



Classroom Social Interactions and STEM Confidence and Competence

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Students' inability to solve STEM-related problems has been an ongoing dilemma and a primary area in need of improvement for years. Students are able to solve problems and transfer their knowledge from one context to another more easily when college instructors strive to be more student-centered and less teacher-centered. Student-centered methods of instruction, including active, cooperative, and small group learning strategies, allow for higher levels of student engagement and interest. Our study focused on determining how using student-centered teaching techniques, such as think-pair-share and peer-instruction, impacted graduate and undergraduate students' levels of confidence and competence in performing STEM skills in a college-level course.

Think-pair-share (TPS) is a teaching method built around student interactions, in which students reflect on a question or prompt from the instructor, then discuss the question in pairs, and finally share their responses with the entire class. TPS is an excellent strategy to get students actively involved in the lesson by encouraging them to take more ownership in their learning. Another active, cooperative learning strategy is peer-instruction, which in this case, consisted of students answering a quiz question first on their own and then a second time after being allowed to discuss the question with their classmates. Both responses counted toward the students' grades. Prior studies have shown that peer-instruction improves students' breadth and depth of understanding the course material, their interest in learning course concepts, and their quiz scores.

Confidence or, more-specifically, self-efficacy is the belief that a person possesses regarding his or her ability to perform specific tasks. As students' levels of self-efficacy increase, educational theory suggests that their competence at performing a particular skill also should elevate. However, because self-efficacy is based primarily on a person's self-perceived abilities, students

may tend to misjudge their capacity to perform tasks. Thus, some independent measure of competence also is required to assess the impact of student-centered teaching methods. In this study, competence was measured by the students' quiz scores and final exam scores.

Students' confidence levels in performing STEM tasks related to the class increased from the start to the end of the semester, and graduate students experienced higher levels of confidence at the end of the semester than did their undergraduate counterparts. The confidence gains were larger for graduate (58%) than undergraduate students (42%). However, self-efficacy was a poor predictor of student success in the class, as weak correlations existed between their confidence and competence. When asked to perform simpler tasks, such as defining key terms, most students were overconfident in their ability to do so correctly. When asked to perform more complex tasks, such as mathematical calculations to quantify a property or process of interest, most students lacked confidence in their ability. Overall, however, in-class interactions using student-centered teaching techniques helped improve student performance in the class, especially with undergraduate students, whose quiz scores improved 26% following peer-instruction, while graduate student quiz scores improved 21% after peer-instruction. The results from this study support the use of student-centered teaching to enhance students' confidence and competence at performing STEM-related processes in higher education settings. For further details, see Ochsner and Robinson (2017).

References

Ochsner, T.E., & J. S. Robinson (2017). The impact of a social interaction technique on students' confidence and competence to apply STEM principles in a college classroom. *NACTA Journal*, 61(1), 14–20.

