

Strategies for Increasing Student Success and Promoting Equity

in a Large STEM Course

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Abstract

Grades in general chemistry indicate that students from underserved groups have a lower rate of success in the course. Various evidence-based methods for improving learning and promoting equity in the course were implemented. As a result, score gaps for underserved groups on exams decreased and the overall rate of student success in the course increased.



Introduction – Course Transformation

An analysis of DFW rates in C117 (general chemistry I) shows that students from underserved groups have a higher rate of not completing the course than their peers.

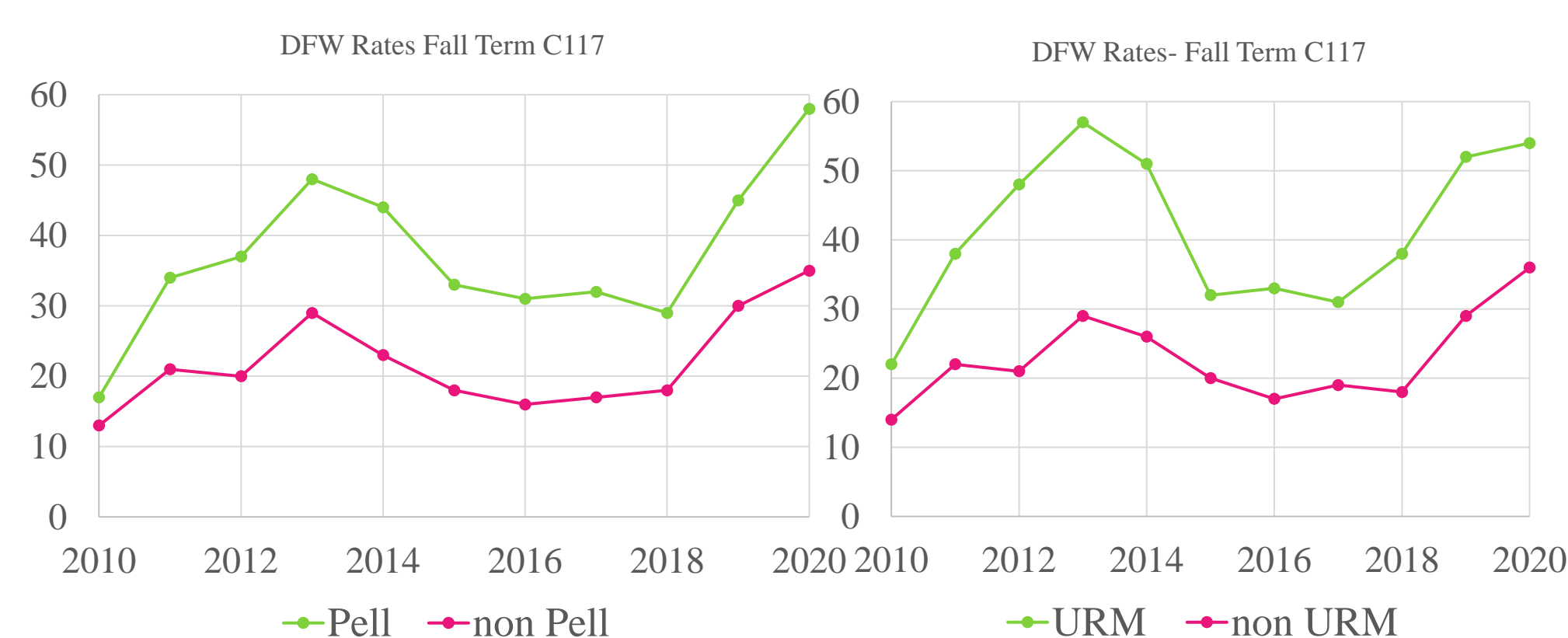


Figure 1. DFW rates for Pell-eligible and underrepresented minority students compared to their peers.

Improvements in Course Structure and Assessment Methods

Evidence-based methods that promote inclusivity, equity and student success were implemented. These include

- a “high structure” course with many low-stakes assignments to provide feedback on learning
- course sessions that involve teamwork and engaged student learning
- multiple opportunities to demonstrate mastery on course assessments through the use of exam retakes.



Results – Changes in Course Exam Scores after Retakes

Table 1 shows how exam averages increased after students took an optional retake of each exam. Students could retake the auto-graded part of the exam which was worth 75% of their score. The long answer portion worth 25% of the score was retained from the initial exam. The averages increased by 4–8% and on each exam over 50% of the class benefitted from another chance to show mastery. Overall, 78% of the class increased their exam scores by retaking exam.

Table 1. Increases in exam percentages after retake opportunities.

	Exam 1	Exam 2	Exam 3	Overall
Initial Average	65.7	75.8	78.5	73.3
Final Average	73.4	81.1	82.1	78.9
Percentage of Class with Increased Score	59	57	52	78

Students with the lowest initial exam scores benefitted the most from the retake opportunities. For those in the lower than 55% score category between 60 and 80% of students increased their exam score. The score increased (on average) between 12 and 17%. This improvement allows these students to move from definitely failing to nearly passing. Also, over half of students in the initial score category of 55–70% increased their exam score by 4–9 percentage points.

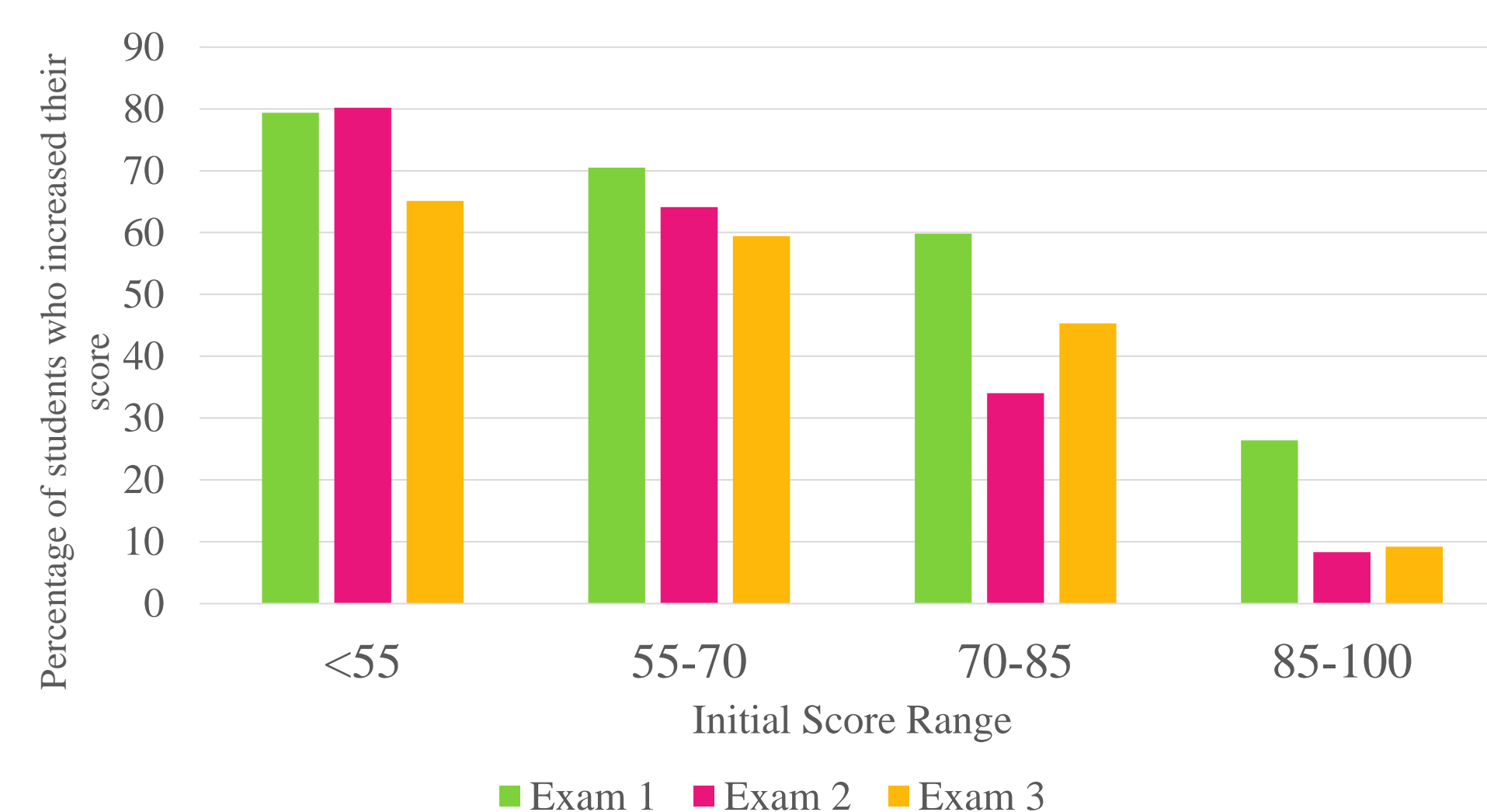


Figure 2. Number of students in each score category that increased their score on the exam after the retake.

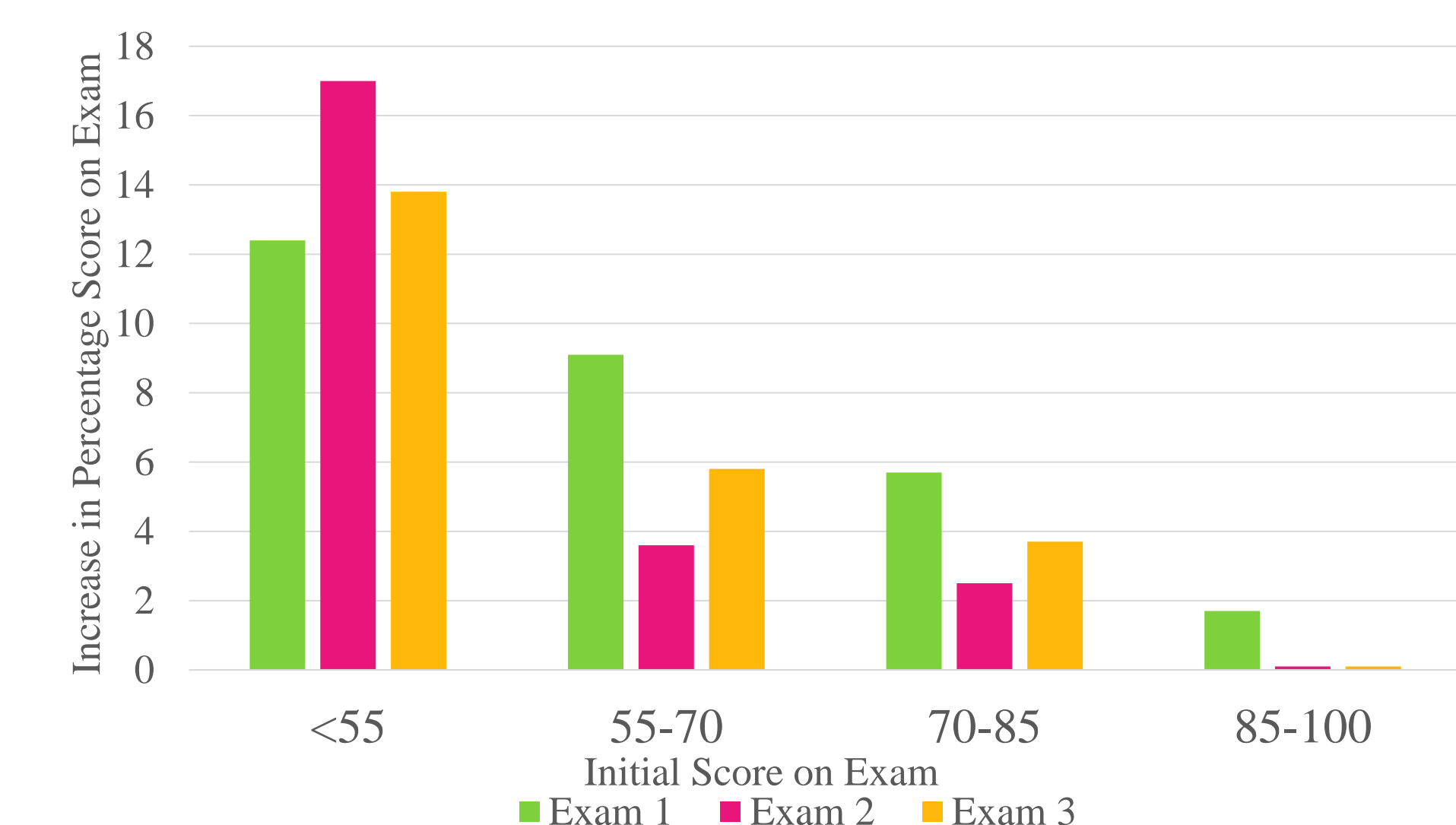


Figure 3. Increase in exam score grouped by initial score.

Results – Effect of Retakes on Underserved Student Population

Students in all demographic categories improved their scores on all exams. Figure 4 shows an example for a challenging exam in Fall 22 which covers the math-heavy topics of kinetic and equilibrium. Students from underserved populations increased their exam scores by a larger amount as a result of the retake opportunity. Figure 5 shows how the score gap changes for different demographic groups between the initial attempt of the exam and the retake. Score gaps decreased for all groups of students from underserved populations.

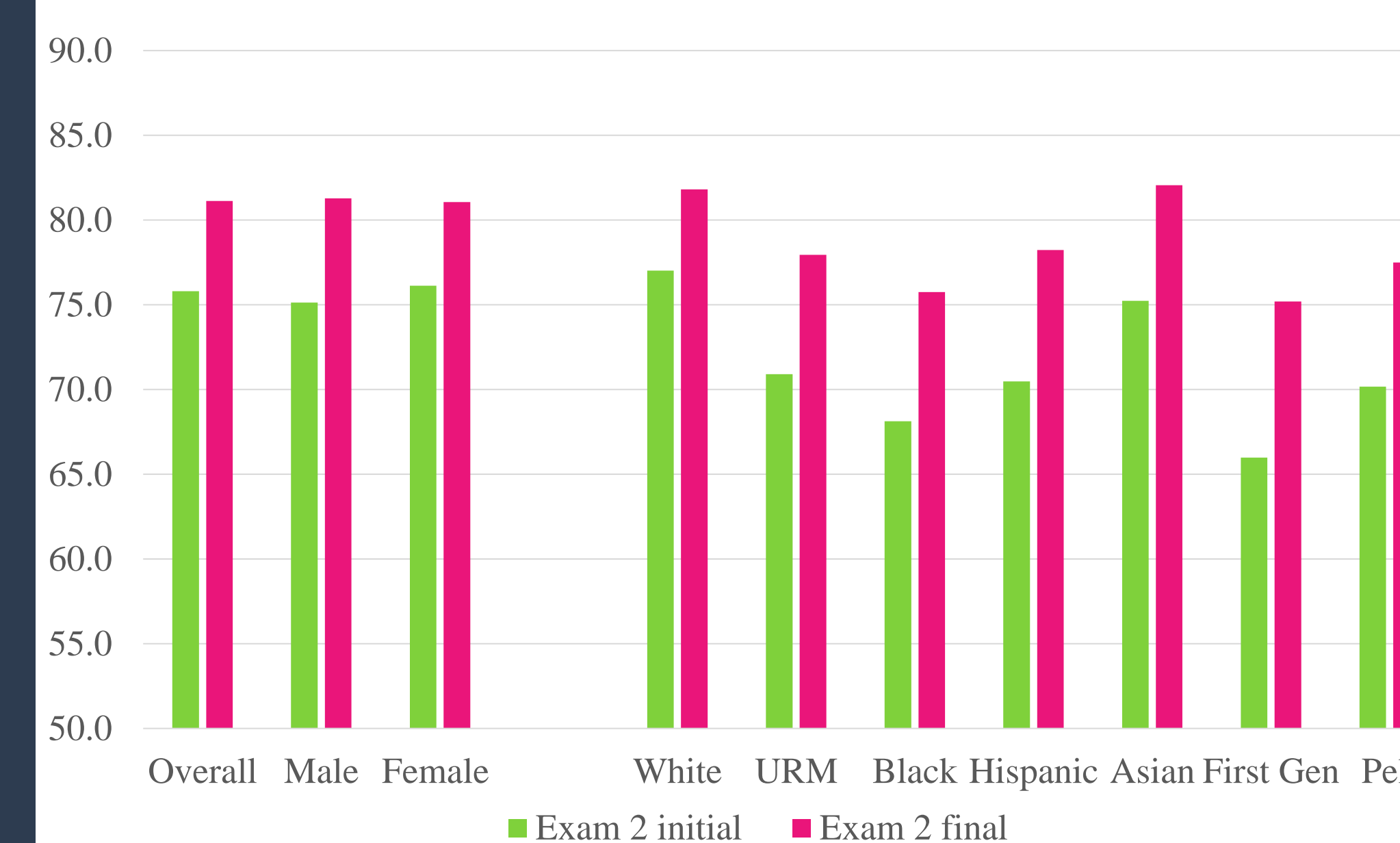


Figure 4. Increase in exam 2 score by demographic category (FA22).

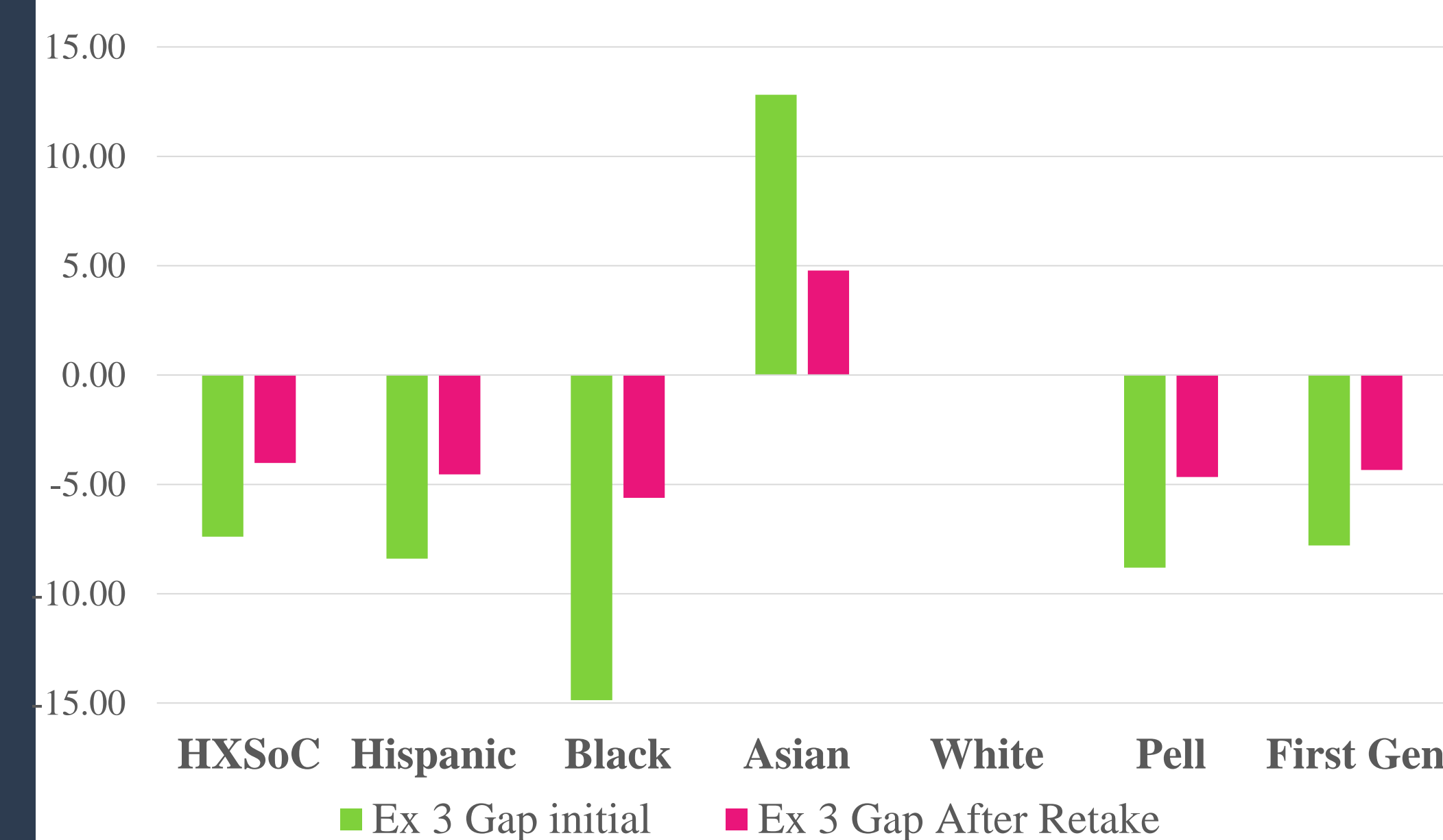


Figure 5. Score gap decreases for underserved groups on exam 3 (FA21).

How many more students passed the class as a result of the retakes?

- 125 students scored lower than 60% on the average of 3 initial exams were able to pass the class due to retake exam scores
- 78 of those students took organic chemistry with a pass rate of 48%
- Group with initial exam scores <60% is overrepresented (Pell, URM, and Black)

Conclusion

The rate of success in the course increased for all students, but the change in success rate was larger for students from underserved populations.

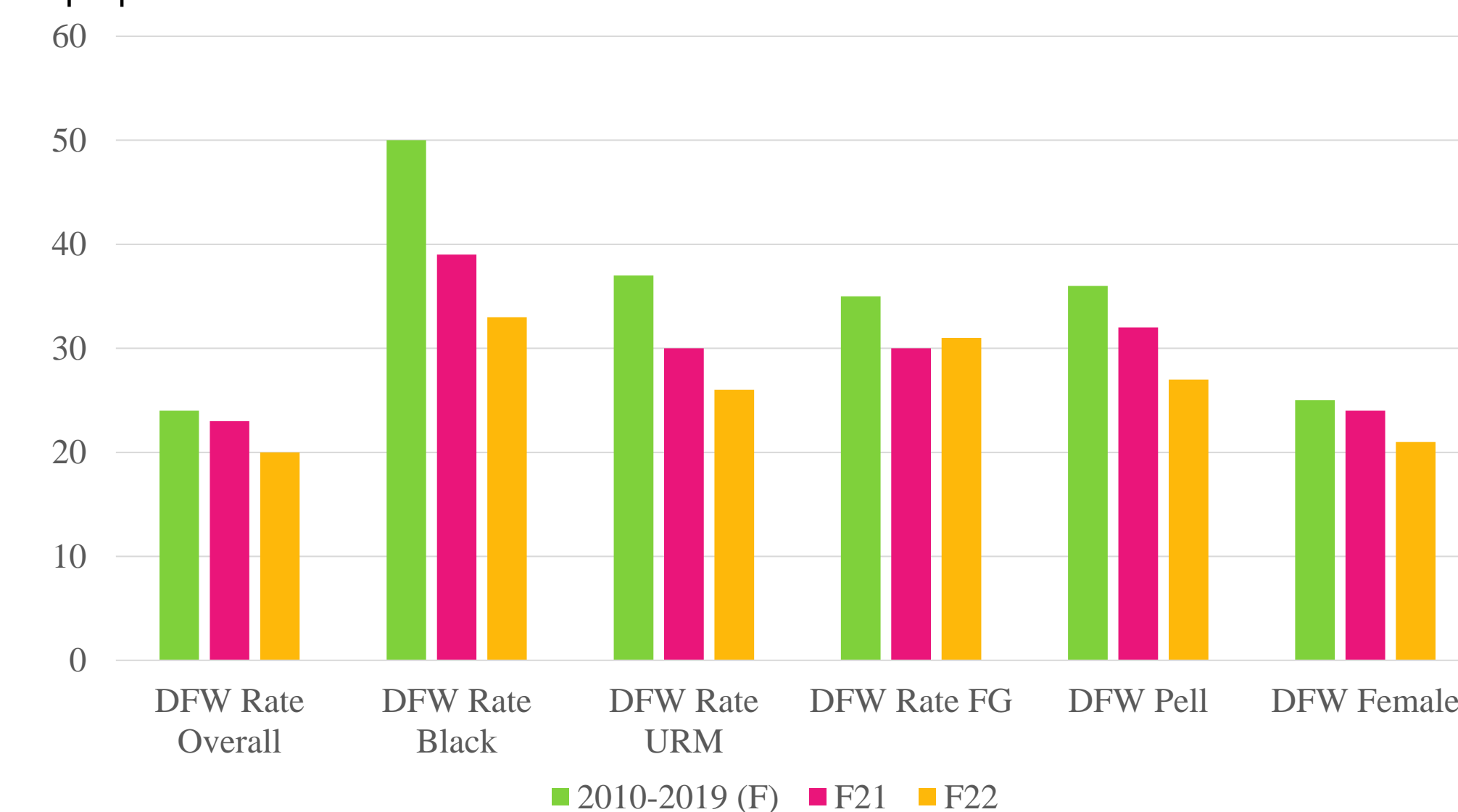
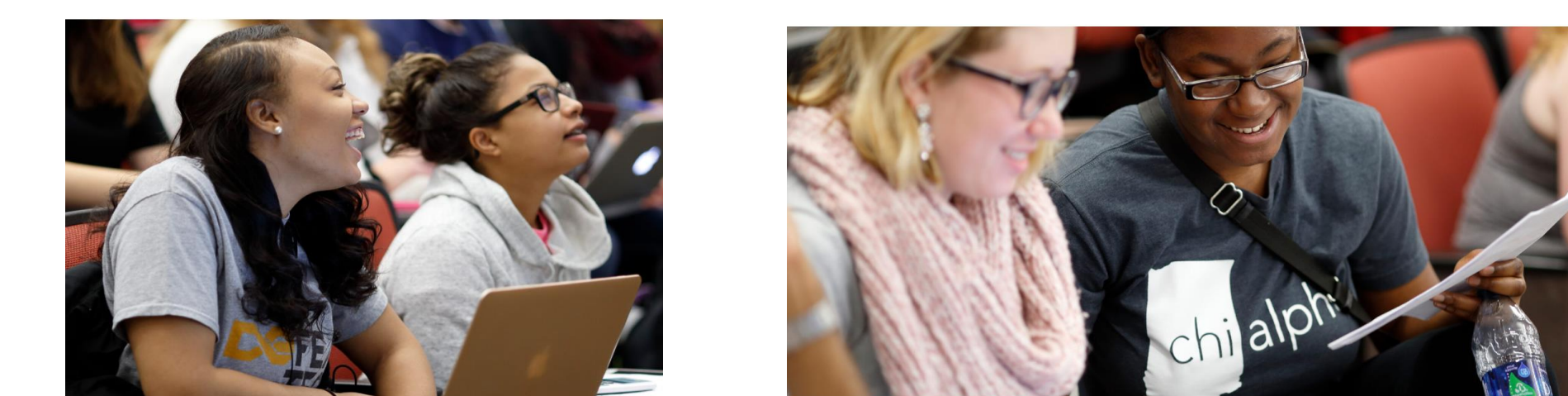


Figure 5. DFW rates for two pilot semesters compared to historical average from 2010–2019.

Student Perceptions:

[...] I pretty much studied the same as I would otherwise. However, it was a massive mental relief, because I knew that I had a backup just in case the exam didn't go as I wanted. That made me less stressed overall, both while studying and taking the exam."

"Yes, the fact that there was a retake made me a lot less stressed both before and during the exam. I still studied the usual amount before the exam because I did not want to rely on the retake, but I was a lot more relaxed and did not cram as much as usual."



	Strongly Agree or Agree	Disagree or Strongly Disagree
The retake opportunities lowered my level of stress/anxiety related to taking exams	94%	3%
Retake opportunities increased my confidence that I could be successful in this course	94%	1%
I feel like I belong in my class	87%	5%
My classmates value my contributions to in-class activities	84%	2%
The teaching team respects and cares about the students	97%	1%
I feel like an outsider in this class	9%	82%
Did the fact that you can retake the exam impact your approach to studying for the exam?	20%	80%

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