency table is presented in Table 6-16. The coefficient of the reliability (CR) was calculated using the formula:
\[ CR = \frac{2 \times M}{N_1 + N_2} \]

where \( M \) = the number of times the two coders agree (represented in the contingency table by the cells along the diagonal) and \( N_1 \) and \( N_2 \) are the number of coding decisions each coder made.

**Table 6-16** Contingency table for the two coders’ coding results

<table>
<thead>
<tr>
<th>Coder 1’s codes</th>
<th>Coder 2’s codes</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
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<td>6</td>
<td>50</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>0</td>
<td>20</td>
<td>110</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>0</td>
<td>13</td>
<td>49</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>0</td>
<td>8</td>
<td>64</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td>0</td>
<td>47</td>
<td>282</td>
<td>74</td>
</tr>
</tbody>
</table>

According to the **Table 6-16**, the coefficient of the reliability is

\[ CR = \frac{2 \times 131}{403 + 403} = 0.33 \]

This means that the coders only agreed on one third of their codes. One factor of this result was the fact that there were five values for a variable in the evaluation. Coders are more likely to agree when there are only three choices than when there are five. On the other hand, as the values of the rationale statements were intended to provide qualitative instead of quantitative understanding about the information that a rationale statement provides, the disagreement between value 2 and 3 would make much less impact on the research study than if the study was intended to obtain an accurate numerical value for the criterion. For example, although both coders may agree that a rationale statement showed some knowledge of the participant but not much, one coder may code it as 3 while the other coder may code it as 2. In this study, the difference between 2 and 3 in this case was not that influential. Taking these factors into
consideration, the number of times that the two coders agreed was recalculated by including the following counts as well:

1. The number of times that one coder coded 3 and the other coded 2
2. The number of times that one coder coded 4 and the other coded 3

The reason of including these counts but not others is that: conceptually, the coders tend to have closer judgments on the end values than the middle values as they represent the extreme situations (i.e., the worst versus the best one); and for the middle values 2, 3, and 4, it is harder for them to give the same codes even if they meant the same judgments for a rationale statement. After considering these counts, the coefficient of reliability was calculated again and the value was

\[
CR = \frac{2 \times (131 + 20 + 50 + 49 + 24)}{403 + 403} = 0.68
\]

A Temple University website on intercoder reliability and content analysis explains (http://www.temple.edu/sct/mmc/reliability/): "Coefficients of .90 or greater are nearly always acceptable, .80 or greater is acceptable in most situations, and .70 may be appropriate in some exploratory studies for some indices". As this is an exploratory study with the focus on qualitative understanding of the rationale statements’ characteristics instead of quantifying the characteristics accurately, 0.68 was considered acceptable in the analysis.

Evaluation of Rationale Statements
After the inter-coder reliability test completed, the investigator calculated a participant’s overall score of his/her rationale statements on a criterion in a project activity as follows:

\( S_{r,i} \): The score of a participant’s rationale statement \( i \). \( S_{r,i} \) is obtained by averaging the two scores given by the evaluators

\( N_r \): Total number of a participant’s rationale statements

\( S_m \): The participant’s overall score of his/her rationale statements on a criterion

\[
S_m = \frac{\sum_{1}^{N_r} S_{r,i}}{N_r}
\]

Table 6-17 presents the three group members’ rationale grade on its knowledge. This grade was calculated using the above formula for the criterion of “knowledge of the

<table>
<thead>
<tr>
<th>Group</th>
<th>Group Member</th>
<th>Rationale Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Bill</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Thomas</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Justin</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Tom</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>Bob</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Jack</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>Jay</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Jeffrey</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Jimmy</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Stephen</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Jonah</td>
<td>7.4</td>
</tr>
<tr>
<td></td>
<td>Laura</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>Kim</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>Martin</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>George</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Jordan</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Rex</td>
<td>6.8</td>
</tr>
<tr>
<td>Orange</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peach</td>
<td></td>
<td></td>
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</tbody>
</table>
participant”. Recall that the evaluators were asked to describe the kinds of knowledge when grading the statements. The knowledge identified by the evaluators were communication, time management, quality management, cost management, change management, risk management, technology (for project management), and organization. This indicates that the evaluators graded the statement based on the participant’s knowledge on project management rather than other knowledge about other subjects.

Table 6-18 presents the three group members’ rationale grade on its contribution. This grade was calculated as follows: first, a participant’s grades for the criterion of “relevance to the project phase” and “the student’s effort on explaining the individual choices” were calculated using the above formula; then, because both criteria were designed to be about whether the statement provides information about the participant’s

<table>
<thead>
<tr>
<th>Group</th>
<th>Group Member</th>
<th>Rationale Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Bill</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>Justin</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>Tom</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>Thomas</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Bob</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>Jack</td>
<td>8.1</td>
</tr>
<tr>
<td>Orange</td>
<td>Jay</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Jimmy</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Jeffrey</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Jonah</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>Stephen</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>Laura</td>
<td>8.1</td>
</tr>
<tr>
<td>Peach</td>
<td>Kim</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>Martin</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>George</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Jordan</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>Rex</td>
<td>7.6</td>
</tr>
</tbody>
</table>
contribution, the grades of both criteria were summed. Therefore, the combined grade had the maximum value of 10 and minimum value of 0.

**Other Artifacts – Photos, Emails, Other Shared Artifacts in the Workspace**

There was no pre-defined script for analyzing the other artifacts. Instead, an artifact was searched and retrieved from the collection of the artifacts when it would be support the investigator’s argument based on her experience of being in the class and observing the groups. For example, the photo ([Figure 6-3](#)) below clearly conveys the message that the investigator wanted to make: the classroom supports computer access; it was difficult to rearrange the seating as the rows were narrow; the face-to-face interactions were affected by the design of the classroom.

![A photo of the project management classroom](image)

**Figure 6-3** A photo of the project management classroom
Observation Notes

The investigator attended each class lecture throughout the semester and took observation notes about the three groups including the members’ class attendance, their relative sitting position, and the members’ interaction in the class. The investigator also attended the group meetings and took the observation notes during the meetings. The notes were not coded but used when the investigator found useful in describing the group process.

Summary

In summary, this study followed a triangulation research method and used several approaches to collect, analyze and compare the data. Various kinds of data were collected in the study, including survey, the artifacts, the class observation notes, semi-structured interviews, and the grades of the participant groups’ activities.

In this study, the epistemological lens is interpretative and the focus is to understand how the rationale awareness played a role in the group process. The investigator viewed the world as socially constructed through individual perceptions, and intends to use the interpretative lens to articulate the social dynamics of the activities through the subjective meanings that the participants experienced. Therefore, the study took interview as the main thread, and incorporated analysis of survey data, rationale statements, observation notes and artifacts as triangulation to draw on strengths of individual methods to examine the phenomena. Next chapter discusses in detail the
investigation of the research propositions using interview data as the major data source, combined with other data sources whenever appropriate and available.

In a field study, the investigator was also an instrument. In this study, the investigator took the emic perspective on research and positioned herself inside the “research field”. Although it was the investigator alone who conducted interviews and observations, and coded and analyzed the interview data, the investigator worked collaboratively with her research advisors and committee members during the project, exposing the data collection and data analysis processes. The interactive involvement between the committee members and the investigator helped improve the reliability of data analysis and identify underlying issues.

Results on the Class and Group Context

Many variables may affect a group activity: the standing group structure defined in terms of compositions of members, interpersonal relations structures, power structures, division of labor on tasks, and the communication structures; the group interaction process including the level and rate of interaction, distribution of participation, extent of member involvement, the flow of work, the flow of information or communications, the flow of influence, and the flow of personal affect; and the environment of the group process, etc (McGrath, 1984). Together, these variables depict the context of a group activity.

Table 6-19 shows the class response and the responses of the three group members on the survey B items about group work experience. For a survey item, the
group’s response was the average value of the group members’ responses of the item. Because there were only five or six members in a group, it would be inappropriate to perform statistical test to examine the significance of the average value with such small N. On the other hand, because the purpose of using these survey data was to do a coarse comparison of the members’ experiences among the three groups, the values without the statistical justification were acceptable for this purpose. Because the biggest difference between two responses would be 6 (i.e., one was 1 and the other was 7), 10% of the difference range, 0.6, was used as the cutoff value for the difference between the response values. The decision of using 10% instead of other percentage was made by the investigator based on her logical understanding that 10% difference should be noticeable difference in this context. Recall that the response of a survey B item was about the level of a participant’s agreement on the item. The higher the value, the participant’s response was closer to the “strongly agree”, and the lower the value, the participant’s response was closer to the “strongly disagree”.

The survey data show that all the three groups were indeed formed, as the members acknowledged the group identity (item 1). However, the orange and peach group’s higher response values on shared group identity seemed to indicate that the groups were more cohesive than apple. Compared to apple group, the orange and peach group had higher value responses for item 2 – 6. The higher values of the groups’

Table 6-19 Survey results on group work experience for Apple, Orange, and Peach group

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Average response</th>
<th>Class Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>item value ranging from 1 “strongly disagree” to “strongly agree”</td>
<td>Apple (N = 6)</td>
<td>Orange (N = 5)</td>
</tr>
<tr>
<td></td>
<td>(N = 30)</td>
<td>Two tailed one</td>
</tr>
</tbody>
</table>
responses seemed to indicate that the orange and peach group members were more satisfied with and confident about their group performance and the quality of their rationale statements than apple group members. For item 3, peach group had higher response value than orange group indicating that peach group members seemed to be more satisfied with their mini-report activities than orange group.

<table>
<thead>
<tr>
<th></th>
<th>I see myself as a member of my group</th>
<th>5.5</th>
<th>6.8</th>
<th>6.8</th>
<th>t=7.75, P &lt; 0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>I felt satisfied about our group work in challenges assessment activities</td>
<td>4.3</td>
<td>6.0</td>
<td>5.8</td>
<td>5.067</td>
</tr>
<tr>
<td>3</td>
<td>I felt satisfied about our group work in mini-report activities</td>
<td>4.7</td>
<td>5.3</td>
<td>6.4</td>
<td>5.067</td>
</tr>
<tr>
<td>4</td>
<td>My group members were competent in terms of generating a diverse set of explanations</td>
<td>4.5</td>
<td>6.2</td>
<td>6.0</td>
<td>5.233</td>
</tr>
<tr>
<td>5</td>
<td>My group members were competent in terms of generating good quality of explanations</td>
<td>4.7</td>
<td>5.7</td>
<td>6.2</td>
<td>5.2</td>
</tr>
<tr>
<td>6</td>
<td>My group members were quite competent in terms of generating good quality of mini-reports</td>
<td>5.0</td>
<td>6.3</td>
<td>6.6</td>
<td>5.467</td>
</tr>
<tr>
<td>7</td>
<td>Much disagreement on performing the tasks existed in challenges assessment activities</td>
<td>2.3</td>
<td>2.0</td>
<td>2.6</td>
<td>2.4</td>
</tr>
<tr>
<td>8</td>
<td>Much disagreement on performing the tasks existed in mini-report activities</td>
<td>2.3</td>
<td>1.8</td>
<td>1.8</td>
<td>2.167</td>
</tr>
<tr>
<td>9</td>
<td>A great deal of disagreement regarding the tasks existed in challenges assessment activities</td>
<td>2.2</td>
<td>1.7</td>
<td>2.2</td>
<td>2.1</td>
</tr>
<tr>
<td>10</td>
<td>A great deal of disagreement regarding the tasks existed in mini-report activities</td>
<td>2.8</td>
<td>1.7</td>
<td>2.2</td>
<td>2.233</td>
</tr>
<tr>
<td>11</td>
<td>Little tension existed in my group</td>
<td>4.3</td>
<td>5.5</td>
<td>6.2</td>
<td>5.267</td>
</tr>
<tr>
<td>12</td>
<td>When I needed help I counted on my group</td>
<td>4.7</td>
<td>6.7</td>
<td>6.6</td>
<td>5.7</td>
</tr>
</tbody>
</table>

responses seemed to indicate that the orange and peach group members were more satisfied with and confident about their group performance and the quality of their rationale statements than apple group members. For item 3, peach group had higher response value than orange group indicating that peach group members seemed to be more satisfied with their mini-report activities than orange group.
The three groups’ responses on item 7 – 10 seemed to indicate that all the three groups had little disagreement during the project regarding the tasks. All the groups agreed that there was little tension among the group members (item 11). However, orange and peach groups had noticeably higher response value than apple group. This result indicates that the members of orange and peach groups seemed to have perceived a better group relationship than apple group members. The highest value of peach group’s response on item 11 indicates that the peach group members seemed to have perceived the best group relationships.

All the groups agreed that one could count on his/her group members in need of help (item 12). However, orange and peach groups had noticeably higher response value than apple group. This result indicates that the members of orange and peach groups seemed to have perceived a better trust than apple group members.

The data help provide a general understanding of these groups but these understandings were limited and the results were not validated. To obtain a richer understanding of the groups’ context and to triangulate the survey results, the interview data were used in the detailed discussion of these groups.

The interview data provide some information of the groups’ context. A coding family of “group work experience” was created in the coding scheme of interview data. The quotations under this family were used for understanding and discussing the aspects of the group context. The investigator used the following categories in the discussion:

- composition of members
- interpersonal relations structure
- the level and rate of interaction
• group meetings, and
• group work process

The first three categories were based on McGrath’s (1984) discussion on the variables of the group context. The fourth category relates to his variables of communication structure. The discussion under the fifth category includes information about the variables like distribution of participation, extent of member involvement, the flow of work, the flow of information or communications, the flow of influence, and the flow of personal affect; and the environment of the group process. To make it easier to describe the group work process, and compare the three groups, the discussion under the fifth category centered on the kinds of activities (e.g., challenges assessment activities, mini-report activities) the groups conducted, as all the three groups conducted the same activities. Table 6-20 shows the codes for the coding family of “group work experience”. The codes were grouped under the above categories so as to show the set of codes that was used for providing the data in the discussion of each category.

Table 6-20 A list of the codes for the coding family – “group work experience”

<table>
<thead>
<tr>
<th>Coding family</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
</table>
| Group work experience | This family refers to a list of codes about the participant’s experience of working in the group | *Group leader establishment*  
the establishment of group leader  
*Interpersonal relations structure, the level and rate of interaction*  
group work history  
members’ relationship  
attitude to group’s division of labor  
awareness of others’ contribution  
critical incident  
enjoyment with project  
collaboration experience with the group  
*Group Meetings*  
group meeting style  
trust in meeting attendance |
Apple group

The composition of members

The apple group consisted of six male members: Tom, Jack, Justin, Bob, Bill, and Thomas. All members were IST majors. Bill, Bob, and Thomas had the same second major. Jack graduated from Psychology first and continued to study in the IST major.

Group leader establishment

After the group was formed, the members did a draw to decide who would be the leader. Justin was therefore chosen as the leader. He had been a group leader for class group projects for several times. He was not happy that he was chosen as the leader this time because he had a very busy class schedule in the semester. He also had negative opinions about a college student group in general such that in his view the members were
passive and reluctant to contribute. For example, when asked about the group leader’s duties, he said, “the first is you have to organize the group, because you gotta get them on speed, get them rolling in a project, cause those people in the group are waiting for the group leader to tell them what to do. And to keep an eye on people, especially in a college group, it is very hard, because their focus isn't on the group. The last thing they worry about is the group work”. Justin also considered it hardest to schedule a group meeting. He said, “And the hardest thing of all is because you have so many group projects. You have to find the time to have group meeting. That's the biggest challenge I've always had”

**Interpersonal relations structure, the level and rate of interaction**

Apple’s members were not interested in building group relationships. Bill and Thomas lived in the same house and were friends. They came to the class together and turned in their report sections together. They seldom talked to other members during the class except asking the group leader occasionally about the assignments and what they were supposed to do. For example, when asked about whether he knew that Bob was also in the same second major, Thomas commented that “I don’t even know who Bob is!”

The remaining four members did not know each other before taking this class together. As the semester went along, it appeared that Justin and Jack became closer, as they were often seen standing outside the classroom talking to each other either before the class or after the class. Tom talked to Justin and Jack during the classes sometimes.
Bob sometimes joined their conversations but stayed quiet most of the time and sat furthest away from the other members.

**Group Meetings**

Apple group did not have an established meeting schedule for the project. Time conflict seems to be an important reason for not having the regular meeting. The group leader said the only time the group could meet would have to be before 8 a.m. or after 10 p.m. and he refused to have group meetings in those time frames. However, at the beginning of the semester, the group did manage to have two meetings; both of the meetings were in the early evenings. It is possible that as the semester went on, the leader or other members had more time commitments to make for other courses.

The group leader also had a strong opinion about group meetings. He believed that it was not crucial for the group to have a meeting because the instructor would not know whether the group had a meeting or not, and scheduling a meeting was hard to do. When asked if the individuals shared their reasons of constructing their sections of the mini-report in a certain way, the leader said, “*it might make the report slightly better, but that would involve group meeting, and we are just pretty much anti-group meetings. The 2 or 3% of doing better on the report is not worth of trying to find an hour time for the group meeting.*” He further elaborated there was no need to get each other’s opinion and knowledge when working on the individual sections and that all the individual work could be done by individuals – “*we don’t need the support or knowledge from everybody*”
else, we can complete the work and get it done individually and turn it in and not have to struggle for group meeting.”

Several members also did not consider it necessary to have more meetings as everyone would work on the same section for the rest of the activities. However, Thomas was quite upset about not having group meetings and complained that the group never really met. It could be because he had issues with the group leader (this is discussed in detail in the next section – “group work process” section) and wanted to have a change to discuss his concerns among the group members.

The members had four meetings in the semester. The first meeting was about the first group assignment – generating a project chart. The meeting lasted about half an hour. The second meeting was about the group’s first mini-report. The group met in a computer lab. They discussed the report template first, and then everyone randomly picked a section and worked on that. Everyone used a computer to search for the information relative to the section he was working on. Because Bob was working on the challenges assessment section (see Chapter 4 for the report template), he logged into the group workspace to look at the group’s decision about the challenges.

The last two meetings were about preparing for the final presentation. In the first meeting, only half of the group was present. The attended three members – Tom, Justin, and Bob, produced an outline for the presentation file and distributed the work to the others. The members met in the second meeting with the purpose of integrating the individual parts of the file together and rehearsing the presentation. Because only Tom and Bob finished their parts before the meeting, the group was not able to rehearse the presentation in the meeting.
Group work process

- Challenges Assessment Activities

In the challenges assessment activities, each group was required to propose at least thirty challenges. There wasn’t a group rule about how many challenges each member should propose. Every member proposed six challenges for all the activities except Bill. Bill proposed six challenges in the first two activities, four in the third activity, five in the fourth activity, and none in the last activity. Also, Bill tended to be the last person who posted the challenges to the group, as his rationale statements were always the last ones from the rationale document. In the task of selecting and ranking top three and bottom three challenges, it was only the first activity in which all six members participated. In the rest of the activities, Bill did not participate at all.

From an outsider’s perspective, the least contributing person in the challenges assessment activities was Bill, as he did not leave his work on the task of selecting and ranking the challenges in the workspace, and he proposed less number of challenges than others. In the last challenges assessment activity, there wasn’t any work from him. Other group members acknowledged this issue. Justin during the interview said that, “We have one member who always does half the work. He refused to do the challenges assessment. He has not done the last two challenges assessment even after email reminders ahead of time. You know ’we have to do it this week’”. Both Justin and Jack asked Bill about his absence in the challenges assessment activities either through email or in person. But Bill did not give any explanation of his absence. For example, Jack sent an email to Bill after the end of the third activity on this:
On Thu, 22 Mar 2007 10:52:59 -0500 "JACK XXX" <XXX@psu.edu> wrote:

Hey Bill,

I don't know what your plans are for this class, but if you could get the challenges rankings done that would be great because it affects our team's grade.

Thanks,

Jack

XXX@psu.edu

However, Bill did not reply to Jack, nor did he talk to Jack to explain the situation. Justin also mentioned that when he reminded him of the task in person in the class, “he doesn't give me an answer why or ‘I will get it done’, he just kind of like gives me a shrug.”

However, when the TA sent an email to Bill asking about this, Bill replied as follows:

“Yeah sorry about that, my internet was down until yesterday so I didn’t really have a chance to log in and do the challenges. By the time I was able to find time to get to a lab I figured you had already graded them so I didn’t bother completing the challenges. Let me know if you want me to complete the challenges still. Again, sorry about that, thanks for letting me know.”

Although we do not know if Bill was given a real reason on his absence or not, it is notable that he chose not to explain his situation or even give an excuse to his group members implying that he did not care that much about the members’ relationship in this project.

Although there were group decisions on the top three and bottom three challenges among the proposed challenges, it was the group leader who made the decision: Justin
made these choices by selecting the ones that had the most occurrences in the members’ choices. Justin said, “It's just easy not to have it. Everyone put their ranked challenges, so i just went through to see the ranks, and which concept comes most in the top three became the top three in the group, and what came up most in the bottom three became the group's bottom three”. Justin told Bob and Jack about the ranking process once because he saw them in the workspace when he was doing the work. However, Bill and Thomas were not aware of it. Bill said, “I actually never helped with that... I don’t know who made the decision, and who wrote down the group explanations.” Thomas also commented, “I think someone went through and looked. Whether it was Jack or Justin. I was never asked for my opinion except I ranked them in the assessment as individual. That was the only input”.

- Mini-report activities

The group assigned each member to work on a section of the mini-report following the template provided by the instructor. There were five sections in a report, so one member was assigned to work as a “compiler” to put each member’s section together into a coherent piece. During the first group meeting, the group leader asked the members for their preference of which section to work on, and assigned work to the members according their preference. The group leader Justin assigned him himself to be the “compiler”. He requested members to send the sections to him two days before the due date so he had time to integrate the sections into one report. Members seemed to recall the group’s division of labor on mini-report task consistently during the interviews. Below are some quotations from the members when asked about how the group worked on the mini-report:
“Well we had group meetings for the first two, delegated the work, and since then, we pretty much just agreed to do the same part, it seems to have worked. So now everyone just does the same part each time”

“I think the first time we just randomly broke it up. We just kind of broke it up. We met at a computer lab and broke it up. We stuck with that.”

“Pretty much we just distributed the work and it comes back, and we just put it together. What helps me get consistent is everybody wrote the same part every time.”

In writing the mini-report sections, Tom and Jack were responsible for discussing the pros and cons of two software tools that could be used for managing the distributed team project at that phase. Therefore, the sections they wrote were indeed the subsections of the tool section. To ensure the consistency of two subsections on writing style Tom sent his part to Jack first and then Jack sent both parts to Justin, instead of sending the individual pieces to Justin. Justin said that this was decided by Tom and Jack, “They decided to do. I talked to them because we were having problem with them. One writes a short section and one writes five pages…I think that’s how they started doing it. And that started happening like about they did it on the last report and it worked out really well, because the information was consistent.”

For the activities of producing mini-reports, members had different view on everyone’s contribution. Thomas complained that Justin did the least amount of work because he did not write anything but just put other people’s work together into one report – “Our group leader is pretty worthless. He assigns everyone else to do the stuff, and he assigns himself to combine the work, which is stupid. I can understand if he does
it once. But he does this every time. I don’t mind doing my section every time, but he doesn’t do anything.” Assuming that everyone thought the same way, Thomas brought this up to Justin several times and said, “I tried to tell him to do some work because nobody tells him…” Bill had the same view on the group’s division of labor with respect to the mini-report. He said, “The group leader contributes to the project the least, as far as the actual mini-report.” However, other members did not think this way. On the other hand, they felt that Bill and Thomas were being unreasonable. For example, Bob commented that, “It was fair. We split it evenly. Our group leader was doing well. So we took some of that off hand and put it on to them. And they still felt it was unfair.” From Tom and Jack’s perspective, Bill and Thomas contributed to the group least. But they also had doubt on Justin’s work. Tom was not satisfied with Justin’s performance as a leader for preparing for the final presentation, “I wish we had a better game plan going into it which unfortunately I have to throw this on Justin. We met on Sunday and he was like what we do. I hoped he would have thought about it but he never did”. Jack during the interview said, “I don’t think Justin really took the time to go through the parts and made it sound like one person did it. Everything just goes to Justin, and he just copied/pasted to the template and submitted it”.

Thomas complained that it was unnecessary to send individual sections to Justin two days before the deadline since compiling wasn’t that much work – “He ask us to give him the individual section two days or a day before the deadline, so he would have time to combine them, which didn’t really take much time. But this limits everyone else’s time on the section, who is actually doing the work.” Interestingly, while Thomas was the only one who complained about this in the interview, Bill and Thomas were the only ones who
sent the parts to Justin within that time frame. Other people always turned in their parts to
Justin late. Justin called this “awkward trust”. He said, “I have like three quarters of trust
in them giving me the assignments, that's why we have the assignment due like two days early. That would then, Bill or Thomas, I can assign to somebody else again or do it. In honesty, they are the only people who turned them in on that day, cause then Jack and Bob, and Tom's come in later. But I know them that they are going to do theirs.” It is possible that because Bill and Thomas were always together, other members “grouped” them together when viewing their contribution to the project. It is also possible that because of their distant attitude to others in the group and Bill’s lack of participation in the challenges assessment activity, members suspected their contribution in mini-report activities. For example, Bob considered Bill and Thomas to be the ones who make the quality of the mini-reports lower than expected, “We split it up the parts evenly. And these two people complained about doing their parts even though they won't that big. They turned them in late a couple of times, or hard to get a hold of, or didn't show up in the class. So we end up having to do stuff in the last minute... And we get dark points because of them”. They were actually the ones who turned in the work on time in producing mini-reports. But Bob wasn’t aware of it at all.

Although Justin had two days to combine the members’ sections together, he never sent the integrated group report back to the members before turning it in. It wasn’t until the members received the instructor’s grade on the report that they saw the report. Thomas had a strong opinion on this issue and believed that because there was no updated version exchanged among the members, there was no effort on making the report a coherent piece – “The only way I got to read the report is when we got it back. I can’t
know until we got it back. Everyone writes their own part and sends it to Justin, one or two days before the deadline, and there is no updated version or exchanged sections among the group members. There is no proof-reading, combining logically, or transitioning. There is no attempt to make it a cohesive piece.” Jack also said that he did not even know who wrote which section except that Tom worked on the same section as he did, “I don’t know who does all the rest of the sections”.

How did Justin manage to integrate everyone’s work into one document without getting them involved in the compiling process? When asked how much he knew about the content of the members’ sections, Justin said, “Not much. I’ve never actually really consumed myself with it. Considering the grades came back very consistent and decent, there was never an area that I need to consume myself on”. It seems that Justin did not take it seriously when combining the individual pieces together.

- Final presentation preparation

In preparing for the final presentation, the group had two meetings. In the first meeting, only Justin, Tom, and Bob were present. Jack had some unexpected personal issue so he wasn’t able to come. Bill and Thomas did not show up, nor did they give a reason. Justin, the group leader, asked the other two group members what to do instead of having an outline before hand. As mentioned earlier, Justin viewed the members of student groups as passive, waiting to be pushed. In this case, he was actually relying on the members to produce a plan. The attending three members – Tom, Justin, and Bob, produced an outline for the presentation file. After a plan was produced, they distributed the work to the whole team and decided to meet again. The purpose of the second meeting was to put everyone’s work together. However, this was not the case. In the
second meeting, everyone attended the meeting but only Bob and Tom had their parts ready for the presentation. Because of this, the team did not have time to rehearse the presentation. It wasn’t until 2 a.m. on the presentation day that all the parts were ready. Tom was the member who put the slides together. He said, “So basically throughout the afternoon and evening on wed. I was waiting, waiting, and waiting for everyone to get the parts done. Eventually Thur. 2 a.m., presentation slides were ready. Tues. only me and Bob prepared.”

Orange group

The composition of members

The orange group consisted of one female member Laura and five male members: Stephen, Jay, Jonah, Jimmy, and Jeffrey. All members were IST major except Jay. Jay’s major was finance, and IST was his minor. Jeffrey and Stephen are sophomores, although this course requires at least junior level.

Group leader establishment

In the interviews, orange group members recalled that Laura told the group that she wanted to be the group leader, because she already knew about project management from her summer internship. The members agreed based on her experience. Laura has been a group leader for about three to six times in past courses, and she was used to being the leader in the group. Another member in this group, Stephen, liked to take the
leadership role in group work as well. But he knew that Laura is more knowledgeable than him on the subject, so he was fine with Laura’s proposal. He said, “Typically in the groups I’ve always been the group leader. But Laura stepped (in) right from the beginning of the semester, ‘I have an internship about project management, so this is something i know how to do’, and I don’t know anything about it, so we all voted for her. ... it's kind of nice too I am not necessarily in charge of anything, I am just one of the workers for this group as opposed to being the leader which sometimes can be little stressful but that's normally where my comfort zone is in the leader”.

From the other group members’ perspectives, Jay did not seem to like the idea of Laura being the group leader. For example, Stephen said, “One of the members didn’t want Laura to be the group leader, seems like one of the group members was a little put off. I don’t know if cause she is a girl, or because right from the start, we didn't even like ask if anyone wants to be a group leader.” Jeffrey also said, “At the beginning, one of the team members seemed to resist listening to the manager. Now this seems to die down. We don’t know the reason”. When Jay was not around, the rest group members would joke about this.

According to Jay’s view, a group leader should play the role of “the administrator of the work amongst the group, also getting their fair share”, rather than “like being a ground, just doing some work.” At the beginning, Laura did the majority of the work for the group, as Jay pointed out – “The initial documents we had like project plan, work breakdown structure, or the agreement to work with. She did mostly on her own, so she let us know what was going on, but she kind of did them”. It is possible that because
Laura did most of the ground work at the beginning instead of distributing the work to the group, Jay was not happy about it.

For Laura, she noticed that Jay seemed to act differently from the others and she had her ways of handling this, “the only thing I notice is that Jay is a little quieter than the rest of us. So I tried to make more effort to inform him of the group issues, or ask him what his opinions are. And he has a long pause, and some one may have jumped in. I went back to ask him about his opinions to make sure his voice is heard.”

As the project went on, Laura’s leadership skills were more recognizable and Jay acknowledged that. When asked who contributed to the project most, he said Laura, and said, “Laura is the leader, seems to really make sure things get done.”

**Interpersonal relations structure, the level and rate of interaction**

Orange’s members sat in the same row in the class. Laura and Jimmy had worked together previously; Stephen and Jonah had worked in a quality team before. The rest of the members did not know each other before taking this class together. In the semester, Stephen and Jeffrey were in the same group of another class, and Laura and Jeffrey were in the same group of another class too. As the semester went along, the members got along very well except Jay, which gave Jay the impression that they all knew each other before this class. Jay said, “uhm. I'd say they all, those five members they all I think they know one another somehow, either it's outside the class, or in other classes. I don't know if they individual one directly knows another one, but I think everyone knows someone else somehow”. It is possible that because nobody has worked with Jay before or in other
classes in the semester and Jay was quiet in general in the class and during group meetings, Jay seemed a little distant from the rest of the groups and members did not seem to interact with him that much either. Jonah said, “I’ve worked with Stephen before the project, I knew what would be expected from him. Jay is finance major, none of us have worked with him before. Laura and Jeffrey know each other. Jimmy and Laura know each other. We sort of know what to expect from each other. We have never worked with Jay before”. But overall, everyone got along with each other in the group and members were all positive about the group including Jay who said, “as far as the people I met, they are not the best friends or anything like that, they're all nice, and the group because they are nice and do well with the work, make things easier and therefore more enjoyable.”

Orange group members developed trust of each other on completing the shared tasks. All members were positive about their collaboration experience in this group. Two members said this group was the best group they’ve ever worked in college. Jonah said in the interview, “We definitely communicate better. It is easier to say that we need to work on this more. You can trust that person will get it done.”

**Group Meetings**

Orange group had both regular face-to-face meetings and regular online meetings. During the challenges assessment activities, the group had regular online meetings besides the class time assigned for doing the activities. In general, for each challenges
assessment activity, the group met online during the class and then at another time. In online meeting, the group generally used AIM group chat room for discussion.

The group had one regular face-to-face meeting for each mini-report activity. Laura explained the reason of having two kinds of regular meetings in the group, “I wanted to have an in-person meeting because it is a lot easier to collaborate in person. Online you tend to get more distracted. Online is good for summarizing things for just making sure that people are task and understand what they have to do, and maybe clear up a few questions. But general brainstorming and talking about what we want to do and how we want to structure the project that kind of stuff that's better to do in-person. By doing both being in-person and online, it kind of makes things more convenient and allows more meeting times”.

Members’ trust of each other on getting the work done impacted the group’s meeting scheduling as well, as evidenced from the interview data – “In the first two meetings, we would only schedule a meeting when everyone is there so we know that everyone will be there. Now if one or two people cannot make a meeting but other people can. We still schedule the meeting. We trust them that they can get the work done even though they are not going to be at the meeting”.

**Group work process**

- Challenges Assessment Activities

The way Orange group divided up the work was fair. Every member in the Orange group proposed six challenges in all the challenges assessment activities. The group first
worked together on proposing the challenges, and then took a break from it. After all the members individually chose the top three and bottom three challenges, the group met online again to make the group decision. Laura explained why the group chose to do it this way, “when we came up with the challenges and stuff, we generally do that together. We all meet to do that together, so we can see each others and make sure that we don't duplicate or things like that...we generally take a break from that, because that takes a while, and then we come back at another day to do the top three (and bottom three)”.

When the group met online to decide on the group choices, they looked at what everyone had picked, and the one that got picked up most was at the top, and if there were ties, they discussed the rationales of the individual decisions. After the group decision is made, the group rationales were written by whoever came up with those top three and bottom three challenges. But as there were six rationales to write and there were six members in the group, everyone would write at least one. Because the group discussed together on choosing the top three and bottom three challenges, members were expected to write down the rationales shared during the meeting.

There were a few members who read others’ rationales during the activity to monitor the quality of the group work. Stephen said, “I had to go back and looked at people's rationale to make sure it's right. Like I had to make one of my group members rewrite all of them because he was saying why it is important as supposed to why it is a challenge, so. we actually have to do more now than before, i actually go and read everyone's explanations or rationale to make sure that they are doing the right thing, ...I don't know if everyone does, I know a few of us will read through all of them, just to make sure that they are answering”
• Mini-report activities

Again, the way that Orange group divided up the work was quite fair. The members applied an interesting rotation strategy in dividing up the work for mini-report activities among the members. All members talked about this rotation strategy in the interview and had positive attitude to it, “there are six of us and five sections. The sixth's role is compiler as someone has to compile the paper. Basically people just kind of got the section the first time, and actually worked very well. And now we are just rotating”.

The group chose two software tools for evaluations for each project phase activity, and discussed the best practice on managing a distributed team project for each software tool. It was a group consensus on deciding which tools to select for this project was a group consensus. The group was divided into two subgroups: three members focusing on one software tool, Groove, and the other three members focusing on the other tool, eRoom. In a simple rotation strategy, for the mini-report of a project phase activity one member would be responsible for the tool section discussing the two tools and another would be responsible for the best practice section discussing the best practices of using the two tools in managing the distributed team project at that particular phase. However, the group found out that it’d be best if the person who wrote about the evaluation of a software tool was also responsible for discussing the best practice of the tool. Therefore, each subgroup had one member who was responsible for the two sections and the member would write part of the tool evaluation section and part of the best practice section, i.e., write parts of both sections just for the tool he or she was focusing on, “the most critical part for the mini-report are tool assessment and best practices, those being the sections D and E. A, B, and C are written by individuals. D and E are combined
efforts. We are assessing two tools: eRoom and Groove. Half of our team researched eRoom, and half of our team researched Groove. So one person from the eRoom and one from Groove wrote the sections D and E because those sections are related” (from the interview of an Orange group member) It was also a group decision on this strategy and this group found out this strategy during the process of actually working on a mini-report, as evidenced from the leader’s interview, “when one of the group members was doing the tool assessment, he is like ‘well, I can't do the tool’ and the other one was ‘I never looked at the tool, I can’t write best practice for that’. And he was like ‘I haven't looked at groove, how can I write best practice for that’, so that is when it had to split. So we tried in the report and we decided this time that that was the best way to go”.

The group created an online group folder so the members can share the files by dropping the files in the group folder. Usually, the members finish their individual sections and drop the sections there. The compiler then collected the pieces and put everything together. The compiler then uploaded the integrated version to the group folder for the group to review. Because the mini-report was usually due on Thursday night, the members were told to get the sections ready on Wednesday night. The compiler then was expected to upload the paper by Thursday afternoon marked with his/her changes and comments, thus leaving some time for the members to discuss the report. The compiler was responsible for submitting the final version and submitting it to the company.

There was one incident in the mini-report activities. In the controlling phase activity, the group did not have a final revision for everyone to look at. What happened was that although everyone submitted their individual work on time, the compiler
messaged the leader through instant messaging at 10 p.m. on Thursday telling her that he didn’t know what to do to compile. The leader then asked another two members for help.

So, for that mini-report, there were three members who worked on compiling together close to the deadline and were not able to put the report in the group folder for the rest of the members to review before turning it in. The leader explained why the compiler failed to do the job on time, “Usually our parts to the mini-report compiler were due on Wednesday night or Thursday afternoon even, just as long as the person who compiles usually says the due time. That’s the norm. And this time we changed the norm. This time we had the conference call and we communicated during the meeting about the change, and I emailed to them and I talked to everyone else in person. The only person who was supposed to do compiling was the person who missed the Deloitte meeting”. The members who were not involved in this collaborative compiling process were not aware of the reason that the integrated report was not in the group folder. One member said, “Usually the compiler would put the document in the group by 9 or 10 p.m. and then sent a quick IM to each other so other people can take a quick look, proof-reading But for this past one, there is no notification received”.

The main sections of a mini-report were the section about the challenges assessment, the section about the tool assessment, and the section about best practice. The challenges assessment section was written based on the challenges assessment activity’s result. Often, the top three challenges were chosen to include in the section so members were aware of the rationale of the challenges assessment section. However, for the content of the tool and best practice section, group members were not so sure. When asked if she knew the rationales of the individual sections’ content, the group leader said,
“No. I just kind of leave that to the person and I trust them to do the work”. Jonah also said the group did not talk about how to write up the individual section at all, except sometimes he asked other people’s opinion on his section.

- Group poster

In the middle of the semester, the instructor announced that there would be a college event when many companies would come to the campus talking to the IST students. The instructor encouraged the student groups to submit posters to the event to show off the project they’ve been doing for this class. Orange group members decided to participate except Jay. The group then met two times without Jay to discuss about the poster. Each member chose a piece to work on, such as writing the summary, the project description, and producing the poster. The group looked at the posters from previous classes and decided the layout and graphics of the poster. Everyone worked on his/her part and sent it to the person who was responsible for producing poster using graphical software.

**Peach group**

*The composition of members*

The peach group consisted of five male members: Kim, George, Martin, Rex, and Jordan. All members were IST majors and were juniors.
**Group leader establishment**

George volunteered to be the group leader at the beginning. George was the group leader of all the class projects since freshman year.

Even before the group was assigned, George already planned on the set up of his team evidenced from the interview, “when I found out he (Jordan) is in this class, I got him on my team, I knew he is smart and dependable. I made sure he sat in our row cause that may bias, I thought Dr.Clark was gonna let us pick or let us go that row [to form a group]. Psychologically, try to get good people and it did work. That's what happened”.

Jordan was always the group leader in other IST courses. However, Jordan was fine with George being the group leader in the class. He said, “I think he was just like I'll be the leader. We are like o.k. ([interviewer] so he volunteered?) volunteered.”

**Interpersonal relations structure, the level and rate of interaction**

Kim, Martin, and George have worked together since their freshman year. Rex never worked with them before but he has been friends with them since his freshman year. Kim and Martin were high school friends and came from the same town. Jordan knew George through a mutual friend.

Because of course schedule conflicts, the only time that the group could meet was in the evening. However, the members of this group really liked meeting with each other. During the meetings, they worked on the projects as well as playing music and joking with each other. Joking was also a strategy the group applied when there was a conflict or tension among the members as Martin said, “We don’t let the tension build up.”
We joke around”. Because they spent much time on other things besides work, the group often met for several hours in order to get things done. The members acknowledged this issue but they still enjoyed this collaboration style. For example, Martin said, “one thing is that every one always look at a sense of humor during the group meetings. We all liked joked around a lot, which definitely helped a lot. It actually made the meetings fun”.

According to George, Jordan was the type of person who is very strict and follows methodology precisely. This was the first time that Jordan worked with the rest four members. In spite of the fact that this group’s work style is far from being strict and following exactly what needs to be done, Jordan also enjoyed working in this group – “I think this has been one of the most interesting groups I have ever worked with, in terms of really just being loose all the time and really being able to just kind of throw out all ideas and we joke around a lot. Unfortunately that also leads to getting off task sometimes, but I feel that we are all very intelligent group members and the quality of our work is very good”.

It is possible that because Jordan was used to being the leader in a group, he kept checking on the project members making sure the work was done. In the interview, Jordan commented that “I’d say that sometimes we butt heads on ideas, especially cause a lot of us have been leaders before, and we know how to pursue that kind of role, so a lot of us want to be able to have the final say sometimes, but then we eventually come to a consensus”. George was aware that Jordan used to be the group leader in other classes and understood his behavior. He said, “he always like ‘I will send out an email make sure it goes’, well, I sent an email (already)...He is good. He will be a good boss one day”.
**Group Meetings**

Peach group had regular face-to-face meetings. The members really loved having meetings. For example, in a meeting starting at 7 p.m. on Wednesday, the members did not finish the meeting until it was close to mid-night. All the group work except the challenges assessment activities were done during the meetings.

**Group work process**

- Challenges Assessment Activities

  The way Peach group worked on the challenges assessment activities was organic: there wasn’t a norm of how many challenges each member should propose and a member may propose different number of challenges during the activities. *Table 6-21* is the summary of the number of challenges posted by each member during the activities. Overall, Jordan and George posted more challenges than others.

*Table 6-21* The number of challenges posted by peach group members for different activity

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>The number of challenges posted by each student</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Initiation</strong></td>
<td>Kyle: 5; Jordan: 9; George: 9; Rex: 4; Kim: 4</td>
</tr>
<tr>
<td><em>(Feb. 13\textsuperscript{th} – Feb. 22\textsuperscript{nd})</em></td>
<td></td>
</tr>
<tr>
<td><strong>Project Planning</strong></td>
<td>Rex: 6; Martin: 5; Jordan: 6; Kim: 6; George: 9</td>
</tr>
<tr>
<td><em>(Feb. 27\textsuperscript{th} – March. 8\textsuperscript{th})</em></td>
<td></td>
</tr>
<tr>
<td><strong>Project Execution</strong></td>
<td>Jordan: 8; Martin: 5; Rex: 8; Kim: 5; George: 6</td>
</tr>
<tr>
<td><em>(March. 20\textsuperscript{th} – March. 29\textsuperscript{th})</em></td>
<td></td>
</tr>
</tbody>
</table>
Unlike the orange group, the peach group did not necessarily meet for making group decisions on which challenges to pick. Often, the person who made his choice last in the workspace would come up with the group choice. George (the group leader) said, “We just aggregate the average. If there is a dispute, we work it out. And if not, whoever is doing it at the time, just make the judgment”. The challenge that had most occurrences was chosen as the group choice. There was one time that there was a tie, and the group looked at the explanations of the challenges, according the interview data.

- Mini-report activities

Peach group’s work on the mini-reports was mostly done during the meetings. Often, the members went through an overview first, wrote down the ideas on the whiteboard, and discussed which ideas or topics to be included in the report and why. Members worked in small groups during the meetings on different sections. When one small group finished the work, they would then switch to a different section or help the others. Members liked this working style. The leader said, “I think cohesively we were better because we don't really like most of the groups everyone just does individual contribution and pieces together, although we sort of do that, it's more of like in a distributed environment, like the work is delegated consistently, and like we form teams and we switch teams, ... it's always usually a group of two, or a group of three when we
work, it's just constantly moving around, communication with each other when we meet face to face and online”.

As discussed earlier, the members really enjoyed having meetings together and had fun during the meetings. In fact, because the group spent a lot of time on joking about other things, the group did not work that efficiently. The leader realized this problem, “we are probably more productive online cause we can't communicate with each other”. He was referring to that with the face-to-face setting members joked with each other a lot while in online setting it was more about just work. However, he also acknowledged that the members liked being together, the cohesiveness of the group made the meeting pleasant, and the members were comfortable brainstorming ideas – “I think we are more creative face-to-face”.

Because the members worked on the mini-report in such a highly collaborative fashion, everyone was aware of each section and how the content was decided. However, the unclear division of labor also made it difficult for the members to identify the individuals' contributions.

- Group poster

Peach group members also participated in the group poster activity. The group met several times to discuss about the poster. The group spent long time discussing the title and design of the poster and had fun in the discussion. No further data available to show their work process for the poster.
Summary

In summary, the interview data were consistent with the survey result and provided insights on understanding the groups’ context. The survey data seemed to indicate that the apple group was less cohesive than the other groups. The interview data show that this could be true, as the apple group had several issues within the group that were not apparent in the other two groups. For example, in apple group, there were complaints about the perceived unequal contribution among the members, the criticism on leader’s strategy about the division of labor, members’ turning in the work later than agreed, and the fewer group meetings. In fact, these may have impacted the group in several ways including the group cohesiveness (survey item 1), the less the satisfaction of the group performance (item 2 – 6), the social relationships in the group (item 11) and the members’ trust (item 12).

The three groups’ grades of mini-reports are presented in Table 6-22. As the grades show, orange and peach group outperformed apple group. The maximum grade of a mini-report would be 85.

Table 6-22 The three groups’ mini-reports’ grades

<table>
<thead>
<tr>
<th>Group</th>
<th>Mini-report 2</th>
<th>Mini-report 3</th>
<th>Mini-report 4</th>
<th>Mini-report 5</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>74</td>
<td>74</td>
<td>75</td>
<td>83</td>
<td>306</td>
</tr>
<tr>
<td>Orange</td>
<td>75.5</td>
<td>80</td>
<td>85</td>
<td>84</td>
<td>324.5</td>
</tr>
<tr>
<td>Peach</td>
<td>82</td>
<td>83</td>
<td>78.5</td>
<td>84.1</td>
<td>327.6</td>
</tr>
</tbody>
</table>

Bereiter (1990) discussed two different contextual modules for describing the learning activities: schoolwork module and intentional learning module. Students whose academic activities are all mediated by schoolwork module do not recognize learning
goals of the activities. Students who adopted the intentional learning module in carrying out the activities, on the other hand, take the goal of learning into consideration when working on the activities. One major difference between two modules is that the intentional learning module is organized around goals of personal knowledge construction while the schoolwork module is organized for the task performance. Scheffler (1977) discussed another distinction between schoolwork module and intentional learning module: students who adopt the intentional learning module commit to a truth and depth of understanding, while those who adopt schoolwork module tend to be satisfied with the superficiality and pretense of knowledge (Scheffler, 1977). Based on these understanding of schoolwork module and intentional learning module, the investigator classified the orange and peach groups as groups that adopted the intentional learning module, and apple group that adopted the schoolwork module. The following sections discuss in detail the reasoning of this classification.

**Apple group – a schoolwork module group**

Work organization for the task performance and Lack of recognition of learning goals

The work style of the Apple group made it fit most with the schoolwork module for a group activity: everyone worked on the same thing in all five activities; no group discussion was made as to the project content; and no feedback was given to each other as to the individuals’ sections. In a word, there was no effort on helping individuals’ learn about the subject in the group. Although writing the same section for all the five reports would not be beneficial for them to learn about other aspects of the project management,
most members were comfortable about doing this. For example, Bob said, “well we had group meetings for the first two, delegated the work, and since then, we pretty much just agreed to do the same part, it seems to have worked. So now everyone just does the same part each time”.

The group leader, Justin, did not see the potential benefit of writing down the rationales not only for this course, but also for other courses as well. During the interview, he talked about another course he was taking in the same semester. In that course, the students had several tests and during each test, the students needed to write down their solutions of problems and explain why. Justin felt unnecessary to answer the question why and even thought that the reason he solved the problem in a certain way was because he was genetically engineered that way. Justin said, “Then, the next question is why? I just don't find that a useful question at that point, cause it's an open ended question at the first place – how would you approach this problem? And then the only logical true explanation to why to me is because that's the knowledge I have to approach the problem. It's all in your background history. Some people do multi tasks naturally because they like to do multitask, or they learned to multitask. And some people are one thing and then another, because that's how they are brought up. I am sure there might be some genetic behind it, but it's how they are brought up, and how I approach a problem is the same thing. Don't ask me why I solve the problem like that”. Justin’s attitude on the requirement of explaining his problem solving process seemed to indicate that he was not recognizing the learning goal but merely focusing on getting the job done by solving the problem. In another word, there was no learning intention in his way of working on the assignments.
Justin did not schedule the group meetings not only because he already had a busy schedule, but also he did not feel the need to meet and discuss with the group members. He thought so because he felt that the work could be done by individuals without getting others input. In another word, he did not see the potential of learning from each other for group project in the class.

A few members complained about not gaining experience from working with the group. Thomas said, “The only thing that I learn is when we actually see each other’s work and why. That helps to better flush out the phase. The report is no teamwork. For each phase, I refer to the book for the overview”. Jack also said, “All IST group projects are supposed to gain experience in working with teams. We are not gaining that type of experiences”. The other members’ complaints indicate that maybe not everyone adopted the schoolwork module in this group, but because Justin was the leader of apple group, the schoolwork module he already adopted for college education affected how this group performed in this class.

**Orange and Peach group – intentional learning module groups**

Work organization for the task performance and Recognition of the learning goal

All group leaders understood that the project was about how to improve project management in distributed team environment. However, Peach group leader also acknowledged learning as a goal of this course project. He said, “…the outcome wasn't as important as the process. We are working together on a team and understanding the concept of project management, making sure your deliverables are on time, dealing with
the client. It is more a way of preparing the students for professional world. I think this is more of educational usage than an actual corporate usage”.

Although Orange group leader did not talk about the learning goal of this course project, the rotation strategy that the orange group applied in writing up the mini-reports had the implicit purpose of benefiting the individual learning experience in the project. For example, the leader commented that

“So we just rotate that way, so everyone will have a chance to do the little bit of work.”

“Everyone will, they will just be like one person will get to do one of each task.”

The members all liked this rotation strategy as it helped them to explore different parts of the project. Stephen (orange group member) also talked about the tradeoff of the rotation strategy such that it’d be good for members to do the rotation as it got everyone to do one part of the report, but for the best output of the group performance, it’d be better if everyone worked on the same section each time. In another word, Stephen acknowledged that the purpose of this project was not just about getting the best performance, but also about gaining the experience by working on different sections.

Because of the rotation strategy, Stephen worked on different sections in the five activities instead of sticking to the section about a software tool that he was most knowledgeable among the group. He said, “I don't argue with the system we have about rotating it, cause it gets everyone to do one part of it, but if we want the best output, I'll probably write my challenges and I'll go back to read the person's tool assessment and best practices for groove, because I am probably the most familiar with groove right now”.
If there are distinctions to be made between Orange and Peach group, the different working styles make orange group a better fit for the cooperative learning model, and peach group for the collaborative learning model. In the orange group, division of labor is clear – everyone was responsible for a part and everyone was aware of that. Although the group met regularly to discuss on the project issues, the majority of the work was done in individual settings. In the peach group, there was no clear rule as to who worked on which section. Most of the work was completed in a group setting. The group was highly collaborative in that sense.
Chapter 7
Discussion

This chapter first discusses the investigation of the research propositions based on the data analysis results, and then discusses the contribution of the study to the existing literature. Lastly, the chapter presents the lessons learnt from the students’ learning experience.

Investigation of the research propositions

This section discusses the investigation of the four research propositions (RP) in this study:

RP1. Knowing group members’ rationale contributes to one’s awareness of their expertise

RP2. Knowing group members’ rationale contributes to one’s awareness of their contribution

RP3. Rationale awareness impacts the group’s way of making its decisions

RP4. The group develops its way of managing the shared rationale space

Using interview data as the main data source in the investigation, the investigator took the interpretative lens in the study and described her understanding of how the rationale awareness played a role in the group process with the data. Different forms of data were used to investigate these propositions including the survey data, interview data, rationale statements’ grades, and the groups’ shared rationale spaces. The section organizes the discussion around the propositions.
RP1. **Knowing group members’ rationale contributes to one’s awareness of their expertise**

The survey data show that the participants perceived that knowing the group members’ rationale contributed to their awareness of the group members’ expertise (Table 6-6). The interview data also show that the knowing the other group members’ rationales contributed to the interviewee’s awareness of their expertise. For example, Jimmy (an orange group member) said “I know Stephen tend to write his all about group performance and analysis. So his challenges include things like client satisfaction, or assessing team member performance”. The quotation shows that Jimmy was aware of the kinds of knowledge that Stephen possessed with respect to the project management from reading his rationale statements. When asked “what did you like least about sharing the explanations with your group members in this project?”, Jordan (a peach group member) said, “I guess the only thing I would say that I like least would be if for one of the phases you can't think a lot of good challenges, then the team members would see your input and they may not be that good.” This seemed to indicate that Jordan acknowledged that knowing his rationales would reveal the level of knowledge he possessed and he was afraid that if he was not able to give good rationales people would know that he was not that knowledgeable on the subject.

The results of the rationale statements evaluation were consistent with the interview data. For example, Laura (orange group leader) was the member who’s rationale statements had the highest grade on knowledge (Table 6-17). And the interview data show that she was considered to be the most knowledgeable person on project management in the group. There was not enough evidence to prove that it was the
awareness of the members’ rationales that made Laura being recognized as the most knowledgeable person on project management. However, the consistency between the evaluation and the interview data seemed to indicate that one’s rationale statements indeed provide the information about his/her expertise in the activities thus knowing the person’s statements could contribute to the awareness of his/her expertise.

Figure 7-1 shows the members’ grades of their rationale statements on knowledge based on the data from Table 6-17.

<table>
<thead>
<tr>
<th>Knowledge distribution in a group</th>
</tr>
</thead>
</table>

![Knowledge distribution in a group](image)

**Figure 7-1** The group members’ grade of rationale statements on knowledge

As is shown in the figure, peach members seemed to have the same level of knowledge on the identifying the challenges for distributed teamwork, that is, the group was homogenous in terms of the knowledge distribution. This finding was consistent with the interview data as well. In the interview, when asked who was most knowledgeable in
the group, Peach group members had difficult time to come up with a name. For example, Martin said, “project management wise, everyone is same knowledgeable”, and Jordan said, “I think we are all equal at project management. I don’t think there is anything we necessarily did that showed anyone better than anyone else”. This consistency between the interview data and the evaluation result again seemed to indicate that one’s rationale statements can serve as additional resources for the others to know about his/her expertise.

RP2. Knowing group members’ rationale contributes to one’s awareness of their contribution

The survey data show that the participants perceived that knowing the group members’ rationale contributed to their awareness of the group members’ contribution (Table 6-6). The interview data also show that the knowing the other group members’ rationales contributed to the interviewee’s awareness of their contribution. For example, Thomas (apple group member) said, “Justin wrote communication as the challenge for several times. It is easy to distinguish Justin’s explanations from Tom’s or Jack’s because theirs are more in depth, and better thought out, and elaborated”. This piece of data shows that Thomas acknowledged that Tom and Jack had put more effort in explaining the challenge than Justin did and had thought about the challenge more deeply. Thus, they had more contribution to the activity.

During the interviews, the group leaders of orange and peach group were recognized by the group members as the one who contributed to the project most. For apple group Jack was considered to be most contributing to the project.
The grades of the members’ rationale statements on contribution (Table 6-18) show that the orange group’s leader had the highest grade on contribution in the group, and Jack’s grade was the highest on contribution in the apple group. These results were consistent with the interview data. However, for peach group, it was Rex not the group leader whose rationale statements had the highest grade. How do we interpret these results comparing the interview data and the evaluation data?

Well, for orange group, the leader’s contribution was recognized not only for her leadership duties but also for her work on the project content. For example, Stephen talked about Laura’s contribution to the challenges assessment activity saying that, “based on the grades, Laura is best at writing rationale and explanations. Like she always gets the most 4s and 5s on her explanations”.

In the apple group, since there were members who had issues with the group leader, members had to rely on other sources to identify who contributed most to the project. The interview data show that Jack was considered to have contributed to the project most because: he made an effort to contact the customer of this project when the leader did not; he worked on an important section of the mini-report; and he wrote good rationale statements. The quotation by Thomas provides one evidence of how rationale awareness contributed to a member’s awareness of Jack’s contribution in the challenges assessment activity – “It is easy to distinguish George’s explanations from Mike’s or Jack’s because theirs are more in depth, and better thought out, and elaborated”.

The consistency between interview and evaluation result for orange and apple group indicates that one’s rationale statements seemed to provide the information about
his/her contribution in the activities thus knowing one’s rationale statements could potentially contribute to the awareness his/her contribution.

For peach group, the members considered Justin to be the person who contributed to the project most only because of his leadership duties. Martin said, “Probably Justin. Cause he is a leader, so he has to do extra stuff like setting up the meetings, things like that”. Jordan also commented that, “I have a hard time to say that someone contributed most, but I would say that we each have different roles in the project. as the leader, George did something beyond what the rest of the group would do in terms of communicating with Dr. Clark and helping to facilitate the meetings. In terms of the overall project though, I feel that everyone’s work was really distributed equally”. In another word, other than the extra duties he had to perform as a group leader, Justin was not considered to be contributing more to the group than the others.

Although Rex’s rationale statements on contribution had the highest grade in the group, his contribution was not recognized by the member. There could be several explanations as to why Rex was not considered to be contributed more than the other group members in the activities. One explanation is that maybe the intellectual contribution is harder to identify when other kinds of contribution was more explicit, such as a leadership contribution, hence Rex’s contribution was not recognized when George’s leadership contribution was evident and acknowledged by the members. The second explanation is that maybe Rex’s contribution was not much more than the other group members’, so his contribution was not recognized.

Figure 7-2 shows the rationale statements’ grade on contribution for all the three groups’ members based on the data from Table 6-18. This shows that peach members’
contribution to the activity were not that much different compared to each other. This result seemed to support the second explanation.

Figure 7-2 The group members’ grade of rationale statements on contribution

RP3. Rationale awareness impacts the group’s way of making its decisions

The third proposition is that rationale awareness impacts the way in which the group makes its decisions. The survey data show that participants acknowledged that the groups developed their way of generating the group rationale (Table 6-6). This indicates that the group developed its way of making the decisions during the project. The interview data show that all the three groups had a similar decision-making process in terms of choosing the top three and bottom three challenges. First, each individual made a
decision, and then, the challenges with most occurrences were picked as group choice.
Then, the group rationales were generated.

Rationale Awareness on Making Individual Choices

The interviewees read the rationales of the members’ choices. Some acknowledged that the others’ rationales had some influence on their individual decision. For example, Stephen (an orange group member) said, “sharing rationales does help when we have to make decisions by ranking them, and if one of us is unclear, like you go oh, this is a challenge, and then you’re like I don't think this is a challenge, you go to rationale, showing the rationale can actually bring to the table a lot of enlightenment”.

Because Jack believed that the rationale statements had an important role in decision-making process, he hoped that his group members would read them. He said, “I read them a lot more when I was selecting the challenges... I hope people will take the time to read the explanations I wrote, especially since we have to rank the challenges”.

Although some interviewees said they did not read the rationales during the task of brainstorming challenges, they said they read them when evaluating and ranking the challenges. For example, when asked “What did you like most about sharing the explanations with your group members in this project?” Justin, the apple group leader, said, “I don’t know. Cause I really didn’t read them”. But when asked if he read the explanations of the group members, why they chose top three and bottom three, he said, “The rationale for the ranked challenges. I did read some of those”.

All these interview data seemed to indicate that the interviewees acknowledged that knowing the group members’ rationales would impact the decision making process.

Rationale Awareness on Making the group decision
During the second step, almost nobody read others’ rationales. Instead, the groups just looked at which challenges appeared most of the times in the individual choices and chose them as the group decision. When there was a tie, the members may read others’ rationales, and may hold a meeting to discuss this directly. However, Justin (apple group leader) mentioned that he read others’ rationales to check if there was minority thinking buried under the group’s choices. When he looked at each individual’s choices, if he found out that none of a person’s six challenges ended up into the group’s ideas, he would check the rationales to see if that person’s thinking is minority thinking. He said, “I looked at their explanations ... to see if maybe their thinking is minority thinking ... sometimes I think the group becomes very automated and they can miss something very important and original”. Although only Justin used the rationales for this purpose, this suggests that sharing rationales has the potential of making the minority opinions heard, which is important for the creativity of the group (Ocker et al., 1995).

Jimmy (an orange group member) thought having the rationales shared could help the group resolve the conflicts and come to a decision. He said, “I think the rationale space can be very useful for conflict resolution because rationale space is very structured. We could each make points about the conflicts and come to conclusion about it, in a formal and professional style”. He also explained why he read the members’ rationales, “The rankings I will read their explanations. I feel the choices are being justified”.

Third step: generating the group rationales
The apple group’s group rationales were all written by the group leader, while the orange and peach group often assigned the member whose challenge was chosen to be in the group choice to write the rationale for selecting that challenge.

Because the members often wrote the rationales for his/her own challenges when generating the group rationales, the members did not refer to the others’ rationales in the process. The effects of knowing the others’ rationales were not examined in this situation.

**RP4. The group develops its way of managing the shared rationale space**

The survey data show that students acknowledged that they developed their way of managing the rationale space (Table 6-6). Six out of the seven groups organized the rationale space by grouping the rationales according to the authors (Figure 7-3), and only one group grouped their rationales according to the group’s rationale number (Figure 7-4). All the three interviewed groups organized the rationale space according to the authors. However, the interview data show that the group’s rationale space was not necessarily pre-allocated to the group members before the activity. Instead, it was like whoever started using the rationale space first set the strategy of managing the space. For example, Jordan described how his group (peach group) used the space, “*Whoever gets it first will allocate a couple of spaces to himself. If I started there, the next person will skip a couple of lines and start from there*”. Laura explained how orange group managed space (Figure 7-3), “*When you get in, you just used the lines. I put a line above, and I write below*”.
Both the survey data and the groups’ shared rationale spaces seemed to indicate that the groups developed ways of managing the space with some structures instead of sharing the space in an ad-hoc way.
Figure 7-3 The screenshot of the orange group’s rationale space showing that the group managed the rationales according to their author

<table>
<thead>
<tr>
<th>Rationale of Challenges Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>File</td>
</tr>
<tr>
<td>Justin 1</td>
</tr>
<tr>
<td>Eric 2</td>
</tr>
<tr>
<td>Justin 3</td>
</tr>
<tr>
<td>Paul 4</td>
</tr>
<tr>
<td>Paul 5</td>
</tr>
<tr>
<td>Pam 8</td>
</tr>
<tr>
<td>Eric 7</td>
</tr>
<tr>
<td>Pam 9</td>
</tr>
<tr>
<td>Anthony 9</td>
</tr>
<tr>
<td>Eric 10</td>
</tr>
<tr>
<td>Pam 11</td>
</tr>
<tr>
<td>Eric 12</td>
</tr>
<tr>
<td>Anthony 13</td>
</tr>
</tbody>
</table>
| Anthony 14 | Because the project team is geographically dispersed, each member of the team will have different...

Figure 7-4 The screenshot of a group’s shared rationale space showing that the group managed the rationale space according to the rationale numbers

Research Contributions

This study explored the effects of computer-supported rationale awareness on common ground and group practice in hybrid collaborative learning activities. The study
contributes to research on situation awareness. A real world collaborative activity that extends over a period time situates in a rich context: organizational planning and business goals, job responsibilities and team roles, social relationships of team members, division of labor, variability of the work locations, etc. To be aware of the context, situation awareness is defined as “knowing what is going on around you” (Endsley, 2000). Researchers studying situation awareness mainly focus on support for one person’s decision-making process through the information that provides awareness of the complex situation. The study was carried out in an educational setting with its own context: individual learning goal as well as the group performance goal, students meeting face-to-face in lectures as well as collaborating using groupware, members’ different course schedules in the semester, etc. The study’s findings indicate that knowing group members’ rationales would facilitate one’s situation awareness in his/her decision-making process and suggest to the research in situation awareness a topic – rationale awareness- that has not been sufficiently examined.

The findings of this study on the effects of computer-supported rationale awareness on common ground and group practice in hybrid collaborative learning activities contribute to research on activity awareness. Carroll et al. studied how to support awareness of planning, acting and task status in a group activity (Carroll et al., 2003), looking at the aspects of the situation that have consequences on group process and group performance. To emphasize their focus on teamwork as activity, they refer to the sharing requirement as activity awareness. Activity awareness is about awareness of an activity, i.e., people work together to reach a common goal. To support a “seamless” collaborative process, activity awareness implies an awareness of collaborators’ plans
and understandings (Carroll et al., 2003). Later, Carroll et al. (2006) theorized that a group’s activity awareness affect the group activity through four facets – common ground, community of practice, social capital, and human development. Theoretically speaking, awareness of the group members’ rationales of their decisions is part of the activity awareness, as it implies the group members’ understandings of the tasks and decisions. The findings of this study suggest that awareness of the group members’ rationales supports the formation of the group’s common ground by supporting the awareness of the members’ contributions in the activity and their expertise with respect to the shared tasks. Also sharing the rationales among the group members impacts the group’s decision-making process, and facilitates the collective management of rationales. These findings provide empirical evidence to support Carroll et al.’s theoretical work on activity awareness and the impact of activity awareness in group activities.

Lessons Learnt

This section discusses the lessons learnt from this study on the design of learning activities, on the design of collaborative tools for college student groups, and on group learning process.

Lesson for the Design of Learning Activities

This study showed that the process of documenting the rationales helped the participants in exploring the basic concepts of project management – the course subject, and understanding how to manage a team project successfully. This study also showed
that documenting the rationales encouraged the students to revisit previous decisions and promoted the students’ reflective thinking. Constructivists believe that it is important to encourage reflective thinking to help learners to think about how they approach problems, and how they look for and find solutions. Reflective journals have been used in course activities as a way of engaging students with deep learning of a subject (Houssman, 1991; Noblitt and Pochis, 1997; George, 2001). The findings of this study suggested another way of promoting reflective thinking in students’ learning process – the requirement of documenting the rationales.

Lessons for the Design of the Shared Rationale Space

This study designed and implemented a group workspace for supporting distributed collaboration among the group members in an undergraduate course. The user experience of the shared rationale space provided several lessons on the design of a shared rationale space:

Lesson One: Because the majority of the groups managed the rationale space by organizing the rationales according to their authors, the design of rationale space should support the author-based ordering;

Lesson Two: as the users preferred their rationales being editable only by themselves, an author-based access control mechanism should be implemented in designing the shared rationale space;

Lesson Three: a visualization mechanism for the rationales should be implemented to support the awareness of intellectual contribution. The results show that although the rationale statements provide information on members’ intellectual
contribution in the group activity, the members may not be aware of that especially when other kinds of contribution are more evident (e.g., leader’s contribution on organizing the group work). Therefore, with the available shared rationales, it would benefit the group if a visualization mechanism is implemented that enable the members to be better aware of each other’s intellectual contribution;

Lesson Four: to alleviate the problem of groupthink, a control mechanism should be implemented in the design so as to make one’s rationale statements available to the group members at certain time instead of right after one writing them done. There can be various ways of implementing a control mechanism adopting either push or pull strategy. For a push strategy, the user chooses when to review others rationales; and for a pull strategy, the system makes a decision as to when to share the rationales in the group. During the study, several members acknowledged that being able to review others’ rationales helped them expand ideas. This seems to suggest that push strategy would be preferred, as this leaves to the users more freedom as to when to review others rationales.

Lessons for Group Learning Activities

The literature has shown that interaction in learning groups is essential for several reasons, but especially for reducing participants' perceptions of isolation, promoting community, and enabling participants to articulate their thoughts and reasoning processes as part of the learning process (Jonassen et al., 1995; Kanuka, 2002; Rovai, 2002; Biesenbach-Lucas, 2004; DeTure, 2004; Molinari, 2004). The findings from the literature indicate that the few number of group meetings in apple group may have impacted the group in a negative way that the members did not realize. These findings seem to also
provide an explanation of why peach group had the higher response value than orange group on item 3 – about the members’ satisfaction with their mini-report activities. Peach group worked together on each mini-report in the group meetings in a highly collaborative fashion, while the orange group members worked on their own sections independently with the divide-and-conquer strategy. The face-to-face meetings and the fact that everyone participated in all the sections of the reports may contribute to the peach group’s higher satisfaction of their work. One possible reason that apple group did not have the group meetings was that the instructor did not require the groups to have the meetings in order to complete the project. In fact, the apple group leader commented that he did not see any necessity of having the group meetings as neither instructor nor the teaching assistant knew whether the group had meetings or not. In many college courses when group activities are offered, the instructor does not require the group meetings. Instead, the groups are evaluated mainly based on their final products. Based on the understanding of the three groups’ work process and performance, it seems that by providing evaluation criteria on the group work process such as demanding on the group meetings and the collaborative activities among the group members the instructor could better offer the collaborative learning opportunities to the students.

As discussed in Chapter 6, because of the different levels of recognizing the learning goal of the activity and the way the group collaborated on the project, the apple group was labeled as school work module group, while the other groups were labeled as intentional learning groups. The interview results seem to suggest that the leader’s understanding of the project and his/her recognition of the learning goal are very important for the whole group’s learning experience and learning outcome. This implies
that in courses that offers group learning activities the formation of group leader should
take into account the individuals’ motivation of the course, and in studying the group
learning activities, the group leader’s learning intention should be considered as factor of
the whole group’s learning outcome.
Chapter 8

Future Research Plan

As one direction to continue the study, the effects of computer-supported rationale awareness in the community development will be investigated in the future research agenda. More specifically, two aspects of the effects are of the interests in the future research:

- Rationale awareness of previous activities contributes to the community development supporting knowledge reuse and promoting learning

As part of the model of a community’s social memory, rationale awareness contributes to the community development through supporting knowledge reuse. Social memory has been a research interest in various fields (e.g., Cattell and Climo, 2002; Connerton, 1989; Crumley, 2002; Fentress and Wickham, 1992). The literature identifies a number of specific features that define social memory. According to Crumley:

“Social memory is the means by which information is transmitted among individuals and groups and from one generation to another. Not necessarily aware that they are doing so, individuals pass on their behaviors and attitudes to others in various contexts but especially through emotional and practical ties and in relationships among generations [...]” — Crumley (2002)

As indicated in the above definition, design for a community’s social memory means archiving not only the facts happened in the community including interactions among the community members, but also the members’ emotions and feelings associated
with these facts and interactions as they are part of the contexts. Hence, designing for an online community’s social memory is beyond archiving the community members’ interaction history and the community’s events. An example of this design philosophy is Lee and Boyd’s prototypes for supporting online chat users’ memory of interactions (Lee and Boyd, 2001).

The members’ rationales of their attitude, behavior, and/or decisions in these facts/interactions should be archived as part of the social memory. The rationale repository of the community is expected to support the community’s awareness of how the members came up with the solutions of projects, how they decided on community issues, how the community moved into current direction and developed from previous stage to current stage, etc. When searching in the social memory, members are able to retrieve not only the previous solutions but also why. Prior studies show that previous experiences and reasoning can play an important role in present situation and can contribute to one’s development, e.g., the studies of case-based reasoning (CBR) (Kolodner, 1993, 2004; Schank, 1982, 1999).

CBR focuses on reasoning based on previous experience and emphasizes that the key to promote learning is the ability and need to explain. In CBR, the ability to explain develops over time through noticing the similarities and differences of the experiences (e.g., Kolodner, 1993; Holyoak, 1984, Redmond, 1992). It is expected that knowing the rationales of previous experience helps the development of the ability to explain by contributing to the process of comparing the previous and present experiences. Considering an online community of practice, we can imagine various scenarios in which members find previous projects to be useful for current activities, and knowing the
rationales of previous projects help members decide what can be re-used and what to be discard in the present situation. Over time, members develop the practice and the community advances its knowledge base through accumulation of previous activities experiences.

- Rationale awareness contributes to the community development promoting reflective and critical thinking process in the community

The results of this study show that the process of documenting rationale helped the students to revisit previous decisions (see Chapter 5). It is expected that the practice of documenting and sharing rationales in the community promotes reflective thinking both at the individual level and at the community level contributing to the community development.

At the individual level, the process of documenting rationales is consistent with the flow of “good learning” (Vygotsky, 1978), not an interruption. Schön also noted that professionals pause to reflect on their approaches or methods in their in daily work practice in various fields (Schön, 1983). Documenting rationale is to externalize that thinking process.

At the group or community level, the rationale awareness is expected to contribute to the co-reflection process. Building on Boud et al.’s (1985) definition of reflection, Yukawa proposed the definition of co-reflection – “a collaborative critical thinking process involving cognitive and affective interactions between two or more individuals who explore their experiences in order to reach new intersubjective understandings and appreciations.” (Yukawa, 2006). She proposed two types of co-reflection: tacit and active. Tacit co-reflection refers to the situation that the reflective self
engages in inquiry without directly seeking feedback during the process. Active co-reflection refers to the situation that the reflective self engages inquiry through explicitly seeking feedback in an overtly interactional and discursive manner. She found out that co-reflection involves cognitive and affective interactions in synergy with relationship building.

Adopting the concept of co-reflection, one future study of this research is to investigate the effects of rationale awareness on the community’s co-reflection process.

**Rationale awareness in Open source community**

Open source software development refers to the “development of software through collaborative, informal networks of professional or amateur programmers, and the networked distribution making it available to developers and end-users free of charge” (Ghosh, 2005). As such, the networks of developers and users are the core backbone of the socio-technical infrastructure that supports the interactions happening through the networks. An open source community therefore creates a complex ecology in which developers and users together contribute to the development of norms, rules, and relationships within the community, and contribute to the direction and evaluation of the software development. Some of the characteristics of an open source community includes: project centric; developers are often intrinsic motivated and self-select work; and the work features many users and developers that collaborate through electronic communication channels on identifying problems, searching for solutions, testing the designed features, and using the software they are working on.
The work in open source software development is distributed. One particular coordination challenge to open source software is to bring together modules of code (Narduzzo & Rossi, 2005). Modularity has been a key element in the success of open source software development. Developers tend to act before declaring their commitment (Yamauchi, Yokozawa, Shinohara, & Ishida, 2000). This bias toward action leads developers to coordinate their work only after they have completed their self-initiated tasks, which poses a challenge on integrating the modules into one piece.

Codes are major information shared within the open source community. An open source community’s social memory inevitably consists of codes exchanged within the community, as well as the members’ collaborative activities (e.g., problem identification and fixation). In literate programming (Knuth, 1984), the emphasis is to communicate with others about the meaning of the code, i.e., explaining the meaning of a program to other people. Hence, the focus of literate programming is on writing the documentation containing codes instead of the code containing documentation. The "program" then becomes primarily a document directed at humans.

Literate programming seems to be an appropriate model to look into as a first step towards modeling for combining the code sharing and rationale sharing in the open source community. The new model aims at supporting rationale awareness and providing an integrated representation of the shared codes and rationales in the social memory. Different from literate programming, however, the rationale of a piece of code explains why the code writer coded the computer behavior in such way (that is, “designed” the code structure in a certain way) instead of explaining the meaning of the code. It can include both the rationale of the module, and the rationale of a code. It is expected that
sharing the rationales of the modules and codes would help developers coordinate their acts that already happened before the declaration to others and integrate their work together.
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Appendix A

Instruction on Writing a Meaningful Rationale Statement in the Usability Engineering Course

Group Project

In this final report, you are required to document the rationale of your idea, your choice, your approach, and your decision regarding all artifacts they have worked on. An example of writing down your rationale is given below:

Your group project is at usability testing stage of the project. You decide to develop a walk through for three types of users. This walk through documentation is a group work in the sense that everyone writes part of it. You are assigned to develop the material for OEV staff. As you are writing the material, document why you write the material in the way you write, i.e., why you think the material you write will be interesting and helpful for the OEV staff.

You are required to share your rationale with your group members, which is to help everyone maximize the benefit of working and studying this course in groups.

You are also required to post a question to your group members related to the shared artifact. Your questions will be graded for its level of profound curiosity. A question that is thoughtful as well as thought provoking gets full score, whereas one that perfunctorily seeks factual answers will not be given credit.

Your rationale will be graded. We will count the number of meaningful rationale to examine how engaged you are in this design project and in the group. If you comment on others’ rationale or respond to others’ comments, your comments and responses are
counted as your rationale as well (if they are meaningful). Additionally, if you answer the questions posted by your group members, your answers will be counted as your rationale too (if they are meaningful).

Please follow the instructions on how to write a meaningful rationale:

**Instructions on writing a meaningful rationale**

You should write your rationale (including your comments and responses to others’ rationale if any) in such way that when you write them, you should explain why you come up with your decision, your choice, or your approach. One easy strategy of writing this is to include at least one "because" in your statement such as:

*Your choice/decision/approach/thought, because blah blah blah*

Examples of meaningful rationale are:

“We used this information metaphor in our project, because it shows that our web site is not just an information repository of these artifacts, but also a place where people can meet and discuss these artifacts”

“Writing information metaphors seem to be a good idea because it can really get us explore possible design ideas for the web site”;

“I don’t think the information metaphor is necessary in our project though because it can be anything and hard for us to focus in this short time”

However, a student can still give comment or write a note that is not insightful at all even if she/he includes a reason within the statement. In another word, the reason the student gives is a false one. A false reason does not really answer why you have such note/comment, i.e., does not really show us your rationale.

Examples of a statement that has a false reason are:
“This information metaphor is useful for our project, because all my group members say so”, or

“Writing information metaphors seem to be a good idea because everyone uses it”, or

“I don’t think the information metaphor is necessary in our project though because it is not required”

Each of the above reasons is false because they do not tell us the real reason. For example, in the first statement, there are several possible real reasons:

- The student understands why all group members say that information metaphor is useful for the project and agrees on this reason
  - If your note/comment is based on someone’s opinion and you understand the reason of their opinion and agree on it, then in your statement you should give the reason in your own word. So the statement might be something like

  “This information metaphor is useful for our project, because all my group members think we can use this information metaphor directly in the group”

  Note that it is not acceptable to say “This information metaphor is useful for our project, because all my group members think it is useful” because you are just repeating their opinion without giving their reason of why it is useful
o The student agrees with all group members not because she/he agrees with their reason, but just because everyone says so

o If your note is based on someone’s opinion and you agree with the person not because you understand and agree on his/her reason, but because of the social dynamics (e.g., that someone is your best friend and you trust him, that someone is the leader of your group and she/he knows a lot in general so you believe what he said, or that someone has higher stake, etc), give the reason that you agree with that person. So the statement might be something like

“This information metaphor is useful for our project, because all my group members say so, and if everyone says so, I have to agree”

Note:

If you decide to use BRIDGE case builder, please write down your rationale in the rationale document created for the artifact (recall from BRIDGE demo: the rationale panel is below the artifact panel in the case builder tool; for example, a rationale document is below the walkthrough document you are developing. Your rationale includes your rationale of your work, your comments and your responses to others’ rationale, the question you post to the group regarding a shared artifact, and your answer(s) to the questions. Please follow the convention in the rationale space:

1. Please do not delete other’s posts (we can track down this behavior with our server log);

2. Please start with [ ] with your BRIDGE id in it when you write down anything (as we will grade your work)
3. Please end with “(response)” if your post is not your rationale of the shared artifact, nor is your question (e.g., it might be your answer to other’s question, your comments’ to others, etc)

You don’t have to turn in your rationale through ANGEL. We will check your group’s BRIDGE case builder when we grade.

If you decide not to use BRIDGE case builder, please turn in your rationale through ANGEL. This includes your rationale of your work, your comments and your responses to others’ rationale, the question you post to the group regarding a shared artifact, and your answer(s) to the questions. Please make your rationale and question available to your group members.

If your group member do not use BRIDGE case builder and you have comments/response to his/her rationale and question, please collect those (if they are not in BRIDGE) and turn in those through ANGEL
Appendix B

Survey Used in the Usability Engineering Course in Fall 2006

1. BRIDGE case builder prototype

Thank you very much for participating in this study. This questionnaire consists of two sections: BRIDGE case builder prototype, and your learning experience. Please fill out the questionnaire by noon Wed. (12/19/2006). All the information you submitted will not be used to evaluate your performance in the course, nor will it be shared with your teammates. Please fill this out individually. This first page is the questions about BRIDGE case builder prototype. These questions help us understand the use of the current prototype and help us better design the next prototype. Thank you for your participation. (N = 9)

1. What did you like most about using the BRIDGE case builder tool and why?

- “The thing that I liked most about using BRIDGE was the feature for real time collaboration. Being able to interact with my group mate while making changes and comments.”
- “I liked the group chat and being able to see changes that other team members are making in real time.”
- “I liked that it was real time display of what was being placed into bridge. Another key feature is that you could speak with your group members that were signed on directly in bridge instead in a separate application such as IM”
• “I enjoyed the connectivity features because it allowed for communication at long distances”

• “I like the organization and how it kept all our project information in order and viewable by all members.”

• “I like that it is a unified place where team members can go to build a case study. Everyone can work on it at the same time and it updates in real-time.”

<table>
<thead>
<tr>
<th>Survey Item (N = 9)</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. It was easy to find where my classmates had left rationale with the tool</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3. I liked the fact that the rationale I leave are related to the document/material I refer to directly</td>
<td></td>
<td></td>
<td>2</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>4. I like the fact when my classmate made a rationale for a material I could notice it while I was still using the tool</td>
<td></td>
<td></td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5. The feature of relating a rationale with a document helped me better understand my teammates’ points in the rationale</td>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6. I liked the fact that the rationale about one document/material by our group are there in one place and everyone can put their arguments there</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

7. Give one design feature that you would suggest to be added to the next prototype, or removed/changed from the current prototype?

Nobody answered it

2. Learning Experience

These questions were planned to carry out through interviews. As scheduling an interview time is very difficult with this class, we decided to make these questions as part of the questionnaire. The questions help us understand how you perceive the project, your
experience of working with the team, and the usefulness of documenting rationale and reflection. Because it is not conducted through interview, we cannot ask for details regarding your answer to better understand your ideas and thoughts. So please try to articulate your answers as clear as possible. Again, please be assured that your identity will not be revealed and your answers will not be evaluated as part of your course grade. Thank you for your participation.

8. How do you like or dislike this project that includes field trips to customer's organization, direct communication with customers, and evaluation from customers for different prototypes during the design?

- “I enjoyed going to the customer’s organization. It gave me a chance to see what we were working for. Having a chance to make a system that would give easy access to XXX’s archive was great. I hope that XXX gets the funding they need to continue with this project.”
- “I think it is a good idea to interact with ‘real world’ users during the class. It helps to prepare for dealing with different types of people in your career.”
- “I liked it. It gave us practice and experience in working with a customer to fulfill their needs and wants.”

9. In retrospect, when and how you played which role in the group project?

- I assumed the role of project manager through the design and conceptualization, then took a backseat to the programmers, while still offering my insight throughout the process.
• I help with what portions of the project needed to be put into bridge. I was active in using the tool the whole time.

• I think my role in this project was group leader. During our meetings I tended to take charge and get my team focused and ready to work.

• For the most part, our roles were equal. One member did act more as leader until it came time to get a lot of work done in a short period of time. During those times, I would often become a bit more demanding and hound the other members to the point that I am not well liked.

• The main role that I played in the project was the group leader. I kept our communication and meetings scheduled and organized while also sharing in the work that was done individually outside of meetings.

• at some times i acted as a leader and took on many aspects of the project, at others. i let people chose what they wanted and took the leftover tasks

• I did not necessarily play a role in any particular group project.

• I was the group leader in the project. I kept everyone under control, designed the prototype, and helped in numerous writings.

• "When and how you played which role"? That doesn't make much sense. I did most of the work actually creating the prototype.

10. Did you read others’ rationale/comments/reflectio

Yes (5)

No (4)
11. If Yes, do you think you have learnt things from their rationale? If so, please give one or two examples here. Please be specific about what you have learnt (e.g., design idea, the way of approaching the problem). If not, please indicate it here as well.

Yes (4)
- “I learned how other people react to what a person says also how design ideas differ from team to team and the way they see how the project should be.”
- “Learned what they were thinking (sometimes - never really know what anyone behind a computer is actually thinking...). I can not recall the specifics.”
- “Yes. I learned how they went about coming up with their ideas on the project.”
- “Yeah, I think I did learn some things. I basically learned how my teammates think.”

No (1)
- “I do not believe I have learned anything about my teammates' rationale from the tool. Our daily meetings afforded me the opportunity to learn far more than any "emotionally-removed" interface ever could.”

12. How do you think reflection and rationale are different or are the same? (this helps us understand how you perceive these two concepts. there is no right or wrong answer. so please do not use web or other sources for definitions of these two. your understanding is what matters)
- Rationale is the ideas behind my thinking. Reflection is what I remember thinking as I look back. Reflection can change as the process continues. Rationale is a core belief that does not change.

- Reflection, I think is about realizing what you did after something has happened. Rationale, is replying to what other people thing about your ideas. So i believe that they are different.

- Reflection is the process of thinking about what you did and how you did it. This can also lead to regret at not doing something sooner. Rationale is more along the lines of why you did it, as well as what unformed that decision.

- They are different. Rationale is developed while you are creating your problem. Reflection occurs after you have created it and are trying to fix it.

- Reflection is looking back on a situation after it is over. Rationale is what you are thinking at a given time to cause you to make a certain decision.

- i think reflection is looking back at what you did when you are done, and rationale is while you are doing it

- I'm not really sure to be honest.

- Reflection is looking back at what you came up with. Rationale is looking at exactly how you came up with the information.

- Rationale is the reasoning behind what you did. Reflection is the process of reviewing or looking back on what you did.
13. Optional Question Please indicate which group you belong to? (this is only used for relating the group activity with your answer. Your identity will not be revealed by answering this question)

Nobody answered it
Appendix C

Background Surveys Used in the Project Management Course in Spring 2007

Please enter your questionnaire code (It is the code stapled to the presentation slides handed out to you. The code consists of your group name and a fruit name, e.g., G1Apple)

How experienced are you using each of the following tools for the purposes other than work?

<table>
<thead>
<tr>
<th>Tool Description</th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant Messaging</td>
<td>3.2% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>3.2% (1)</td>
<td>93.5% (29)</td>
</tr>
<tr>
<td>Data spreadsheet</td>
<td>6.3% (2)</td>
<td>9.4% (3)</td>
<td>40.6% (13)</td>
<td>21.9% (7)</td>
<td>21.9% (7)</td>
</tr>
<tr>
<td>Concept mapping tools (e.g., SmartDraw, CmapTools)</td>
<td>40.6% (13)</td>
<td>43.8% (14)</td>
<td>15.6% (5)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Play online game with others</td>
<td>3.1% (1)</td>
<td>12.5% (4)</td>
<td>21.9% (7)</td>
<td>12.5% (4)</td>
<td>50.0% (16)</td>
</tr>
</tbody>
</table>

How experienced are you using each of the following tools for work purposes:

<table>
<thead>
<tr>
<th>Tool Description</th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant Messaging</td>
<td>0.0% (0)</td>
<td>9.4% (3)</td>
<td>15.6% (5)</td>
<td>28.1% (9)</td>
<td>46.9% (15)</td>
</tr>
</tbody>
</table>
Have you worked on exercises that require you to write down your explanations before?

Yes 83.9% (26) / No 16.1% (5)

Experience with Tools

How many hours do you spend daily on the computer?
How many years have you been using computers?

How comfortable are you with writing and posting notes on a wall that is shared by others?
- Not at all comfortable: 3.2% (1)
- Not very comfortable: 0.0% (0)
- Somewhat comfortable: 16.1% (5)
- Fairly comfortable: 38.7% (12)
- Very comfortable: 41.9% (13)

How comfortable are you with writing and posting notes on a computer screen space that is shared by others?
- Not at all comfortable: 0.0% (0)
- Not very comfortable: 0.0% (0)
- Somewhat comfortable: 25.8% (8)
- Fairly comfortable: 35.5% (11)
- Very comfortable: 38.7% (12)

Prior domain experience

On a scale from 1 (novice) to 5 (expert), please rate your LEVEL OF EXPERTISE with each of the following domains.

<table>
<thead>
<tr>
<th>Experience</th>
<th>Not at all experienced</th>
<th>Not very experienced</th>
<th>Somewhat experienced</th>
<th>Fairly experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing an individual project</td>
<td>3.2% (1)</td>
<td>6.5% (2)</td>
<td>12.9% (4)</td>
<td>48.4% (15)</td>
<td>29.0% (9)</td>
</tr>
<tr>
<td>Managing a team project</td>
<td>0.0% (0)</td>
<td>6.5% (2)</td>
<td>35.5% (11)</td>
<td>48.4% (15)</td>
<td>9.7% (3)</td>
</tr>
<tr>
<td>Working in distributed team</td>
<td>3.2% (1)</td>
<td>29.0% (9)</td>
<td>35.5% (11)</td>
<td>25.8% (8)</td>
<td>6.5% (2)</td>
</tr>
</tbody>
</table>
How would you rate your experience on managing a distributed team project? 9.7% (3) 35.5% (11) 32.3% (10) 19.4% (6) 3.2% (1)

Preferences and attitudes

**On a scale from 1 (strongly disagree) to 5 (strongly agree), please rate your LEVEL OF AGREEMENT with each of the following statements.**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Mildly agree</th>
<th>Neither agree nor disagree</th>
<th>Mildly disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I prefer to work alone rather than in group</td>
<td>12.9% (4)</td>
<td>38.7% (12)</td>
<td>25.8% (8)</td>
<td>19.4% (6)</td>
<td>3.2% (1)</td>
</tr>
<tr>
<td>I enjoy working in a group situation</td>
<td>6.5% (2)</td>
<td>58.1% (18)</td>
<td>16.1% (5)</td>
<td>16.1% (5)</td>
<td>3.2% (1)</td>
</tr>
<tr>
<td>I prefer to work on paper rather than on a computer</td>
<td>3.2% (1)</td>
<td>12.9% (4)</td>
<td>9.7% (3)</td>
<td>32.3% (10)</td>
<td>41.9% (13)</td>
</tr>
<tr>
<td>I enjoy working on the computer</td>
<td>74.2% (23)</td>
<td>19.4% (6)</td>
<td>0.0% (0)</td>
<td>3.2% (1)</td>
<td>3.2% (1)</td>
</tr>
</tbody>
</table>

Personal Information

Gender

Male 29

Female 1

University Level

Undergraduate

University major

IST 26  Telecommunication 1  Finance 1  Marketing 1  Film/IST 2

Number of years you have been studying it
First language

If English is your second language, then rate your proficiency on a scale from 1 (not proficient) to 6 (native proficiency) as the following (check one):

1. Not proficient: I cannot communicate at all with a native speaker of the language

2. Somewhat proficient: I can communicate with a native speaker of the language to a very limited degree (i.e., using broken words or phrases), but cannot carry on a conversation with a native speaker.

3. Intermediate proficiency: I can communicate with a native speaker of the language, although I find it difficult to do so; I can carry on a conversation with a native speaker of the language if (s)he speaks very slowly.

4. Advanced proficiency: I can carry on a conversation with a native speaker of
the language, although it is highly evident that I am not a native speaker of the language.

5. Near-native proficiency: I can carry on a conversation with a native speaker of the language with very little difficulty. Sometimes I am mistaken as a native speaker of the language.

6. Native proficiency: I am considered by other speakers of the language as a native speaker

Two students whose first language were not English, and they rated 6.
Appendix D

End Survey in the Project Management Course (Survey A)

Please answer the following questions with respect to your experience of working on the Deloitte group project this semester. All answers will remain confidential. Your responses will NOT impact your grade on this project in any way. The goal is to increase our understanding of teams, therefore your honest answers are most appreciated.

(All items were given the scale options of: Strongly Disagree 2 3 4 5 6 Strongly Agree)

6. I was aware of each member's contribution in challenges assessment activities

7. I was aware of each member's contribution in mini-report activities

8. Knowing my group members' explanations contributed to my awareness of their contribution in challenges assessment activities

9. Knowing my group members' explanations contributed to my awareness of their contribution in mini-report activities

10. If we had worked on the challenges assessment without sharing the explanations, I would have been less aware of my group members' contributions

11. I was aware of my group members' expertise as we were working on challenges assessment activities

12. I was aware of my group members' expertise as we were working on mini-report activities
13. Knowing my group members' explanations contributed to my awareness of their expertise in challenges assessment activities

14. Knowing my group members' explanations contributed to my awareness of their expertise in mini-report activities

15. I would have been less aware of my group members' expertise with respect to this project if I did not know their explanations.

16. We referred to the explanations of the challenges assessment from the previous assignments when we were working on present group activities

17. Although we could access to the explanations of the challenges assessment, we did not find it necessary in producing mini-reports

18. Our group found it useful for this project that we were able to access to the explanations of the challenges assessment from previous assignments

19. In the challenges assessment assignments, I read my members' explanations to monitor their work progress

20. We developed our own way of sharing the given rationale space now

21. We developed our own way of allocating the rationale space to the group members now

22. We did not develop our strategy on how to share the rationale space

23. We developed our own way of generating the group rationale now.

24. We developed our own way on deciding who writes the group rationale during the challenges assessment
Appendix E

End Survey in the Project Management Course (Survey B)

Please answer the following questions with respect to your experience of working on the Deloitte group project this semester. All answers will remain confidential. Your responses will NOT impact your grade on this project in any way. The goal is to increase our understanding of teams, therefore your honest answers are most appreciated.
(All items were given the scale options of: Strongly Disagree 2 3 4 5 6 Strongly Agree)

UGroup Work Experience

1. I see myself as a member of my group
2. I felt satisfied about our group work in challenges assessment activities
3. I felt satisfied about our group work in mini-report activities
4. My group members were competent in terms of generating a diverse set of explanations
5. My group members were competent in terms of generating good quality of explanations
6. My group members were quite competent in terms of generating good quality of mini-reports
7. Much disagreement on performing the tasks existed in challenges assessment activities
8. Much disagreement on performing the tasks existed in mini-report activities
9. A great deal of disagreement regarding the tasks existed in challenges assessment activities

10. A great deal of disagreement regarding the tasks existed in mini-report activities

11. Little tension existed in my group

12. When I needed help I counted on my group

Design of Rationale Space

1. I am comfortable with my explanations being shared with my group members as I was writing them

2. I prefer that my group members give me comments on the explanations instead of changing my explanations

3. I like the fact that when I open a document (e.g., a challenges map), the rationale space of the document is opened as well

4. I like the BRIDGE feature that each rationale space is associated with its document

5. I prefer to have one rationale space for all the group documents

6. I prefer to have a rationale space for each challenge note

Learning Experience

1. The process of generating my explanations helped me better articulate my thoughts

2. The process of generating my explanations helped me in understanding the project management subject
3. I found it helped me to explore the basic concepts of project management by generating the challenges during the challenges assessment

4. I found it helped me to explore the basic concepts of project management by generating my explanations of the challenges during the challenges assessment

5. I found it helped me to explore the basic concepts of project management by ranking the challenges during the challenges assessment

6. I found it helped me to explore the basic concepts of project management by generating my explanations of the ranking during the challenges assessment

7. I found it helped me to explore the basic concepts of project management by reading my group members' explanations

8. I found it helped me to explore the basic concepts of project management by writing mini-report

9. I found it helped me to explore the basic concepts of project management by attending the class

10. I found it helped me to understand how to manage IT projects successfully by generating the challenges during the challenges assessment

11. I found it helped me to understand how to manage IT projects successfully by generating my explanations of the challenges during the challenges assessment
12. I found it helped me to understand how to manage IT projects successfully by ranking the challenges during the challenges assessment.
13. I found it helped me to understand how to manage IT projects successfully by generating my explanations of the ranking during the challenges assessment.
14. I found it helped me to understand how to manage IT projects successfully by reading my group members' explanations.
15. I found it helped me to understand how to manage IT projects successfully by writing mini-report.
16. I found it helped me to understand how to manage IT projects successfully by attending the class.
VITA

Lu Xiao

Education
2008  PhD – The Pennsylvania State University, College of Information Sciences and Technology, State College, PA
2001  M.Sc. – The University of Florida, Department of Computer Information Sciences and Engineering, Gainesville, FL
1996  B.Eng. – Hunan University, Department of Chemical Engineering, Changsha, HN, P.R.China

Research Interests
Computer-Supported Collaborative Learning, Computer-Supported Cooperative Work, Community Computing

Award
Finalist of Google Anita Borg Memorial Scholarship (National Award for Women in Computing), 2006

Selected Publications
• Beyond Being Aware, Carroll, J. M., Rosson, M. B., Farooq, U., Xiao, L., Merkel, C., and Schafer, W., Information and Organization, accepted for publication
• Promoting Reflective Thinking in Collaborative Learning Activities, Xiao, L., Clark, S., Carroll, J. M., Rosson, M. B, Proceedings of the 8th IEEE International Conference on Advanced Learning Technologies (Santander, Spain, July 1st – July 5th, 2008)
• Support of Case-based Authentic Learning Activities: A Collaborative Case Commenting Tool and a Collaborative Case Builder, Xiao, L., Carroll, J. M., Clemson, P., Rosson, M.B, Proceedings of 41st Annual Hawaii International Conference on System Sciences (January 7-10, 2008, Big Island, Hawaii)
• Students as Teachers and Teachers as Facilitators, Xiao, L. et al., Hawaii International Conference on System Sciences (HICSS-38), January 3-6, 2005, Hilton Waikoloa Village, Big Island, Hawaii, p.4a.

Teaching Experience
• Course Instructor – Usability Engineering
• Graduate Teaching Assistant – Project Management, Security and Risk Analysis, Fundamentals of Systems and Enterprise Integration, Programming in C++, Computer-Based Business Management, Programming in JAVA

Work Experience
• Graduate Research Assistant
• Worked with John M. Carroll & Mary Beth Rosson from Aug’02 to Aug’08
• Worked with Stephen Haynes on design research from May’07 to Dec’07

Professional Organizations
    ACM, ACM-SIGCHI, ISLS, ALISE