Investigating the impact of postexam grade-adjustment practices in introductory physics



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Background

- Introductory STEM courses have grade inequities [1, 2].
- These grade differences are due in part to high-stakes assignments like exams, which typically make up the majority of the final grade [3,4]
- These grade gaps are the result of course structures, not differences in prior preparation [5].
- Previous studies have examined changes to course design that could reduce these grade gaps:
- Reducing the weight of exams in the final grade reduces the D, F, withdrawal rate, especially among women and underrepresented minorities [6]
- Grading exams directly on the 4.0 scale instead of the percent scale could close grade gaps up to 25% [7]
- What about other changes to the course like how individual exams are counted towards the final grade?

Methods

- Exam grades from 2,290 physics 1 students from Winter 2017 until Fall 2019 via the ECoach platform [8].
- Typical grading scheme in this course: each of the three exams counts for 12% of final grade

Let's consider alternatives and see what effect they would have* on the final grades:

- 1. Drop the lowest exam score (each remaining exam score counts for 18% of the final grade)
- 2. Replace the lowest exam score with the final exam score if the student does better on the final
- 3. Have the best exam score count for 50% more (18% of final grade) and have the worst exam score count for 50% less (6% of final grade)

*We assume that student behavior is unchanged, which may not happen in practice.



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ASTRONOMY

All three alternative methods to incorporate exam grades into the final grade increase students' grades...





Grade gaps between female and male students on exams are nearly the same, ~5 points, regardless of how we incorporate individual exam grades into the final grade.

If there were a differential effect, we would expect the slopes of the lines to be different and not parallel.

different assessment methods and the underlying mechanisms: The case of incoming preparation and test anxiety. In Frontiers in Education (Vol. 4, We thank Erin Murray for her assistance in accessing and preparing the data for this project. p. 107). Frontiers Media SA. [5] Webb, D. J., & Paul, C. A. (2023). Attributing equity gaps to course structure in introductory physics. *Physical Review Physics Education* [1] Castle, S. D., Byrd, W. C., Koester, B. P., Pearson, M. I., Bonem, E., Caporale, N., ... & Matz, R. L. (2024). Systemic advantage has a meaningful Research, 19(2), 020126. relationship with grade outcomes in students' early STEM courses at six research universities. International Journal of STEM Education, 11(1), 1-20. [6] Simmons, A. B., & Heckler, A. F. (2020). Grades, grade component weighting, and demographic disparities in introductory physics. Physical [2] Malespina, A., & Singh, C. (2022). Gender differences in grades versus grade penalties: Are grade anomalies more detrimental for female Review Physics Education Research, 16(2), 020125. physics majors?. *Physical Review Physics Education Research*, 18(2), 020127. [7] Paul, C. A., & Webb, D. J. (2022). Percent grade scale amplifies racial or ethnic inequities in introductory physics. Physical Review Physics [3] Kost, L. E., Pollock, S. J., & Finkelstein, N. D. (2009). Characterizing the gender gap in introductory physics. Physical Review Special Topics-Physics Education Research, 18(2), 020103.

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Dropping the lowest exam score resulted the greatest increase in score, ~5.7 points or ~ 2 percentage points in the final course grade.

Replacing the lowest exam score with the final exam grade or weighting the best exam score more than the other exam scores also increased student's exam scores, but to a lesser degree.

but none of them reduced exam grade gaps. Aggregated exam scores by (binary) race



We find the same result for grade gaps between Black, Hispanic, multi-racial, and Native American students and Asian and white students, also with a grade gap of ~5 points.

Taken together, these results suggest that these practices are not useful for addressing grade gaps.

Acknowledgements & References