Investigating the effects of course structure on students' sense of belonging in an introductory physics course

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Findings

- Students' **sense of belonging correlates with** their **course performance and conceptual understanding** of the material
- Preliminary result: Students express a **stronger sense of belonging with quiz structure** in Year 2 S2 **compared to** their prior experience in a physics course with **midterm exams**

Methods

General structure of PHGN200:

- Students watch out-of-class preparatory video
- Followed by interactive one-hour class, extensive discussion among students
- Next day, students work in groups for two-hours of problem-solving and lab activities (Studio)
- Students' complete homework problems out-of-class

Differences in course structures:

- **Year 1 Semester 1 (S1) and Semester 2 (S2):** Rotated between attending in-person and remotely during in-class portions of the course. Three midterm exams. Final exam but optional in Year 1 S1.
- **Year 2 S1:** Attendance all in-person for in-class portions of the course. Three midterm exams and required final exam.
- **Year 2 S2:** Attendance all in-person for in-class portions of the course. Seven quizzes using homework problems and required final exam.

Survey administered at the end-of-semester:

- I feel like I belong in this physics class
- I feel like an outsider in this physics class
- I feel comfortable in this physics class
- I feel like I can be myself in this physics class
- Sometimes I worry that I do not belong in this physics class

Sense of Belonging

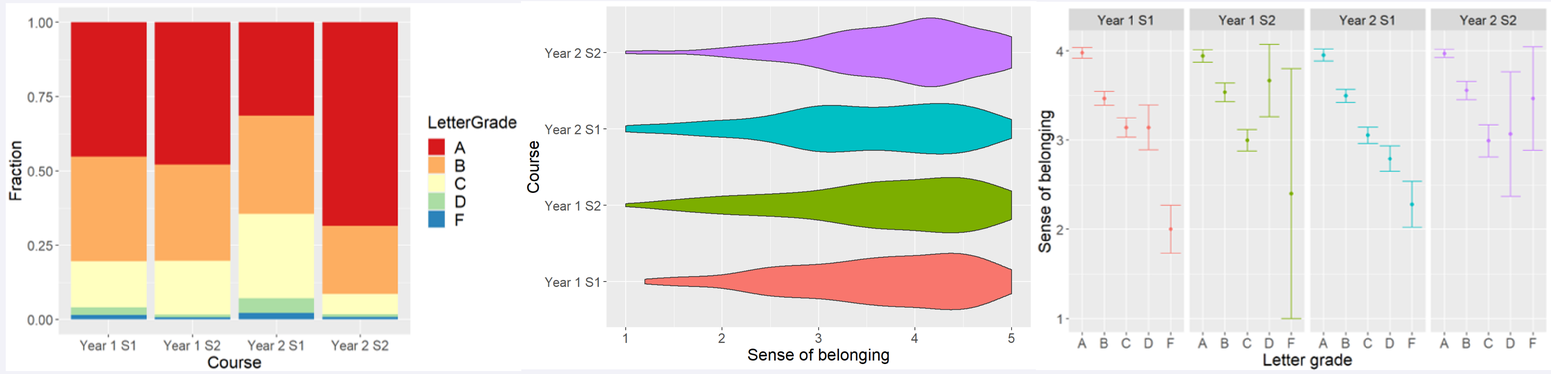
We defined students' sense of belonging, like Lewis et al. (2017), as the extent a student feels valued, accepted, and a legitimate member of the scientific community. [1]

- Rainey found that students who persist in STEM majors report a greater sense of belonging than those who choose to leave STEM. [2]
- Callan and Smith found that students' course performance is not correlated with the gender composition of students' studio groups but is correlated with students' self-reported level of test anxiety and sense of belonging in the course.[3]

[1] K. L. Lewis, J.G. Stout, S. J. Pollock, N.D. Finkelstein, and T. A. Ito, Fitting in or opting out: A review of key social-psychological factors influencing a sense of belonging for women in physics, Phys. Rev. Phys. Educ. Res. 12, 020110 (2016).
[2] Rainey, K., Dancy, M., Mickelson, R. *et al.* Race and gender differences in how sense of belonging influences decisions to major in STEM. *IJ STEM Ed* **5,** 10 (2018). https://doi.org/10.1186/s40594-018-0115-6
[3] E. Smith and K. Callan, presented at the Physics Education Research Conference 2021, Virtual Conference, 2021, WWW Document, (https://www.compadre.org/Repository/document/ServeFile.cfm?ID=15788&DocID=5517).

Results

Sense of belonging ranges from 1 (weak sense of belonging) to 5 (strong sense of belonging)



- On average, students who earned higher overall letter grades reported a stronger sense of belonging; these means, when segregated by letter grade, were relatively consistent across different course structures.
- Course structure with quizzes corresponded to higher overall letter grades and a stronger sense of belonging in the course than course structures with midterm exams.
- Surprisingly, students' sense of belonging did not change drastically from a hybrid course structure to being entirely in-person when the midterm exam structure was in place.

Students' Comments

"One thing I have found helpful during my physics experience at Mines is **seeing people of color as professors and TAs**. As a person of color, seeing someone who **looks more like me in positions of power is inspiring**. I am sure other students feel the same, as it can often make students of color relate to their instructors on a deeper level."

"After taking the two different versions of PHGN200 (midterm and quiz), I believe that the current quiz system is much better, and I feel that I have **enjoyed physics and learned a lot more this semester** than when I took it before."

"I like the quiz style over the big midterm exams, I feel like it has helped me to **understand the concepts more and I've bonded with my peers over studying** for them and explaining problems together."

"If I could have a say, I would recommend the quizzes. Like I said it was it's been **a lot less stressful**, and I feel like I can **take more time to understand concepts**. The last time took Phys 2; I was trying to cram a lot before every exam. Going through both versions, the quiz system has been **a lot better on my mental health**."