



Effects of gender grouping on students' group performance, individual achievements and attitudes in computer-supported collaborative learning



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ABSTRACT

The purpose of this study was to examine the effects of gender grouping on students' group performance, individual learning achievements and attitudes in computer-supported collaborative learning (CSCL). 588 undergraduate students enrolled in a digital design course were randomly divided into 147 four-student groups that fell into five categories according to the composition of group members' gender, namely 4M (four males), 3M1F (three males and one female), 2M2F (two males and two females), 1M3F (one male and three females) and 4F (four females). Results indicated that: (1) For group performance, 2M2F and 4F groups significantly outperformed the other groups. (2) For individual learning achievements, no significant difference was found in females among different gender grouping interventions; however, males in mixed-gender groups performed significantly better than those in single-gender groups. (3) In terms of individual attitudes, males preferred mixed-gender, gender-balanced, and gender-majority grouping; however, females preferred single-gender and gender-minority grouping. (4) The effect of gender grouping mainly influences students' attitudes, rather than performance. These findings provide evidence that female-only and balanced-gender grouping are two kinds of good grouping interventions that could be recommended for CSCL, and male-minority groups should be avoided because they led to the worst group performance and individual attitudes.

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1. Introduction

Computer-supported collaborative learning (CSCL) is one of the most promising learner-centered approaches for students to learn as a group via social interaction by using computers or through Internet (Stahl, Koschmann, & Suthers, 2006). It enables students to share and co-create knowledge through a series of collaborative activities, which helps to improve their problem-solving, decision-making and collaboration skills (Popov et al., 2014). With the advancement of computer and information technology, CSCL now incorporates more possibilities and flexible support. Examples

include online forum, blog, micro-blog, WIKI, SNS, Moodle, MOOC, and other course-based online learning communities that have gradually been introduced to CSCL in recent years to help students to communicate and share resources more efficiently and effectively (Zhan & Mei, 2013).

To organize CSCL, dividing students into collaborative groups is a necessary step and an important issue that needs to be taken into consideration (Draper, 2004; Janssen, Erkens, Kirschner, & Kanselaar, 2009; Kreijns, Kirschner, & Jochems, 2003; Schumm, Moody, & Vaughn, 2000). Since gender is a fixed and visible attribute of each individual, it is not necessary to assess students' gender before grouping them. Therefore, compared to the other grouping strategies (such as ability grouping and learning style grouping), gender grouping is the easiest and most feasible method, thus it has been used most widely and frequently in various educational settings (Sopka et al., 2013; Underwood, Underwood, & Wood, 2000; Willoughby et al., 2009). Consequently,

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gender grouping is becoming an increasingly important topic and is in need of further exploration.

Several attempts have been made to analyze the effects of gender grouping on students' group performance in CSCL, but the findings to date have been varied. Some authors found no significant difference between groups with different gender composition in terms of group productivity. For example, the experimental study conducted by Xie (2011) concluded that group composition based on gender had no significant impact on collaborative learning outcomes. Similarly, Cheng, Lam, and Chan (2008) stated that in small group work such as project-based learning, gender grouping and group size were not related to student-reported collective and self-efficacy. By contrast, Underwood et al. (2000) held a slightly different outcome, finding that although there were few differences in task performance between same-gender pairs and mixed-gender pairs, the mixed-gender pairs showed lower levels of verbal interaction and less keyboard co-operation than same-gender pairs, and all students working in pairs outperformed those working individually.

Other researchers have clearly addressed the effects of gender grouping in group performance in CSCL; however, a debate is taking place on the opposing effects of gender grouping interventions. Researchers from one side of the debate believe that single-gender grouping is a better choice than mixed-gender grouping. Dalton (1990) made the point that mixed-gender groups scored lower than single-gender groups. Underwood, McCaffrey, and Underwood (1990) concluded that only homogeneous gender pairs improved their performance compared to individuals working alone. Stephenson (1994) noted that mixed-gender groups of college students were more socially oriented than same-gender groups, but same-gender groups produced higher achievement. Bennett, Hogarth, Lubben, Campbell, and Robinson (2010) found that although improvements in understanding are independent of the gender composition of groups, single-gender groups function more purposefully than mixed-gender groups. Monereo, Castello, and Martinez-Fernandez (2013) stated that a predominance of females in groups is one of the best predictors of group success.

Opponents argue that in mixed-gender groups, students' knowledge elaboration processes are more inclined to diverge from each other, which should be a significant predictor for successful group project outcomes in CSCL (Ding, Bosker, & Harskamp, 2011). Willoughby et al. (2009) found that students engaged in more collaborative behaviors in mixed-gender than in same-gender groups. Kirschner, Beers, Boshuizen, and Gijssels (2008) found that heterogeneous groups allow different perspectives to be brought to bear on a problem and thus enrich the problem space and allow for rich problem analysis and solutions. Even in mixed-gender groups, there are differences. Some studies reported a greater degree of cooperative learning in groups with either gender majority than in equal gender composition groups (Busch, 1996; Maskit & Hertz-Lazarowitz, 1986). However, contrasting results found by Takeda and Homberg (2014) demonstrate that students in gender-balanced groups display enhanced collaboration in group work processes, which could be associated with less social loafing behaviors and more equitable contributions to group work. Stefanou, Lord, Prince, and Chen (2014) added that a relatively student gender-balanced classroom and gender match between students and instructors provided better development of many adaptive self-regulated learning behaviors and attitudes.

At the individual level, gender differences have been reported in various perspectives in CSCL. From the perspective of inter-personal interactions, some researchers found that male and female students have different communication styles (Guiller & Durndell, 2007; Li, 2002). Guntermann and Tovar (1987) reported a greater tendency for male students to ask for information than for females, but female students were much more likely to express agreement

with their peers than male students. Howe (1997) found that teachers rated male students as slightly more assertive than female students; females often had more difficulties in solving problems independently as they preferred support and interaction with others more than male students, according to Gallagher and Kaufman (2005). Some other researchers pointed out a gender difference in intra-personal learning behaviors in CSCL. Willoughby et al. (2009) found that boys were more likely than girls to dominate computers in the classroom when working on computer-supported collaborative learning. Gonzalez-Gomez, Guardiola, Rodriguez, and Alonso (2012) found that female students assign more importance to the planning of learning, as well as being able to contact teachers in various ways. Furthermore, Green and Cillessen (2008) found that female groups had more collaborators than male ones, whereas male groups had more onlookers (i.e. low viewing, low helping). In addition, male students used a greater number and range of strategies to maintain control of the resources than females did. Ding et al. (2011) found that when students discussed physics problems online, males preferred illustrating the variables, drawing the relationships and mapping the solutions. In contrast, their female counterparts tended to use text-based messages to convey their ideas.

Only limited research has been conducted to analyze the effects of gender grouping on male and female students' learning in CSCL; however, a variety of results have been found. Ding et al. (2011) found that female students in single-gender groups significantly outperformed those in mixed-gender groups, whereas this was not the case for male students. Harskamp, Ding, and Suhre (2008) found that partner gender was a significant factor for female students' learning achievement. Within mixed-gender pairs, male students outperformed females. However, females in all-female pairs did just as well as males, whilst other studies found that gender differences had only minor moderating effects on learning outcomes and is not specifically related to sex itself, but relates to the complexity of the learners' social context (Abbiss, 2008; Chu, 2010).

There are also different findings on the effects of gender grouping on students' attitudes toward instruction in CSCL. Some research found that female students would have greater satisfaction in a novel computer-supported environment (Gonzalez-Gomez et al., 2012), and that they are more inclined to work with each other in a community atmosphere (Agnew, Mertzman, Longwell-Grice, & Saffold, 2008), while male students enjoy a premium in the traditional classroom setting (Gratton-Lavoie & Stanley, 2009). Nevertheless, Wang, Liu, and Lin (2009) hold a different viewpoint and found that mixed-gender and male-only groups had a higher degree of satisfaction and involvement than female-only groups. Sopka et al. (2013) further reported that participants of male-only groups felt significantly more uncomfortable and disturbed by their groups than male participants in mixed-gender groups. In contrast, female participants felt more comfortable in female-only groups. In addition, McCaslin et al. (1994) investigated group processes characterized by the giving or receiving of help in small groups and found that no gender differences existed, but that a more active learning environment was found to develop in mixed groups. However, in contrast to the above findings, Liu, Lim, and Zhong (2007) indicated that both male and female students achieved the best learning outcomes and had the best attitudes when they were in single-gender groups, because of the identified styles of communication. Due to the limitations and controversial opinions in previous studies, and because most of these studies were focused on analyzing gender difference rather than gender grouping in CSCL, we thought it beneficial and necessary to conduct a study to get deeper insights into how gender and gender grouping affect students' learning and attitudes. Gender grouping refers to the methods employed when dividing students into

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