



HUMANIZING ONLINE STEM

PRELIMINARY RESEARCH FINDINGS

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HumanizeOL.org

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EXECUTIVE SUMMARY

This report summarizes the findings from the two-year "scaling" phase of the Humanizing Online STEM Academy project, which prepared faculty to employ inclusive, student-centered practices to improve the learning experience in online STEM courses. We examine the impacts of this study in two strands: instructor beliefs and practices, measured through survey analysis, and student-level outcomes, measured through administrative data analysis.

Instructor Beliefs and Practices: Survey Findings

We surveyed 52 instructors from five institutions through two waves of surveys, conducted pre- and post-training. The survey results from the Humanizing Online STEM Academy reveal significant improvements in several areas:

- **Equity Awareness:** Significant increases in instructors' understanding of equity-minded elements post-Academy, indicating awareness of emotional factors and sense of belonging
- **Increased Confidence and Flexibility:** Increase in instructor self-efficacy and flexibility, showing confidence in designing online courses that more effectively support diverse learners
- **Culturally Responsive Practices:** Increased understanding of instructor responsibilities to promote culturally responsive and student-centered practices
- **Humanizing Strategies:** Strong shifts towards humanized teaching strategies, including providing video feedback, personalizing course homepages, and implementing surveys to identify the varying support needs of students
- **Enhanced Relationships:** Increased focus to build supportive relationships with students, foster peer-to-peer connections, and create collaborative learning environments
- **Expanded Use of Visual Communications:** Increased use of tools, resulting in more video and visually-oriented communications,

These findings highlight the Academy's effectiveness in promoting inclusive, dynamic teaching strategies, ultimately creating more supportive and engaging learning environments in online STEM education.

Student Outcomes: Administrative Data Findings

Using de-identified student transcript data (Spring 2017–Fall 2023) and a difference-in-differences (DiD) methodology, we examined the Academy's effect on student performance. The analysis focused on asynchronous online courses taught by Academy-trained instructors compared to those taught by non-participants. Results revealed substantial gains for underrepresented minority (URM) students¹, narrowing performance gaps in grades, persistence, and pass rates:

Pre-existing gaps (before the Academy)

- *Grades:* URM students scored 0.307 grade points lower on average (B- vs. B).
- *Persistence rates:* URM students were 3.1 percentage points less likely to persist compared to non-URM students.
- *Pass rates:* URM students were 6.1 percentage points less likely to pass compared to non-URM students.

¹ URM students include American Indian/Alaska Native, Black, Latinx, Native Hawaiian/Pacific Islander, and multiracial students. We acknowledge that racial and ethnic categories are socially constructed and that our analysis relies on the limited racial categories informed by the U.S. Census. Due to small sample sizes for some groups, we aggregate these categories for statistical purposes. This grouping aims to capture students historically marginalized in higher education. However, we also recognize the limitations and complexities of using acronyms to represent diverse and heterogeneous groups.

Academy Impact on URM Students

- *Grades:* Academy raised URM students' grades by 0.315 grade points more than it raised grades for non-URM students
- *Persistence rates:* Academy raised URM students' persistence rates by 11.4 percentage points more than it raised persistence rates for non-URM students.
- *Pass rates:* Academy raised URM students' persistence pass rates by 12.6 percentage points more than it raised pass rates for non-URM students.
- *Equity gaps:* In the context of pre-existing gaps, these differential impacts of the Academy on URM students narrowed these gaps.

Analysis of administrative data reveals that while URM students initially underperformed in grades, persistence, and pass rates, courses taught by Academy-trained instructors significantly narrowed these performance gaps. By fostering inclusive teaching practices, these findings suggest that the Academy's humanizing strategies can promote greater equity in online STEM education.

INSTRUCTOR SURVEY ANALYSIS

Background

We surveyed 65 instructors who participated in the Humanizing Online STEM Academy, with 52 completing both pre- and post-surveys (80% response rate). Our analysis focuses on these 52 instructors, affiliated with five institutions (4 community colleges and 1 CSU), who completed training between March and August 2023. The surveys aimed to capture instructors' changes in perceptions and attitudes and shifts in instructional practices. We conducted paired t-tests² to evaluate changes in these areas before and after Academy participation.

Participant demographics

Academy participants represented varied experiences and demographics. Women constitute 58% of the sample. Instructors were predominantly White (60%), followed by Black (14%) and Latinx (12%). Half of the sample holds a master's degree, while 46% have earned doctoral degrees. Most participants were between 35 and 44 years old, averaging 11 years of teaching experience, including 4 years in online education. Fewer than half (40%) had previously engaged in professional development training focused on equitable and inclusive online teaching practices.

Figure 1. Distribution of Participant Age Groups

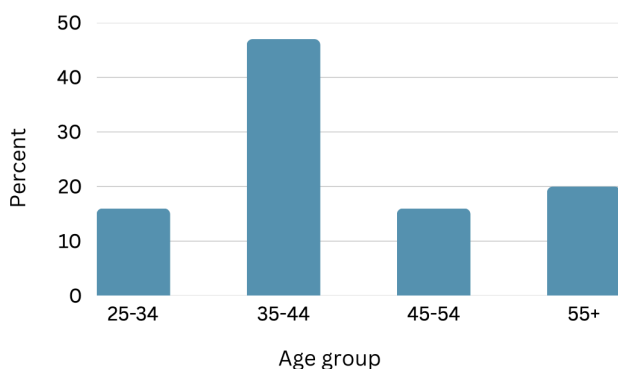
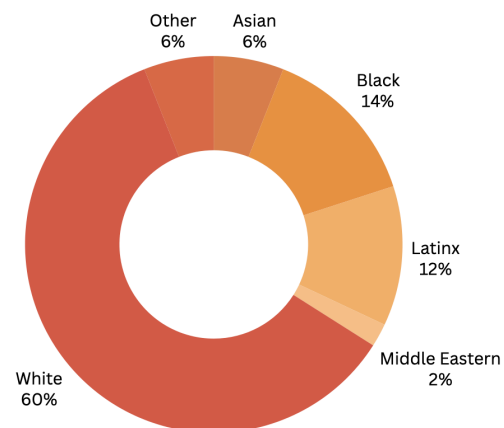


Figure 2. Racial Composition of Participants



² All survey analysis based on survey responses from 52 instructors. Paired t-test for changes in pre- and post- responses, where * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

KEY FINDINGS

Changes in Instructor Perceptions and Attitudes

Changes in instructor equity mindsets

Instructors were asked to rate their agreement with various statements about equity on a 5-point Likert scale, where 1 represented "Strongly Disagree" and 5 represented "Strongly Agree." The pre- and post-Academy survey analysis revealed significant shifts in instructors' beliefs regarding elements of educational experiences that positively or negatively influence students. Following the Academy, instructors demonstrated a heightened awareness of how the online instructional environment shapes student emotions and fosters a sense of belonging, with an average change of +0.38 ($p < 0.001$). Similarly, there was a notable increase in their recognition of the critical role that belonging and emotions play in student success within STEM disciplines, reflected by the same +0.38 ($p < 0.001$) change. Additionally, instructors reported a greater belief in students' capability to succeed, with a change of +0.31 ($p < 0.001$).

These findings underscore the Academy's effectiveness in enhancing instructors' understanding of the affective factors that influence student success and reinforcing the pivotal role teaching plays in fostering inclusive, supportive online learning environments.

Changes in instructor flexibility and self-efficacy

Instructor self-efficacy significantly increased following the Academy. The average self-efficacy score, measured on a 5-point scale from "not at all confident" (1) to "extremely confident" (5), rose by 0.56 points, from 4.02 pre-Academy to 4.58 post-Academy ($***p < 0.001$). This score indicated that the Academy made instructors more confident in their ability to effectively design and deliver online courses that welcome and support diverse learners.

Additionally, instructors showed greater flexibility in their course policies post-Academy. The average score on flexibility with policies such as late submissions and make-up assignments, measured on a 5-point scale (1 = very inflexible to 5 = very flexible), increased by 0.26 points, from 3.71 to 3.97 ($*p < 0.05$). This shift reflects a move toward more accommodating and student-centered teaching practices, which is also key to achieving equitable outcomes.

Changes in beliefs about instructor responsibilities

There were significant shifts in instructors' cultural responsiveness and inclusivity following the Academy. Instructors were asked to rate their agreement with various statements regarding their teaching responsibilities. The belief that fostering belonging and connection is part of an instructor's responsibility increased by 0.27 points, from a pre-Academy mean of 4.29 to a post-Academy mean of 4.56 ($***p < 0.001$) on a 5-point scale ranging from "strongly disagree" (1) to "strongly agree" (5). There was also an increased agreement that it is instructors' responsibility to incorporate culturally responsive and student-centered teaching practices, with a 0.25-point increase ($***p < 0.001$), from 4.16 to 4.41. These changes suggest that the Academy effectively encouraged instructors to adopt more inclusive teaching practices, which are better aligned with the needs of diverse student populations.

Changes in Instructional Practices

Change in use of teaching strategies

A significant outcome of the Academy was the widespread adoption of humanizing instructional practices among nearly all instructors. For instance, the use of personalized course homepages increased dramatically from 55% pre-Academy to 99% post-Academy; the use of visually-oriented "bumper videos" to demystify difficult concepts increased from 48% to 98%; and the use of surveys to identify high-opportunity students who may benefit most from high-touch interactions rose from 27% to 96%. Furthermore, the likelihood of implementing microlectures (short video lectures, summaries, or topic introductions) increased by 1.28 points ($***p < 0.001$, from 2.83 to 4.11) on a 5-point Likert

scale. Similarly, the likelihood of providing supportive and motivating voice/video feedback increased by 1.24 points (**p < 0.001, from 2.92 to 4.16). These changes show a clear shift toward practices that increase an instructor's verbal and non-verbal cues online and promote and foster inclusion for students.

Changes in instructor-student interaction

Instructor-student interactions, both academic and social, showed significant improvements post-Academy. Academic interactions, including offering office hours, providing feedback on student work, and engaging with students through synchronous (e.g., Zoom) and asynchronous (e.g., discussion boards) communication tools, increased by 0.39 points (**p < 0.001, from 3.85 to 4.24) on a 5-point scale (1 = never, 5 = very frequently). Management interactions, such as providing opportunities for student feedback, sharing grading criteria, proactively identifying and supporting struggling students, and responding promptly to logistical questions, increased by 0.52 points (**p < 0.001, from 3.95 to 4.47). Additionally, the presence of social interaction opportunities, including instructors introducing themselves to students through written, visual, or video communication and sharing a personal video in a non-academic context, increased from 63% pre-Academy to 97% post-Academy (p < 0.001). These findings indicate that instructors were increasingly willing to construct their presence online and build strong, supportive relationships with students—a key outcome of humanized online instruction.

Changes in student-student interactions

Instructors also demonstrated a greater focus on providing opportunities to promote student-student interactions. Academic interactions, such as collaborative group assignments, increased by 0.56 points (p < 0.01, from 2.96 to 3.52) on a 5-point scale (1 = never, 5 = very frequently). Similarly, the presence of social interactions, such as icebreaker activities, rose from 62% pre-Academy to 96% post-Academy (p < 0.001). These changes reflect an increased emphasis on fostering peer connections and collaborative learning.

Changes in media use

Media use in instruction expanded significantly as a result of the Academy. Instructors reported greater use of audio and video tools across multiple areas (e.g., announcements, feedback beyond grades, etc.), with the use of audio rising by 1.27 points (p < 0.001, from 1.10 to 2.37) on a 5-point scale (1 = never, 5 = very frequently). Similarly, the use of video increased by 1.87 points (p < 0.001, from 2.25 to 4.12) on the same scale. This shift toward more diverse communication formats demonstrates that instructors became more comfortable using dynamic, interactive methods to engage students and support intercultural communication among students from collectivist and individualistic cultures.

ADMINISTRATIVE DATA ANALYSIS

Overview

To evaluate the impact of the Humanizing Online STEM Academy on student performance, we conducted an analysis using de-identified student-level data from Spring 2017 to Fall 2023. This analysis focused on humanized online courses taught by Academy participants, who made modifications to their courses based on the strategies and principles learned in the Academy. These humanized courses were compared to the same online courses taught by instructors who did not participate in the Academy at three partner institutions, both before and after the Academy's implementation. This approach allowed us to assess the influence of humanizing teaching practices on student outcomes while controlling for external factors that might independently affect student outcomes, such as institutional policies, course characteristics, and temporal trends.

Sample Construction

The analytical sample was constructed by first selecting courses that Academy participants had identified to “humanize” in pre-Academy surveys. To be included, courses had to meet the following criteria:

1. Identified for humanizing by Academy participants.
2. Taught by at least one Academy participant and one non-participant instructor before the Academy.
3. Taught by at least one Academy participant and one non-participant instructor after the Academy.

A total of 14 unique courses from the administrative data met this criteria. Once identified, all instances of that course taught by non-participants during the same period were included in the sample. This ensured that the analysis captured the full range of outcomes for students enrolled in both humanized courses taught by participants and comparable non-humanized courses taught by non-participants. For instance, if an Academy participant at Institution A completed the Academy in Spring 2023 and applied humanizing strategies to Math 1A in Fall 2023, all instructors who taught Math 1A at Institution A, both before and during Fall 2023, would be included in the analytical sample. It is important to note that, because Academy participants completed the training at different times, the post-period for each instructor begins based on when they completed the Academy. For instance, if an instructor completed the training in Spring 2023, their post-period would include courses taught in Summer 2023 or later.

Methodology

The difference-in-differences (DiD) method evaluates changes in student performance over time by comparing two groups: students taught by Academy participants (the treatment group) and students taught by non-participants teaching the same courses (the control group). This comparison spans both before and after the Academy’s implementation. The first step in the model measures how student outcomes, such as persistence rates, changed over time within each group. For instance, we analyzed course persistence rates for students taught by Academy participants and non-participants before and after the Academy. The second step isolates the specific impact of the Academy by comparing these changes between the two groups, effectively identifying the unique effects of humanizing strategies introduced by Academy participants. By incorporating these comparisons, the DiD method controls for external factors—such as curriculum changes or institution-wide policies—that might independently affect all students, allowing us to focus exclusively on the impacts attributable to the Academy.

Key Outcomes

1. **Course Persistence Rate:** This measures whether students remained enrolled and completed the course with any valid grade (i.e., students who did not withdraw).
2. **Course Pass Rate:** This metric reflects whether students persisted to the end of the course and passed (receiving an A, B, C, D, or P). A non-passing outcome includes withdrawals and failing grades.
3. **Course Grade:** For students who persisted to the end, we analyzed their final course grades to provide a continuous measure of academic performance.

Descriptive Statistics

As shown in Figure 3, Academy participants come from a variety of fields, with the highest concentration in mathematics (10), followed by engineering (3) and psychology (3). To illustrate potential differences across participant and non-participant instructors, Figures 4 and 5 descriptively compare outcomes between students taught by Academy instructors and non-Academy instructors, segmented by URM and non-URM students. These graphs provide a preliminary view of average differences, with no statistical controls applied to account for other factors.

Figure 3. Participating Instructors By Department

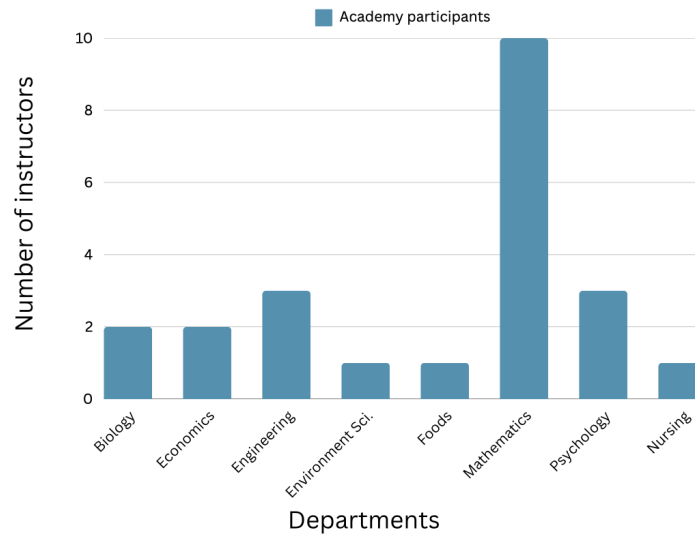
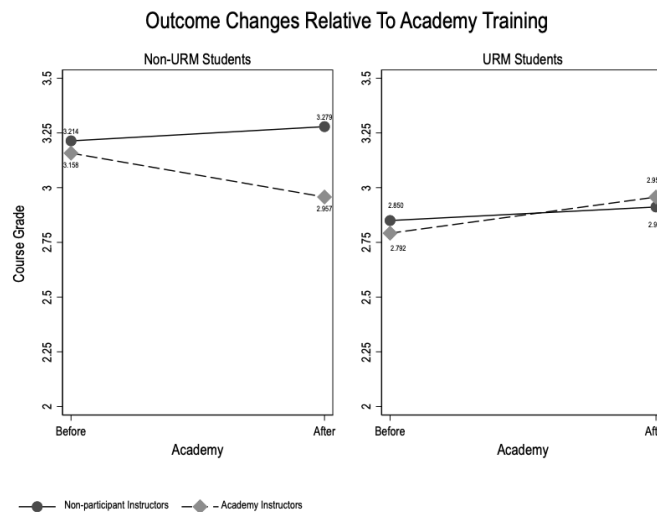


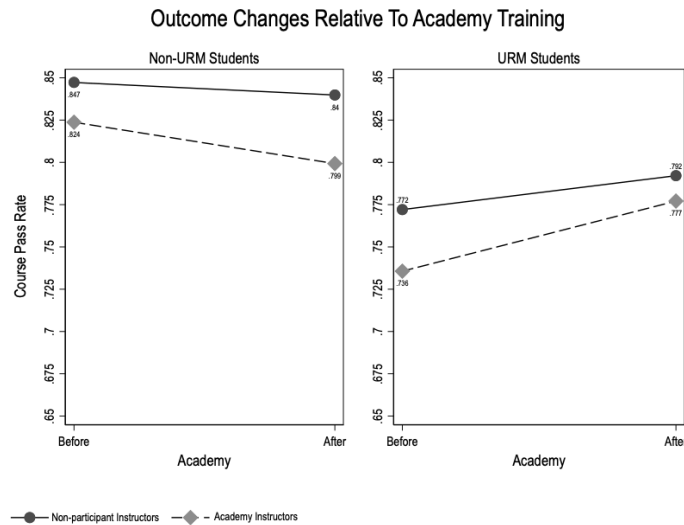
Figure 4 illustrates the changes in average course grades for these groups before and after the Academy training. Overall, it seems that the Academy training had a differential impact on URM and non-URM students. Specifically, for URM students, both Academy and non-Academy instructors saw slight improvements in average grades over time, but the increase seemed to be noticeably larger for those taught by Academy instructors. In contrast, the trend seemed to be opposite among non-URM students who experienced a decline in average course grades after the Academy training. Figure 5 displays changes in course pass rates and shows similar patterns: URM students taught by Academy instructors seemed to experience a larger improvement in average course pass rates post-Academy, which is not observed among non-URM students.

Figure 4. Changes in course grades for URM versus non-URM students³



³ Graph notes: Full sample has 11,239 observations from non-participating instructors in the before period; 989 in the after period. Full sample has 2,219 observations from the Academy instructors in the before period; 377 in the after period. URM students include American Indian/Alaska Native, Black, Latinx, Native Hawaiian/Pacific Islander, and multiracial students. URM only sample has 3,782 observations from non-participating instructors in the before period; 397 in the after period. URM only sample has 764 observations from Academy instructors in the before period; 140 in the after period. Non-URM students include Asian and White students. Non-URM only sample has 7,215 observations from non-participating instructors in the before period; 581 in the after period. Non-URM only sample has 1,408 observations from Academy instructors in the before period; 234 in the after period.

Figure 5. Changes in course pass rates for URM versus non-URM students⁴



KEY FINDINGS

Building on the descriptive findings, the regression analysis provides a more detailed understanding of the Academy's impact by accounting for important factors that could influence student outcomes. These include differences in student demographics, the specific courses being taught, the time of year the courses were offered, and instructor fixed effects. To understand the differential impact on underrepresented minority (URM) students, we include an interaction term between URM status and Academy participation. This interaction term directly captures how the program affected URM students compared to their non-URM peers.

Table 1 presents the regression results that evaluate the impact of the Academy on reducing racial equity gaps in three key student outcomes: course grades, course persistence rates, and course pass rates. The coefficient for URM indicates the pre-existing performance gaps between underrepresented minority (URM) students and non-URM students before the Academy. The results show that URM students scored 0.307 grade points lower than their non-URM peers (such as B- versus B; Column 1), were 3.1 percentage points less likely to persist in their courses (Column 2), and were 6.1 percentage points less likely to pass their courses (Column 3). These coefficients underscore the substantial inequities in academic outcomes prior to the Academy's implementation.

The Academy coefficient captures the impact of Academy participation on non-URM students, as the interaction term isolates the differential effect on URM students. For non-URM students, the Academy is associated with a slight decline in grades (-0.295 in Column 1) and persistence rates (-0.098 in Column 2), both statistically significant. The effect on pass rates (-0.107 in Column 3) is not statistically significant, indicating no meaningful change in pass rates for non-URM students in Academy-taught courses.

⁴ Graph notes: Course pass is equal to one if course grade is A, B, C, D, or P; and zero if course grade is F or W. Full sample has 12,668 observations from non-participating instructors in the before period; 1,138 in the after period. Full sample has 2,569 observations from the Academy instructors in the before period; 444 in the after period. URM students include American Indian/Alaska Native, Black, Latinx, Native Hawaiian/Pacific Islander, and multiracial students. URM only sample has 4,383 observations from non-participating instructors in the before period; 457 in the after period. URM only sample has 923 observations from Academy instructors in the before period; 166 in the after period. Non-URM students include Asian and White students. Non-URM only sample has 8,014 observations from non-participating instructors in the before period; 668 in the after period. Non-URM only sample has 1,594 observations from Academy instructors in the before period; 274 in the after period.

The Academy*URM interaction term captures the additional impact of the Academy on URM students relative to non-URM students. The positive and statistically significant coefficients across all three outcomes demonstrate that the Academy had a significantly greater positive impact on URM students, effectively narrowing or reversing the performance gaps:

- For course grades (Column 1), the Academy increased URM students' grades by 0.315 points more than non-URM students. This improvement effectively closes the original 0.307-point gap.
- In persistence rates (Column 2), the Academy improved URM students' rates by 11.4 percentage points more than non-URM students, reversing the original disparity of 3.1 percentage points.
- For pass rates (Column 3), URM students experienced a 12.6 percentage point improvement compared to non-URM students, similarly reversing the original 6.1 gap.

These findings highlight that the Academy had a disproportionately positive effect on URM students, helping to close or even reverse long-standing performance gaps. By including the interaction term, the model clearly demonstrates the Academy's potential to promote equity in online STEM education through its humanizing teaching practices.

CONCLUSION

The Humanizing Online STEM Academy represents a meaningful step toward fostering equity and inclusivity in online STEM education. By equipping instructors with the digital fluency, equity mindset, and tools to humanize their online teaching practices, the Academy has had a transformative impact, not only on how instructors approach online education but also on the academic outcomes of their students, particularly underrepresented minority (URM) students.

Survey findings reveal that Academy-prepared instructors experienced substantial shifts in their teaching philosophies and practices. The program deepened their understanding of equity and inclusivity, highlighting the influence of emotions in learning, belonging, and culturally responsive teaching in student success. Instructors reported greater confidence in designing engaging, student-centered online courses and adopting flexible policies to support diverse learners. This resulted in increased use of personalized course design, dynamic communication strategies, and approaches with the intention of fostering relationships with students and among peers. These changes reflect a critical rethinking of how online education can be more inclusive and supportive for all students.

The administrative data further underscore the Academy's equity-driven mission. Before the Academy, URM students faced persistent and significant gaps in grades, persistence, and pass rates compared to their non-URM peers. By adopting humanizing strategies, Academy-trained instructors were able to effectively close the gap in grades and reverse disparities in persistence and pass rates. For the first time, URM students in humanized courses outperformed their non-URM counterparts in persistence and pass rates, underscoring the program's success in creating inclusive and supportive learning environments.

It is important to interpret the findings for non-URM students with nuance. The administrative data show a slight decline in grades and persistence rates among non-URM students in Academy-taught courses, which might reflect shifts in teaching practices designed to better serve historically underserved populations. However, it is also important to recognize that racial and ethnic categories obscure vast differences within each group. These results suggest an opportunity to better understand how humanizing strategies can support improved outcomes for all student groups. Future research should explore how these approaches can be refined to ensure equitable benefits across diverse student populations, with particular attention to the nuanced ways in which instructional changes may impact different groups. By deepening our understanding of these dynamics, we can better align inclusive teaching practices with the needs of all learners.

Table 1. The impact of the Academy on reducing racial equity gaps

	(1) Course grade	(2) Course persist	(3) Course pass
Academy	-0.295 [*] (0.133)	-0.098 [*] (0.049)	-0.107 (0.054)
URM	-0.307 ^{***} (0.022)	-0.031 ^{***} (0.006)	-0.061 ^{***} (0.007)
Academy*URM	0.315 [*] (0.133)	0.114 [*] (0.045)	0.126 [*] (0.049)
Course FE	X	X	X
Term FE	X	X	X
Instructor FE	X	X	X
Student controls	X	X	X
Constant	15.654 ^{***} (3.784)	-3.777 ^{***} (0.936)	-1.499 (1.243)
Observations	25788	31526	31526

Note: URM students include American Indian/Alaska Native, Black, Latinx, Native Hawaiian/Pacific Islander, and multiracial students. White and Asian students are the omitted category. Student controls include gender, major, age, cohort, enrollment status (full-time/part-time), and first-time student status. Mean-imputation method used for missing data; missingness indicators included in the regression. Column (1) is a continuous outcome on a 0-4 GPA scale. Columns (2) and (3) are linear probability models of binary outcomes. Standard errors for all models are clustered at the instructor level, shown in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001.