# Psychological Safety by Blending in Engineering Mechanics

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## Author Biographies

Donald Webster joined the faculty at the Georgia Institute of Technology in 1997 and is currently the Karen & John Huff School Chair and Professor in the School of Civil & Environmental Engineering. Dr. Webster's research expertise lies in environmental fluid mechanics focused on the influence of fluid motion and turbulence on biological systems. Dr. Webster is a Sustaining Fellow of the Association for the Sciences of Limnology and Oceanography and has won numerous awards including the Felton Jenkins Jr. Hall of Fame Faculty Award, the Eichholz Faculty Teaching Award, and the Class of 1934 Outstanding Innovative Use of Education Technology Award.

Wendy Newstetter is the Assistant Dean of Educational Research and Innovation in the College of Engineering at the Georgia Institute of Technology. Dr. Newstetter's research focuses on understanding cognition and learning in interdisciplines with an eye towards designing educational environments that support the development of integrative thinking, inclusive leadership, and innovative problem solving. Dr. Newstetter is a recipient of the 2019 National Academy of Engineering Gordon Prize for Innovation in Engineering and Technology Education.

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## Goal of the Activity

In numerous organizations today, *psychological safety* has been identified as a precursor to both individual and organizational learning. In fact, a recent longitudinal study conducted by Google's People Analytics unit showed that psychological safety was the number one predictor of a successful, high-functioning team.

So, what is psychological safety and how can it be used in the design of learning environments? Edmondson (1999) has defined psychological safety as "the shared belief held by members of a team that the team is safe for interpersonal risk taking." More recently, a growing literature has shown links between psychological safety and positive learning behaviors. If a learner feels safe to voice an opinion, to ask a question, to claim a knowledge gap or to try something he or she is unsure of without fear of ridicule or rejection, the opportunities for learning are enhanced. Of particular importance and relevance to engineering education, psychological safety has also been shown to be helpful in having learners understand how to use failure as the starting point for learning (Carmeli et al. 2009).

In many postsecondary educational settings, where class sizes are generally twenty-five or more, students are wary about asking questions, voicing opinions, revealing knowledge gaps and misunderstandings, or taking risks for fear of peer ridicule or rejection. And yet, this fear diminishes opportunities for doing the key things that are the starting points for learning. In this context, our goal is to design a learning environment in which students feel safe enough to admit and embrace misunderstandings and failure, to ask questions, to work closely with learning mates, and to respect peers.

## Description of the Activity

As we have described in previous publications, the intervention is to transform the learning environment in undergraduate engineering mechanics courses to a blended pedagogy (Webster et al. 2016, 2019, 2020). These courses, such as Fluid Mechanics and Engineering Dynamics, often have reputations among students of being highly challenging, and students are often apprehensive and intimidated when entering the course. The course design is to use emerging technologies to effectively move the traditional lecture content to outside the classroom. This opens the possibility to reimagine the classroom experience and create a safe learning space in which the students feel secure and confident to explore and learn.

The in-class environment is the key. When students arrive at the session, the instructor typically starts a problem-solving exercise on the board. This provides a collective beginning to the session, addresses gaps that remain in understanding from the on-line lecture content, and allows for collective participation and questions from the class. After ten minutes, the instructor releases the students to work in pairs to complete the exercise and work on additional exercises addressing the daily topic. The exercises are sequenced in increasing order of difficulty, so the students can progressively build proficiency and confidence. The instructor and teaching assistants roam the room talking to the student teams. This most often takes the form of the student team asking questions about a step in the problem solving on which they are stuck. The term “just-in-time tutoring” is appropriate since the students are situated at the moment when they are most receptive to receiving insight or a hint from the instructors. It is very common to have the students respond with an “ah-ha!” moment of discovery as they figure it out. At the end of the session, student work is neither collected nor assessed; the only direct impact on the students’ grade is attendance/participation credit.

## Reflection on How This Activity Meets the Author’s Goal

The in-class format succeeds in creating a psychologically safe environment. For instance, the students express more security in asking questions. The intimacy created in dyads encourages open conversation and negotiation about how to approach the exercises. Students also feel less inhibited to ask for help when stuck or confused. Further, they do not feel pressure to complete the assignment (during the session, at least) and are not motivated to circumvent independent problem solving in order to achieve a score. One student expressed this perception in the course survey: “Every lecture, we speak to each other, the TAs, and the professor. This opportunity to talk about what we understand helps us bridge the gaps of misunderstanding and confusion.”

When compared to a traditional lecture course (by the same instructor), the students report a significant increase in amount learned, the degree that the assignments facilitated learning, and the effectiveness of the course (Webster et al. 2020), again reflecting the students’ perception of psychological safety. In this regard, the students appear to understand the opportunity to make mistakes during the class session in order to learn from those missteps and perform at a more proficient level during the summative assessments (i.e., exams).

We also have suggestions in the student achievement data that female students gain more in the blended classroom (Webster et al. 2020). This indicates that members of a traditionally under-represented group in engineering, in this case women, feel psychologically safe to explore and, ultimately, succeed in the course. When one feels that they belong, it is much easier to ask questions and build confidence and proficiency. Indeed, the sense of belonging follows naturally from working with a single partner during the semester and readily receiving just-in-time tutoring from the instructors.

As a closing thought, we present another student survey comment that captures many of the ideas above:

> *WOW! Honestly when I signed up for [Fluid Mechanics] I was scared from the stories I had heard from recent students. This class was nothing like I expected. Granted it was still a challenging course that required studying and work, but the professor did a great job in preparing all of his students for homeworks and tests. I loved the class structure and found it so much more effective than a regular classroom. A lot of students learn better by doing examples, NOT taking notes. Having the lectures online also allowed us to go back and re-listen to any of the things we have trouble with. Great class, great instructor and I have ALREADY told all the young engineers I know to take [the course].*

## References

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