Gender Differences in Stress, Perceived Competence, and Perceived Choice during Remote Collaborative Problem Solving

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Abstract: This poster reports on a study of 29 undergraduate student pairs collaborating remotely on a programming task. We found that women reported significantly higher levels of stress and significantly lower levels of perceived competence and choice compared to men. These findings motivate further investigation on how we can better support women during collaborative problem solving.

Introduction

Collaborative learning has become widespread in many educational contexts. Compared to competitive and individual learning, collaborative learning generally results in greater productivity and higher achievement, more supportive and committed relationships, greater self-esteem and social competence, and better mental health (Laal & Ghodsi, 2001).

Despite all the benefits associated with collaborative learning, there are still many challenges. Partners or team members can experience tensions regarding differing viewpoints and general incompatibility, which could be caused by factors such as differences in prior knowledge (Weinberger, Stegmann, & Fischer, 2007) or conflicting personality types (Kramer, Bhave, & Johnson, 2014). While some collaboration researchers have focused on finding optimal team formations (e.g., Konert, Bellhäuser, Röpke, Gallwas, & Zucik, 2016), we argue that it is also important for students to be able to work with many different types of people, since they will inevitably need to do so in real-world scenarios. Our work aims to move toward this goal in the context of dyadic computer science learning at the undergraduate level. In this context, women have been historically marginalized and continue to comprise only a small fraction of post-secondary computer science learners, earning just 20.9% of computer science bachelor's degrees in 2018 in the U.S. and Canada (Zweben & Bizot, 2019). By developing a deeper understanding of women's experiences during collaborative computer science learning, we can create more enjoyable and effective learning experiences for these students.

Study

Participants for this study were recruited in Spring 2019 from an introductory computer science course at a large public university in the Southeastern United States. A total of 58 students (24 women, 34 men) were assigned to work in pairs based on order of arrival to their corresponding study session, totaling 29 pairs. Participants did not know the identity of their partner, as they collaborated remotely and communicated via textual chat. They completed a pre-test, collaborated for approximately 60 minutes on a coding task, and then completed a post-test and post-survey.

For the coding task, participants were asked to create a two-player tic-tac-toe game. They were also instructed to incorporate a programming construct they had not previously learned into their solution, *try-catch blocks*. Students completed an assessment of their knowledge on this construct in the form of pre- and post-tests. Additionally, they completed three post-surveys relating to the usability of their programming interface and their collaboration experience. This analysis focuses on 18 questions from the validated Intrinsic Motivation Inventory (IMI) (McAuley, Duncan, & Tammen, 1989). The IMI consists of seven subscales measuring Interest/Enjoyment, Perceived Competence, Effort/Importance, Pressure/Tension, Perceived Choice, Value/Usefulness, and Relatedness. Participants respond to each survey item using a Likert scale from 1 (not at all true) to 7 (very true). At the very end, participants were asked demographic information such as age, gender identity, race, student classification, and prior programming experience. All participants identified their gender as either "male" or "female"; two additional options (an "other" option with a field to self-describe, and a "prefer not to say" option) were also available.

Findings

The results revealed several significant differences by gender on items from the IMI. After applying the Benjamini-Hochberg procedure as a correction for multiple comparisons (Thissen, Steinberg, & Kuang, 2002), four items remained significant: two from the Pressure/Tension subscale, one from the Perceived Competence subscale, and one from the Perceived Choice subscale (see Table 1 for a summary of the results).

Table 1: Significant gender differences in Likert scores for Intrinsic Motivation Inventory items

Intrinsic Motivation Inventory Item	**Subscale**	**Women's average Likert score**	**Men's average Likert score**	***p*-value**
I felt very tense while doing this activity.	Pressure/Tension	4.0	2.4	0.0005
I was very relaxed in doing these.	Pressure/Tension	3.7	4.9	0.0024
I think I did pretty well at this activity, compared to other students.	Perceived Competence	2.9	4.1	0.0026
I did this activity because I wanted to.	Perceived Choice	4.5	5.5	0.0085

Discussion and Conclusion

Students collaborating on problem-solving activities can have vastly different experiences due to a number of factors, both at the individual and environmental level. We found that women's responses differed significantly from men's responses to specific survey items related to stress, perceived competence, and perceived choice. More research is needed in order to understand the relationship between stress and learning in computer science and collaborative problem solving. Joëls, Pu, Wiegert, Oitzl, & Krugers (2006) suggest that stress can improve focus and memory during learning; however, an empirical study found that learning under stress can impair memory (Schwabe & Wolf, 2010). Stress in a collaborative setting has not been investigated at length, therefore research is needed on how stress differs between individual learning and collaborative learning, as well as how it differs between different collaborative learning paradigms, such as remote collaboration and co-located collaboration. By understanding students' intrinsic motivation during different collaborative learning situations, we can better provide support for these learners and improve their learning experiences.

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