Abstract
Earlier research has suggested that anonymous communication is appropriate for creative task, and identified communication is suitable for decision-making task. The current study brings into this picture a third dimension – gender composition. Specifically, the work seeks for a better understanding on how the three components will intertwine in a collaborative learning context. The novel elements of gender and learning are in and of themselves significant. Through theoretical analyses, the paper arrives at a set of fruitful propositions. A central proposition conjectures that all-male learning groups will achieve the best learning outcome while performing decision-making tasks using an identified style of communication; as well, all-female learning groups are expected to achieve the best learning outcomes while performing creative tasks via anonymous communication.

Keywords: Gender composition, Collaborative learning, Anonymous communication, Task types

Introduction
Fuelled by the knowledge economy, the importance of education and training to individual and the society has been widely recognized. With the swift advancement of computer hardware, software and network technologies, learning is enhanced by various information and communication technological supports. Technology-mediated learning has received increasing attention in the field of information systems research (e.g. Alavi and Leidner, 2001). In fact, IT has been deemed by many researchers to be ubiquitous in the delivery and management of education (Currier and Campbell, 2002). Communication support, which may entail message exchange and document sharing, is a fundamental form of technological tool for learning (Newman et al., 1997). The sophistication levels of communication in the context of learning can vary widely. An important aspect concerns the providence of anonymity.

Whereas the approach and process of learning can take on many forms, collaborative learning has deservedly attracted considerable attention. Collaborative learning refers to a process where groups of people work together to create meaning, explore a topic, or improve skills (Harasim, et al., 1995). Its effectiveness has been demonstrated in various studies (e.g., Blaye and Light, 1994). Knowledge construction during collaborative learning occurs as individuals “exercise, verify, solidify, and improve their mental models through discussion and information sharing” (Leidner and Jarvenpaa, 1995). In a computer-supported collaborative learning (CSCL) context, an individual’s knowledge is gained through performing a learning task collaboratively with a group of other learners. Essentially, technology, task type and characteristics of learning groups form major factors influencing learning outcomes.

The nature of task plays an important role in a group’s interaction process and performance (Hackman and Morris, 1975; Goodman, 1986). Task characteristics are believed to affect
technology effectiveness on group performance (Straus and McGrath, 1994). They are found to variate the occurrence of elaborative activities during collaboration and in turn affect individual learning outcomes (van Boxtel, et al., 2000). The concept of task comprises multiple dimensions. In this connection, task type has been addressed by McGrath’s task circumplex (1984), which arguably is the most widely adopted task classification scheme. It is used not only in theoretical studies on small groups (e.g., Goodman, 1986; Jackson, 1992), but also as a conceptual foundation for empirical studies, particularly in the area of communication technologies and cooperative group work (e.g. Zigures et al., 1988). This circumplex organizes eight types of tasks into a two-dimensional space with the horizontal axis denoting whether the task requires cognitive or behavioral performance, and the vertical axis reflecting the relationship among group members as required by the task (McGrath, 1984), referred to as interdependence in McGrath’s later study (Argote and McGrath, 1993). Three levels of interdependence are specified, namely collaboration, coordination, and conflict resolution. In the current study, we focus primarily on two collaborative cognitive tasks defined by McGrath, i.e., creative and decision-making task.

For a creative task, more alternatives would lead to a greater examination of the problem and would enhance the depth of thinking concerning the problem. On the other hand, for a decision-making task which requires a choice among fixed alternatives, the problem will be solved by a dominant coalition in the group. Shaping the performing of tasks in light of a communication process, an aspect whose importance cannot be emphasized is anonymity. Borrowing from minority influence theory (Nemeth, 1986), arguments have been put forth that because anonymity can encourage participation of all members (Jarvenpaa et al., 1988), the resultant increase of minority participation would lead to more novel and better ideas being generated. Some earlier work has shown that anonymous communication is more effective for creative tasks than for decision-making tasks (Rao and Jarvenpaa, 1991). However, whether the effect is consistent for different group compositions remains unearthed.

Gender difference as a learner characteristic is shown to affect technology-mediated learning (Blum, 1997). In terms of communication styles, men tend to be more aggressive and argumentative in communication than women (Nicotera and Rancer, 1994). Moreover, male and female differ in their styles of learning and collaboration (Edwards et al., 1997). However, most of the studies on gender in technology-mediated learning have been conducted at the individual level. In a collaborative learning context, learners’ performance may vary with gender composition of a learning group (Edwards, et al., 1997). In this study, we attempt to examine the joint effects of anonymity in communication and task type on learning in all-female learning groups, and see how those would differ from all-male learning groups.

Theoretical Background on Computer-Supported Collaborative Learning
The use of computer-supported tools in an educational setting must be guided by certain learning theories. The underlying pedagogical model of collaborative learning is constructivism. Constructivism is a psychological and philosophical perspective stating that individuals form or construct by themselves much of what they learn and understand (Bruning, et al., 1995). A basic assumption of constructivism is that individuals are active learners and knowledge is constructed internally rather than from external transference (Geary, 1995). Theoretical studies (e.g. Whipple, 1987) and experimental efforts (e.g., Flynn, 1992) both point to the effectiveness of collaboration on human cognitive construction of knowledge as well as the need for collaborative techniques in learning environments. As an
extension of the constructivist model, the cooperative model of learning states that learning emerges through individuals’ interaction (Slavin, 1990). The major goal of cooperative learning is to construct shared understanding through interaction with other individuals (Leidner and Jarvenpaa, 1995). Learners learn from one another by actively engaging in exchanging knowledge and information based on their understanding as well as individual experiences (Harasim et al., 1995). Enabled with technology supports, effective learning can be achieved through more interactive communications and teamwork with a group of learners.

**Propositions**

**Collaborative tasks and gender composition**

Compared to other task types, creative tasks involve the least degree of cooperation among group members. Quite in contrast, as decision-making tasks require the reaching of consensus on a preferred answer (Straus, 1999), they require greater interdependence among group members. This level of interdependence among group members refers to the characteristics inherent in a task, instead of originating from the convergence or divergence pertaining to individual value/interest (Argote and McGrath, 1993). To complete a creative task, every member in the group contributes independently. Therefore, the completion of the task is based on the simple combination or summation of everyone’s ideas (McGrath, 1984). In such a situation, little or no efforts were required to achieve consensus for task completion. However, decision-making tasks require higher group member interdependence and ask for a preferred solution (McGrath, 1984). Group members need to evaluate each alternative and persuade each other before a decision can be made to complete the task.

Since men exhibit more task-oriented interaction (Wood, 1987), when assigned a decision-making task, they are more likely to elaborate the pros and cons of every alternative and stick to their own stand until being persuaded by strong evidence. From the constructivist perspective of learning, learners will benefit more from extensive elaboration, discussion and negotiation among group members, which are especially important in the setting of computer-supported learning, since people are more reluctant to communicate using computers. On the opposite, when performing a creative task requiring less group member interdependence, there will be less interaction among learners in an all-male group. Men may engage in a pattern of continually proposing their own ideas while ignoring others’, especially in a computer-supported learning context where learners are more disconnected as the physical proximity is not guaranteed. Thus, they enjoy less benefits of knowledge construction from creative tasks when involved in CSCL.

All-female groups are shown to behave in a more positive socio-emotional way than all-male groups (Carli 1989; Anderson and Blanchard 1982). Computer-mediated communication is believed to reduce social cues in communication. Generally, female has a tendency to avoid conflict in communication. When women perform a decision-making task, they try to foster cooperation and connection within the group. As a result, members of an all-female learning group tend to reserve their opinions and compromise their stands to complete the task while maintaining a peaceful atmosphere. When performing a creative task, because of their tendency in building cohesion during communication, women would ask more probing questions to foster cooperation and connection, information sharing and other group members’ participation (Hawkins and Power 1999), and they have demonstrated greater social interdependence in computer-mediated groups (Jaffé, et al., 1999). In this case, women show interest on each other’s proposed idea and ask for more details of each idea, and this
will be more effective in achieving a better learning outcome in a CSCL context. 
Along this line, when given a decision-making learning task, as men have less concerns on 
whether the fierce discussion would ruin the harmony among group members than women, 
they will participate more and benefit more from the interaction during learning process. For 
a creative task, as men tend to contribute somewhat independently and ignore other’s idea, 
the effectiveness of interaction will be limited. However, women pay more attention to each 
other’s opinion and ask questions on others points to foster a harmonious atmosphere. 
Therefore, the following are proposed.

Proposition 1: In a CSCL context, male groups have better learning outcomes with decision-
making tasks than creative tasks; female groups have better learning outcomes with creative 
tasks than decision-making tasks.

Proposition 2: In a CSCL context, learning outcomes through decision-making tasks are 
better for male group than for female group; collaborative learning outcomes in creative 
tasks are better for female group than for male group.

Anonymous communication and gender composition

Anonymity provides members with equal opportunities to express ideas by reducing the cues 
of social status and thus the fear of disapproval from other members. Research has shown that 
the reduction of social cues caused by computer-mediated communication (Dubrovsky et al., 
1991) encourages greater participation (Siegel, et al., 1986) and minimizes the potential 
disadvantages associated with gender stereotypes (Herschel, et al., 1994).

As men are more likely to create social cues or gender-related references (Flanagin et al., 
2002), they are more willing to communicate non-anonymously with the identification of all 
group members available. Therefore, as identified communication provides men a 
comfortable environment for participation and communication, it will lead to better learning 
outcomes for male groups than anonymous communication.

Anonymous communications help mask any gender-related status differences that could 
potentially be perceived by members in e-collaboration, it is shown to be effective in 
encouraging more efforts and participation in collaborative learning by overcoming female 
learners’ inner restraints and evaluation apprehension (Hakkarainen and Palonen, 2003). 
Since women are always trying to maintain the reduced social cues of collaborative 
technology (Flanagin et al., 2002), they prefer to interact through collaborative technology 
anonymously because the sensitivity about risks of being judged is addressed (Gopal, et al., 
1997). Therefore, they are able to communicate and interact with group members more 
freely, and learn better through anonymous communication.

As men are more comfortable with identified participation and women are more comfortable 
with participating anonymously, from the viewpoint of constructivism, better interaction and 
communication would lead to better learning outcomes. The following are proposed.

Proposition 3: In a CSCL context, male groups have better learning outcomes through 
identified communication than anonymous communication; female groups have better 
learning outcomes than male groups through anonymous communication.

Proposition 4: In a CSCL context, male groups have better learning outcomes through 
identified communication than anonymous communication; female groups have better 
learning outcomes than male groups through anonymous communication.
Implications

Theoretical implications

In the previous section, we put forth an explanation on how gender composition would interact with task type and anonymity of communication, separately and jointly, to affect learning outcome. Combining the above propositions, we posit that for all-male learning groups, the best learning outcomes can be achieved with decision-making tasks using identified communication; and for all-female learning groups, the best learning outcomes are achieved with creative tasks performed through anonymous communication. Previous research has suggested that anonymous communication is appropriate for creative tasks (Rao and Jarvenpaa, 1991) and identified communication for decision-making tasks, but neglected the difference caused by gender composition of learner groups. The propositions of this paper foster a better understanding on the effect of gender composition on collaborative learning.

Practical implications

The current study also provides important practical guidelines in aspects concerning collaborative task design as well as the selection of technological support for learning. Designers of learning materials and activities need to pay attention to the gender difference of targeted groups and select the most appropriate technological support to achieve the best learning outcomes. By being aware that gender difference of learning group has a significant impact on the effectiveness due to technological support and types of collaborative task, instructors and teachers should seek and incorporate appropriate guidelines and actions to encourage learners’ participation, facilitate the communication process and improve learning outcomes. Moreover, a comprehensive set of design principles should be compiled to guide feminine learning design relative to the joint effect of gender, technology and task (Campbell, 2000).

Concluding Remarks

This study posits that all-male learning groups would achieve optimal learning outcome with decision-making tasks using identified communication, and all-female learning groups would achieve optimal learning outcomes with creative tasks using anonymous communication. The propositions could be empirically tested by a laboratory experiment with 2×2×2 factorial design. The independent variables are task type, technology-facilitated anonymity in communication and gender composition. Learning outcomes can be accessed through actual learning, which is measured by tests and exams, or perceived learning, which refers to “changes in the learner’s perceptions of skill and knowledge levels before and after the learning experience” (Alavi et al., 2002).

In summary, the propositions proposed in this study highlight the importance of learning groups’ characteristics for collaborative learning research. Of course, some features have greater significance than others; this paper takes the position that gender composition cannot be ignored. It will be productive for future research to build upon this study by comparing mixed-gender groups with gender-homogenous groups.

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