Chad N. Loes, MOUNT MERCY UNIVERSITY, cloes@mtmercy.edu

Effective Teaching Practices and Academic Motivation: A Multi-Institutional Longitudinal Study

ABSTRACT

This study tracked 6,236 students across 44 colleges and universities to assess whether various effective teaching practices influenced end-of-fourth-year academic motivation, while also accounting for a wide range of potential confounders, such as precollege academic motivation. Results suggest that prompt instructor feedback, clarity and organization of instruction, challenging courses with high instructor expectations, integrative learning, and collaborative learning positively influenced end-of-fourth-year academic motivation. Exposure to challenging courses with high instructor expectations, however, failed to exert a statistically reliable influence on this outcome measure.

KEYWORDS

academic motivation, integrative learning, collaborative learning, feedback, instruction

INTRODUCTION

Academic motivation is a key factor in students' development and success, as it is closely linked to engagement, well-being, and achievement (Wu 2019). Despite this evidence, early higher education research often overlooked academic motivation as an outcome (Yoshida et al. 2008). With some exception (e.g., Ishida and Sekiyama 2024), research exploring how specific collegiate teaching practices influence academic motivation remains limited, despite strong associations with important outcomes like course and degree completion (Benden and Lauermann 2022). The salience of these points is further underscored by growing concerns within universities about potential declines in higher education enrollment (Pavlov and Katsamakas 2020).

Extant research in this area suggests that motivation declines through the college years (Benden et al. 2022; Blaich and Wise 2011). Notwithstanding this general trend, certain experiences like student-faculty interaction and positive peer relationships are associated with increases in academic motivation (Furrer, Skinner, and Pitzer 2014; Trolian, Jach, Hanson, and Pascarella 2016). As the exploration of academic motivation as a student outcome develops, researchers continue to examine other factors that influence student development and success.

A remarkable body of evidence documents the influence of effective collegiate instructional practices (hereinafter effective teaching practices) on a range of important student cognitive and non-cognitive outcomes that are theoretically associated with a liberal arts education (Pascarella and Terenzini 2005; Perry and Smart 2007). However, the volume of work connecting effective teaching practices to academic motivation is relatively sparse. Additionally, many studies on academic motivation rely on cross-sectional designs (e.g., Nguyen, Le, Vo, Huynh, Nguyen, and Nguyen 2023; Pourfeiz 2016) and often focus solely on first-year students (e.g., Kowalski 2007). As a result, higher education scholars have called for greater use of longitudinal studies in order to more effectively capture the growth in students' motivation over time, as influenced by their collegiate experiences (Rogaten, Rienties, Sharpe, Cross, Whitelock, Lygo-Baker, and Littlejohn 2019; Xu, Lem, and Onghena

2021). To address these issues, this study aimed to explore—which aspects of effective teaching practices are associated with changes in students' academic motivation over the course of four years of college, while controlling for other potential confounding factors.

LITERATURE REVIEW

Effective teaching practices

Effective teaching in higher education is commonly defined as student-centered instruction that promotes learning (Devlin and Samarawickrema 2010). It encompasses both classroom behaviors (e.g., clarity, organization, prompt feedback) and educational activities beyond class, such as active learning projects and internships (Cabrera, Colbeck, and Terenzini 2001; Chickering and Gamson 1987). Extensive research connects effective teaching practices to a range of important student outcomes, such as content acquisition and critical thinking (Abrami, d'Apollonia, and Rosenfield 2007; Loes and Pascarella 2017; Loes, Salisbury, and Pascarella 2014) and dispositions, such as need for cognition and positive attitudes toward literacy (Loes, Saichaie, Padgett, and Pascarella 2012; Mayhew, Wolniak, and Pascarella 2008). Beyond cognitive outcomes, longitudinal studies link effective teaching to graduate school aspirations, persistence, and degree completion (Hanson, Paulsen, and Pascarella 2016; Loes, An, and Pascarella 2019; Loes and Pascarella 2015). Yet research directly connecting these practices to academic motivation in higher education remains limited.

Motivation

Motivation, derived from the Latin word *movere* (to move), refers to the energizing of behavior toward goals (Simpson and Balsam 2016). Psychology distinguishes intrinsic motivation, acting for inherent satisfaction, from extrinsic motivation, driven by external rewards or pressures; amotivation denotes the absence of either (Ryan and Deci 2000a). In education, academic motivation incorporates both intrinsic and extrinsic elements (Vallerand and Bissonnette 1992). Related constructs include achievement motivation, motivation for learning, and engagement (Ames 1992; Atkinson 1957). Multiple studies use the phrase "academic motivation" to describe the outcome measure explored here (Trolian et al. 2016; Wu 2019).

Theoretical foundations of academic motivation

Research on academic motivation often draws on five theories: social cognitive, expectancy-value, attribution, achievement goal, and self-determination (Koenka 2020; Wigfield and Koenka 2020). Social cognitive theory highlights reciprocal links among environment, beliefs, and behavior with self-efficacy encouraging students to take on challenges (Bandura 1986). Expectancy-value theory views motivation as a function of success expectations and the value of tasks (Eccles and Wigfield 1995). Attribution theory explains differences of how students interpret success or failure (Weiner 2012). Achievement-goal theory contrasts mastery goals, which focus on learning, with performance goals, which focus on outperforming others (Elliot 1999). Self-determination theory posits that autonomy, competence, and relatedness underpin motivation (Ryan et al. 2000a). Together, these perspectives emphasize goal-directed behavior, perceived control, and the growth of competence—core elements of students' academic motivation.

Although substantial evidence links effective teaching practices to academic motivation at the primary and secondary levels of education, fewer studies have explored this relationship at the tertiary level (Jansen, Meyer, Wigfield, and Möller 2022). Within this smaller body of research, evidence suggests a positive connection between various forms of effective teaching and students' academic motivation. For example, in a single-institution study using a convenience sample of 119 focus group participants, Sogunro (2017) found that students' perceptions of effective instruction predicted higher

levels of self-reported academic motivation. Similarly, another study at a single institution showed that instructors' use of active learning strategies compared to traditional lectures was more strongly correlated with course engagement, a key component of overall academic motivation (Komarraju and Karau 2008). Additionally, a large-scale study following over 2,000 students across 17 institutions found that one aspect of effective teaching—collaborative learning—predicted increases in academic motivation over the course of four years in college (Loes 2022). While this research contributed important insights into academic motivation, it focused on a limited range of teaching practices. Moreover, much of the existing literature is based on single-institution samples, which limits the generalizability of these findings. As a result, it remains unclear how a broader range of teaching practices, implemented across multiple institutions over several years, might influence academic motivation. While this study draws on data from higher education institutions in the United States, the findings may offer valuable insights for educators and policymakers in post-secondary systems worldwide who face similar challenges related to student motivation and persistence.

Taken together, it seems reasonable to assume exposure to effective teaching practices will be associated with enhanced academic motivation. However, a review of the literature suggests there is a gap in existing research regarding this important area of inquiry. Considering the research and theory reviewed here, the following hypothesis guided this investigation: Net of a range of potential confounders, including a pretest measure of the outcome variable, exposure to effective teaching practices would be associated with gains in end-of-fourth-year academic motivation.

METHODS

Samples

The data used in this study came from the Wabash National Study of Liberal Arts Education (WNS). Funded by the Center of Inquiry in the Liberal Arts at Wabash College, the WNS was a large study that included multiple higher learning institutions throughout the US. Study administrators initially captured data on students early in the fall term of 2006 (cohort one), 2007 (cohort two), and 2008 (cohort three). Follow-up surveys were conducted late in the spring term of 2010 for cohort one, 2011 for cohort two, and 2012 for cohort three. During each follow-up period, administrators also collected information on student background characteristics, high school experiences, and posttest measures parallel to each pretest (including academic motivation).

The primary focus of the WNS was to investigate how liberal arts educational experiences influence a wide-range of student outcomes theoretically associated with a liberal arts education. Given this focus, study administrators oversampled liberal arts colleges (undergraduate-focused institutions emphasizing broad-based education). They invited students to take part in the WNS before classes commenced during the fall term or during their first two to three weeks in college. A total of 17,453 students participated in the initial data collection for the WNS. Though the sample initially consisted of 17,453 students, it is important to note that considering this study is concerned with the influence of teaching behaviors on academic motivation over four years of higher education, 785 community college students were not included in the analyses. Limiting the sample to students who completed the Time 3 data collection (in the spring of their final undergraduate year of college), led to 6,236 students from 44 institutions (29 liberal arts colleges, six research universities [large institutions with a primary focus on research and graduate education], and nine regional universities [which typically serve local or state populations and emphasize undergraduate teaching]) remaining in the sample—an overall response rate of 36.2%. These samples were identical to those reported in other WNS studies examining students throughout all four years of university (e.g., An and Loes 2023).

The Institutional Review Board of the author's institution approved the secondary analysis of the data used in this study.

Variables

The outcome measure used in this study is end-of-fourth-year academic motivation. This measure is captured with an eight-item scale (alpha = 0.76) that assesses the extent to which respondents report being motivated to complete academic tasks. The items in this scale reflect achievement goal and expectancy-value theories (Dweck 1986; Pintrich 2000; Wigfield and Eccles 2000). For example, the scale contains items that capture mastery-oriented motivation (e.g., "I am willing to work hard in a course to learn the material even if it won't lead to a higher grade," "I enjoy the challenge of learning complicated new material"), performance-based motivation (e.g., "Getting the best grades I can is very important to me"), and the value students place on academic experiences (e.g., "My academic experiences will be the most important/enjoyable part of college"). This scale is the same measure used in multiple other academic motivation studies (e.g., Loes 2022; Trolian et al. 2016; Wu 2019). Table 1 presents descriptive statistics for each variable and detailed definitions of the variables are provided in Appendix A.

Table 1. Descriptive statistics

Variable	M/%	SD	Min.	Max.
Male	39%	–	0	1
Black	7%	–	0	1
American Indian/other	1%	–	0	1
Asian/Pacific Islander	6%	–	0	1
Hispanic	6%	–	0	1
Federal grant	14%	–	0	1
Pre-college academic ability	26.59	4.56	8	36
Precollege academic motivation	3.63	0.55	1	5
STEM major	25%	–	0	1
College grades (A- or higher)	50%	–	0	1
Worked for pay	76%	–	0	1
Co-curricular activities	82%	–	0	1
Lives on campus	44%	–	0	1
Graduate degree aspirations	82%	–	0	1
Prompt feedback	3.39	0.64	1	5
Teacher clarity and organization	4.08	0.52	1	5
Challenging classes	3.77	0.70	1	5
Higher-order exams/assignments	3.82	0.76	1	5

Integrative learning	3.53	0.50	1	5
Collaborative learning	3.31	0.76	1	5
Fourth-year academic motivation	3.49	0.63	1	5

Note. WNS. N=6,236. Reference for sex is female. The reference for race is White. Values reported here reflect data before imputation.

Guided by other research on effective instruction (e.g., Hanson et al. 2016; Liu, Hu, and Pascarella 2021; Loes et al. 2012; Loes et al. 2015), the predictor variables in this study consist of six effective teaching practices that are associated with a range of important student outcomes. First, the organization and clarity scale is a 10-item measure (alpha = 0.90) that captures the extent to which students perceived the instruction they received as clear and organized. Next, prompt feedback is assessed with a three-item scale (alpha = 0.66) that captures students' perceptions of how quickly faculty give them feedback on their work. Although this alpha value is slightly below the conventional threshold of 0.70, this value is virtually identical to those reported in other studies using the same scale (e.g., Hanson et al. 2016; Kilgo, Culver, Young, and Paulsen 2017; Loes et al. 2012). Furthermore, the strong factor loadings (all exceeding 0.70) indicate that each item significantly contributes to and measures the underlying "prompt feedback" construct, providing evidence of good convergent validity. Challenging classes and high faculty expectations is captured with a six-item scale (alpha = 0.83) that estimates the extent to which they perceive their classes as challenging and that their faculty had high expectations of their work. Next, a five-item scale termed "frequency of higher-order exams and assignments" (alpha = 0.79) assessed how often respondents completed exams or assignments that required them to use higher-order thinking. The next effective teaching practice, integrative learning (alpha = 0.77) is a nine-item scale that assesses students' perceptions of how often they integrate ideas, information, and activities between their classroom experiences and other experiences. Lastly, collaborative learning was captured with a four-item scale (alpha = 0.72) that includes how often students worked collaboratively with other students on coursework.

All analyses include several control variables. These variables were included based on past research in an attempt to isolate the influence of effective teaching practices on end-of-fourth-year academic motivation. Broadly, these factors include student precollege characteristics, institutional characteristics, and other influences that may confound the relationship between the predictor and outcome variables (Pascarella 1985). In particular, all estimates in the current investigation include dummy variables (e.g., male vs. female) reflecting the 2007 or 2008 WNS cohort (reference group is the 2006 cohort), and sex (students identifying as male coded as 1, students identifying as female as 0). Race/ethnicity is captured with dummy variables representing U.S. Census categories of Black, Hispanic, Asian/Pacific Islander, and other races (White is the reference category).

Financial background is assessed with a dummy variable indicating whether the respondent received a federal grant (refers to financial aid programs from the U.S. government) (yes coded as 1, no as 0), precollege academic ability (measured with respondents' ACT or SAT equivalent score), and precollege academic motivation (eight items; alpha = 0.69). The analyses also include a dummy variable representing whether the respondent is a STEM major (biological science, engineering, physical science, or mathematics = 1, all other majors = 0), college GPA (respondent fourth-year grades were "A-" or above = 1, B+ or below = 0), worked for pay on or off campus (yes coded as 1, no as 0), participated in co-curricular activities (yes coded as 1, no as 0), lived on campus (yes coded as 1, no as 0), and has aspirations to obtain a graduate degree (yes coded as 1, no as 0). Lastly, institution fixed

effects are also included in all analyses to adjust for any potential differences among students nested within the 44 institutions in the sample.

Data analysis

The data were analyzed by regressing the end-of-fourth-year academic motivation outcome variable on the six effective teaching practices (clarity and organization, prompt feedback, challenging classes and high faculty expectations, frequency of higher-order exams and assignments, integrative learning, and collaborative learning) as well as all the control measures described earlier. Given that students were nested within institutions, all models also included the use of institution fixed effects. This approach controls for time-invariant differences between institutions, allowing for the assessment of relationships between individual-level factors and end-of-fourth-year academic motivation within each institution (Allison 2009). Potential issues regarding collinearity were assessed with a variance inflation factor test (i.e., a test to check for overlap among variables that might affect the results). The results ranged from 1.01 to 2.22 (with a mean of 1.30), which are well below established thresholds, suggesting collinearity is not biasing the estimates (Cohen, Cohen, West, and Aiken 2003). Variable missingness was assessed using Little's (1988) test, which suggested the missing data were not missing completely at random. Missingness on each variable ranged from under one percent to just under 11% on any variable, and the use of listwise deletion would result in losing 30 percent of the sample. 50 imputed data sets were generated in order to address the missingness among the study variables (Von Hippel 2020). This approach led to a final analytical sample of 6,236 participants.

Limitations

The current investigation had several limitations. First, the researchers collected the last wave of data used in this study roughly 12 years ago. Though researchers continue to conduct studies using WNS data, it would be preferable to use more recent findings. This is also an important point considering the rapidly changing educational landscape, especially after the relatively recent COVID-19 pandemic and the advent of artificial intelligence. Future research should consider how these changes might impact this study's findings. These points noted, the WNS data set is rather unique given the robustness of its assessments, especially considering it is based on a longitudinal design among multiple institutions over four years of university.

Next, there are a variety of conceptualizations of academic motivation in higher education literature. Though multiple studies have used the measure of academic motivation employed in this investigation (e.g., Roksa and Whitley 2017; Trolian et al. 2016; Wu 2019), there are various ways this concept can be measured. Accordingly, future research should endeavor to test the robustness of the findings reported here with different measures of motivation. Lastly, an obvious strength of the WNS study is the breadth of institutions included in its sample. Despite this benefit, the sample is not representative of all higher education institutions in the US. Importantly, however, the oversampling of liberal arts colleges provides unique insight into the influence of a range of student experiences on various student outcomes theoretically associated with a liberal arts education.

RESULTS

Table 2 includes regression estimates for all analyses related to testing this study's hypothesis. Overall, the model explained 36% of the variance in end-of-the-fourth-year academic motivation. Looking first at the control measures, precollege academic motivation, as expected, had the greatest influence on academic motivation at the end of the fourth year ($\beta = .29$, $p < .001$). This can

be interpreted as a 1 *SD* increase in precollege academic motivation is associated with a .29 *SD* increase on average in end-of-fourth-year academic motivation. Several other covariates also significantly influenced the outcome measure. Notably, those majoring in STEM disciplines (b = .15, $p < .001$) and those reporting college grades of "A-" (on a U.S. letter grading scale where A- represents excellent performance) or higher (b = .22, $p < .001$) were more likely than their counterparts to exhibit gains in end-of-fourth-year academic motivation.

Turning next to the scales that captured effective teaching techniques, net of covariates, receiving prompt instructor feedback were positively associated with end-of-fourth-year academic motivation (β = .11, $p < .001$). This finding can be interpreted as a 1 *SD* increase in prompt instructor feedback is associated with a .11 *SD* increase on average in academic motivation. Similarly, receipt of clear and organized instruction was associated with increases in the outcome measure (β = .13, $p < .001$). Put differently, a 1 *SD* increase in receipt of clear and organized instruction averaged a .13 *SD* increase in academic motivation. Next, the results suggest that taking challenging classes from faculty with high expectations did not exert a statistically reliable influence on students' academic motivation levels (β = .00, $p = .807$).

Table 2. Regression estimates for effective teaching practices on end-of-fourth-year academic motivation

Variable	**β**	*SE*	b
Male	0.00	(0.01)	0.00
Black	0.02	(0.01)	0.04
Other	0.02*	(0.01)	0.18**
Asian/Pacific Islander	0.02*	(0.01)	0.05*
Hispanic	0.03***	(0.01)	0.08***
Federal grant	-0.01	(0.01)	-0.02
Pre-college academic ability	-0.04***	(0.02)	-0.01***
Precollege academic motivation	0.29***	(0.01)	0.33***
STEM major	0.10***	(0.01)	0.15***
College grades (A- or higher)	0.18***	(0.01)	0.22***
Worked for pay	-0.02	(0.01)	-0.02
Co-curricular activities	-0.02**	(0.01)	-0.04**
Lives on campus	0.01	(0.01)	0.01
Graduate degree aspirations	0.03***	(0.01)	0.05***
Prompt feedback	0.11***	(0.01)	0.11***
Teacher clarity and organization	0.13***	(0.01)	0.16***
Challenging classes	0.00	(0.01)	0.00
Higher-order exams/assignments	0.03*	(0.01)	0.03*
Integrative learning	0.18***	(0.01)	0.23***
Collaborative learning	0.11***	(0.01)	0.09***
Constant	0.12	(0.10)	
R^2	0.36		

Note. **β**/b=standardized/unstandardized coefficient. Estimates include controls for cohort and institutional fixed effects. N= 6,236. *p < .05. **p < .01. ***p < .001 (two-tailed).

The frequency with which students completed higher-order exams and assignments (β = .03, p = .022), engaged in integrative learning (β = .18, $p < .001$), and utilized collaborative learning (β = .11, $p < .001$) were all more likely to report gains in academic motivation. This can be interpreted as a 1 *SD* increase in higher-order exams and assignments, engagement in integrative learning, and collaborative learning is associated with a .03, .18, and .11 *SD* increase, respectively, in end-of-fourth-year academic motivation.

DISCUSSION

This study examined whether effective teaching practices shape students' academic motivation after four years of college. Although previous research explored how teaching influences many student outcomes, few studies focused on motivation across four years, despite the evidence connecting motivation to engagement, achievement, and persistence (Wu 2019). Except for challenging classes and high instructor expectations, all teaching practices exerted a positive and statistically reliable influence on academic motivation in this study.

These findings contribute to the literature in several important ways. Though some higher education research explores how instructional practices influence academic motivation—both generally (Komarraju et al. 2008; Yoshida et al. 2008) and within specific disciplines (e.g., Saeedi, Ghafouri, Tehrani, and Abedini 2021)—much of this work focuses on students from single institutions (Komarraju, Musulkin, and Bhattacharya 2010), limiting the generalizability of the results to other contexts and institutions.

Lastly, several studies examining how effective teaching practices influence students' motivation rely on cross-sectional research designs (e.g., Yoshida et al. 2008). While these designs are sometimes unavoidable, they nevertheless limit researchers' ability to understand how instructional practices impact motivation over time. The results of this study are particularly valuable and unique because this investigation included a comprehensive set of established measures and followed thousands of the same students throughout their college years.

It is important to emphasize that students completed parallel pretest and posttest measures of academic motivation—once at the beginning of college and again during the final year of their undergraduate degree. This is significant for two reasons: first, the longitudinal design used in this study is a powerful method for adjusting for potential selection effects, which is a particularly persistent issue in higher education research (Astin and Lee 2003). Second, it allowed for the estimation of actual gains in academic motivation as a result of exposure to effective teaching practices (Pascarella, Wolniak, and Pierson 2003). This finding is especially important considering the body of literature suggesting motivation levels tend to decrease over time among various groups of students (Benden et al. 2022; Blaich et al. 2011).

While the effect sizes of the effective teaching practices might initially appear small, it is important to remember that the models included not only a wide range of covariates, such as measures of precollege academic ability and institution fixed effects, but also a pretest measure of the outcome variable. Consistent with the argument made by Loes and An (2021), who also relied on WNS data in their study on collaborative learning, the conservative prediction equations used here underscore the importance of the statistically significant relationships uncovered in these analyses.

Also important, the precollege academic motivation measure exerted the largest influence on end-of-fourth-year academic motivation among all variables in the model. Even with the expected decline in academic motivation from the first year to the last year of college from 3.63 to 3.49 (out of 5), exposure to effective teaching practices led to actual gains in end-of-fourth-year academic motivation. Among the effective teaching practices examined in the final model of this study, students

who reported engaging in integrative learning (one's ability to connect or synthesize information learned [Barber 2012]) exhibited the largest gains in end-of-fourth-year academic motivation.

This finding is relatively unsurprising, considering the volume of evidence suggesting integrative learning fosters a deeper understanding of the relevance of material, greater mastery of concepts, intellectual curiosity, engagement, and personal agency in the learning process (Nahon, Segev, and Hayak 2024; Ryan and Deci 2000b; Wigfield et al. 2000). This finding also comports with other research connecting this effective teaching practice to other outcomes, including language acquisition and measures of academic and personal development (Awang-Hashim et al. 2022; Somers and Llinares 2018; Wawan, Retnawati, and Setyaningrum 2023), which also lend support to the concept of intrinsic motivation that is central to achievement goal and expectancy-value theories (Dweck 1986; Wigfield et al. 2000). Collectively, the research reviewed here, along with the findings reported in this study, provides clear evidence underscoring the importance of encouraging the use of integrative learning in the university classroom. Doing so has the potential to influence students' academic motivation along with a variety of other important student outcomes.

The finding that exposure to clear and organized instruction was positively associated with academic motivation aligns with previous research linking effective teaching behaviors to a variety of important student outcomes (for a review of this evidence, see Loes et al. 2015). Engaging in collaborative learning activities also exerted a positive and statistically significant influence on academic motivation. This finding comports with a large corpus of evidence linking collaborative learning to multiple salient student outcomes (Barkley, Cross, and Major 2014). Though an earlier study using the WNS data established the relationship between collaborative learning and academic motivation (Loes 2022), this study expands on that work by also considering how collaborative learning influences academic motivation while simultaneously estimating the effects of other effective teaching practices that students are likely to experience at the same time.

These findings also lend support to achievement goal and expectancy-value theories (Dweck 1986; Wigfield et al. 2000). These results are also consistent with other work that relies on these theories in explaining the influence of instructional environments on academic motivation (e.g., Harackiewicz, Barron, Tauer, Carter, and Elliot 2000). According to the mastery (sometimes referred to as learning) goals component of achievement goal theory, exposure to effective teaching practices increases the likelihood that students will be more motivated to learn by being exposed to a supportive and stimulating learning environment fostered by effective instructional practices. Similarly, receipt of clear instruction and prompt feedback enhances students' expectations for success, thereby helping them believe they are capable of succeeding, which in turn helps them become more academically motivated (Dweck 1986; Wigfield et al. 2000).

Future research might also consider how levels of engagement in collaborative and integrative learning, as well as academic motivation, vary across student demographics. It is also important to note that although the indicators of effective teaching practices used in this study could arguably overlap conceptually, decades of studies have examined these measures as independent predictors. Therefore, this study comports with a large body of work that examines how these individual practices influence a range of important university student outcomes (Abrami et al. 2007; Chickering et al. 1987; Feldman 1997; Kuh 2001; Pascarella et al. 2005). It is also important to reiterate the finding that challenging classes/high instructor expectations failed to significantly influence academic motivation in the final model. Though this finding might initially appear surprising, it is consistent with evidence on this topic. For example, although challenge is important for students' growth, excessive challenge—especially when students perceive the instructor as overly demanding—can diminish motivation (Schunk and DiBenedetto 2020; Vansteenkiste, Simons, Lens, Sheldon, and

Deci 2004). This experience may also lead to students feeling less connected to the course and its content, which may reduce their overall engagement and motivation to learn (Deci and Ryan 1985).

The results reported here have important implications for students, faculty, and administrators in higher education. Academic motivation among college students is linked to higher engagement, improved grades, and greater persistence (Means, Bakx, Klimstra, and Denissen 2018; Wu 2019). Strategies that strengthen student motivation may help address the widespread concern about declining college enrollment. Faculty development initiatives can support instructors in integrating evidence-based teaching practices that foster motivation and student success.

Lastly, there is an established body of literature on faculty development that provides clear, evidence-based guidance on effectively integrating best teaching practices into the classroom. Faculty members wishing to enhance their students' academic motivation and overall success can benefit from engaging with faculty developers through workshops, seminars, and one-on-one consultations. These resources are invaluable in helping faculty refine their teaching strategies, which, in turn, directly supports students' academic growth and accelerates their progress toward degree completion (Pascarella 2005; Weimer and Lenze 1997). By taking advantage of these opportunities, faculty may foster a more motivating and engaging learning environment, thereby empowering students to thrive and reach their educational goals with greater confidence.

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AUTHOR BIOGRAPHY

Chad Loes (United States) is professor and chair in the Department of History, Politics, and Justice at Mount Mercy University.

ETHICS

The Mount Mercy University Institutional Review Board approved this research.

REFERENCES

Abrami, Philip C., Sylvia d'Apollonia, and Steven Rosenfield. 2007. "The Dimensionality of Student Ratings of Instruction: What We Know and What We Do Not." In *The Scholarship of Teaching and Learning in Higher Education: An Evidence-Based Perspective*. Springer. https://doi.org/10.1007/1-4020-5742-3_10.

Allison, Paul D. 2009. *Fixed Effects Regression Models.* Sage.

Ames, Carole. 1992. "Classrooms: Goals, Structures, and Student Motivation." *Journal of Educational Psychology* 84 (3): 261–71. https://doi.org/10.1037/0022-0663.84.3.261.

An, Brian P., and Chad N. Loes. 2023. "Participation in High-Impact Practices: Considering the Role of Institutional Context and a Person-Centered Approach." *Research in Higher Education* 64 (4): 520–46. https://doi.org/10.1007/s11162-022-09715-6.

Astin, Alexander, and Jenny Lee. 2003. "How Risky Are One-Shot Cross-Sectional Assessments of Undergraduate Students?" *Research in Higher Education* 44 (6): 657–72. https://doi.org/10.1023/A:1026175525173.

Atkinson, John W. 1957. "Motivational Determinants of Risk-Taking Behavior." *Psychological Review* 64 (6, Pt. 1): 359–72. https://doi.org/10.1037/h0043445.

Awang-Hashim, Rosna, Amrita Kaur, Norhafezah Yusof, S. Kanageswari a/p S. Shanmugam, Nor Aziah Abdul Manaf, Ainol Madziah Zubairi, Angelina Yee Seow Voon, and Marzura Abdul Malek. 2022. "Reflective and Integrative Learning and the Role of Instructors and Institutions—Evidence from Malaysia." *Higher Education* 83 (3): 1–20. https://doi.org/10.1007/s10734-021-00689-5.

Bandura, Albert. 1986. *Social Foundations of Thought and Action: A Social Cognitive Theory.* Prentice Hall.

Barber, James P. 2012. "Integration of Learning: A Grounded Theory Analysis of College Students' Learning." *American Educational Research Journal* 49 (3): 590–617. https://doi.org/10.3102/0002831212437854.

Barkley, Elizabeth, K. Patricia Cross, and Claire Major. 2014. *Collaborative Learning Techniques: A Handbook for College Faculty*. 2nd ed. Jossey-Bass.

Benden, Daria K., and Fani Lauermann. 2022. "Students' Motivational Trajectories and Academic Success in Math-Intensive Study Programs: Why Short-Term Motivational Assessments Matter." *Journal of Educational Psychology* 114 (5): 1062–85. https://doi.org/10.1037/edu0000708.

Blaich, Charles F., and Kathleen Wise. 2011. "From Gathering to Using Assessment Results: Lessons from the Wabash National Study (NILOA Occasional Paper No. 8)." University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment.

Cabrera, Alberto F., Carol L. Colbeck, and Patrick T. Terenzini. 2001. "Developing Performance Indicators for Assessing Classroom Teaching Practices and Student Learning: The Case for Engineering." *Research in Higher Education* 42 (3): 327–52. https://doi.org/10.1023/A:1018874023323.

Chickering, Arthur W., and Zelda Gamson. 1987. "Seven Principles for Good Practice in Undergraduate Education." *AAHE Bulletin* 39 (7): 3–7.

Cohen, Jacob, Patricia Cohen, Stephen G. West, and Leona S. Aiken. 2003. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd ed. L. Erlbaum Associates.

Deci, Edward L., and Richard M. Ryan. 1985. "The General Causality Orientations Scale: Self-Determination in Personality." *Journal of Research in Personality* 19 (2): 109–34. https://doi.org/10.1016/0092-6566(85)90023-6.

Devlin, Marcia, and Gayani Samarawickrema. 2010. "The Criteria of Effective Teaching in a Changing Higher Education Context." *Higher Education Research & Development* 29 (2): 111–24. https://doi.org/10.1080/07294360903244398.

Dweck, Carol S. 1986. "Motivational Processes Affecting Learning." *American Psychologist* 41 (10): 1040. https://doi.org/10.1037/0003-066X.41.10.1040.

Eccles, Jacquelynne S., and Allan Wigfield. 1995. "In the Mind of the Actor: The Structure of Adolescents' Achievement Task Values and Expectancy-Related Beliefs." *Personality and Social Psychology Bulletin* 21 (3): 215–25. https://doi.org/10.1177/0146167295213003.

Elliot, Andrew J. 1999. "Approach and Avoidance Motivation and Achievement Goals." *Educational Psychologist* 34 (3): 169–89. https://doi.org/10.1207/s15326985ep3403_3.

Feldman, Kenneth A. 1997. "Identifying Exemplary Teachers and Teaching: Evidence from Student Ratings." In *Effective Teaching in Higher Education: Research and Practice*, edited by Raymond Perry and John Smart. Agathon Press.

Furrer, Carrie J., Ellen A. Skinner, and Jennifer R. Pitzer. 2014. "The Influence of Teacher and Peer Relationships on Students' Classroom Engagement and Everyday Motivational Resilience." *Teachers College Record* 116 (13): 101–23. https://doi.org/10.1177/016146811411601319.

Hanson, Jana M., Michael B. Paulsen, and Ernest T. Pascarella. 2016. "Understanding Graduate School Aspirations: The Effect of Good Teaching Practices." *Higher Education* 71: 735–52. https://doi.org/10.1007/s10734-015-9934-2.

Harackiewicz, Judith M., Kenneth E. Barron, John M. Tauer, Suzanne M. Carter, and Andrew J. Elliot. 2000. "Short-Term and Long-Term Consequences of Achievement Goals: Predicting Interest and Performance over Time." *Journal of Educational Psychology* 92 (2): 316. https://doi.org/10.1037/0022-0663.92.2.316.

Ishida, Ayame, and Takashi Sekiyama. 2024. "Variables Influencing Students' Learning Motivation: Critical Literature Review." *Frontiers in Education* 9: 1445011. https://doi.org/10.3389/feduc.2024.1445011.

Jansen, Thorben, Jennifer Meyer, Allan Wigfield, and Jens Möller. 2022. "Which Student and Instructional Variables Are Most Strongly Related to Academic Motivation in K–12 Education? A Systematic Review of Meta-Analyses." *Psychological Bulletin* 148 (1–2): 1–26. https://doi.org/10.1037/bul0000354.

Kilgo, Cindy A., K. C. Culver, Ryan L. Young, and Michael B. Paulsen. 2017. "The Relationship between Students' Perceptions of 'Good Practices for Undergraduate Education' and the Paradigmatic Development of Disciplines in Course-Taking Behavior." *Research in Higher Education* 58: 430–48. https://doi.org/10.1007/s11162-016-9433-z.

Koenka, Alison C. 2020. "Academic Motivation Theories Revisited: An Interactive Dialog between Motivation Scholars on Recent Contributions, Underexplored Issues, and Future Directions." *Contemporary Educational Psychology* 61: 101831. https://doi.org/10.1016/j.cedpsych.2019.101831.

Komarraju, Meera, and Steven J. Karau. 2008. "Relationships between the Perceived Value of Instructional Techniques and Academic Motivation." *Journal of Instructional Psychology* 35 (1): 70–82.

Komarraju, Meera, Sergey Musulkin, and Gargi Bhattacharya. 2010. "Role of Student—Faculty Interactions in Developing College Students' Academic Self-Concept, Motivation, and Achievement." *Journal of College Student Development* 51 (3): 332–42. https://doi.org/10.1353/csd.0.0137.

Kowalski, Patricia. 2007. "Changes in Students' Motivation to Learn during the First Year of College." *Psychological Reports* 101 (1): 79–89. https://doi.org/10.2466/pr0.101.1.79-89.

Kuh, George D. 2001. "Assessing What Really Matters to Student Learning inside the National Survey of Student Engagement." *Change: The Magazine of Higher Learning* 33 (3): 10–17. https://doi.org/10.1080/00091380109601795.

Little, Roderick J. A. 1988. "A Test of Missing Completely at Random for Multivariate Data with Missing Values." *Journal of the American Statistical Association* 83 (404): 1198–1202. https://doi.org/10.1080/01621459.1988.10478722.

Liu, Jiajun, Shouping Hu, and Ernest T. Pascarella. 2021. "Are Non-Native English Speaking Students Disadvantaged in College Experiences and Cognitive Outcomes?" *Journal of Diversity in Higher Education* 14 (3): 398–407. http://dx.doi.org/10.1037/dhe0000164.

Loes, Chad N. 2022. "The Effect of Collaborative Learning on Academic Motivation." *Teaching & Learning Inquiry* 10: 1–17. https://doi.org/10.20343/teachlearninqu.10.4.

Loes, Chad N., and Brian P. An. 2021. "Collaborative Learning and Need for Cognition: Considering the Mediating Role of Deep Approaches to Learning." *The Review of Higher Education* 45 (2): 149–79. https://doi.org/10.1353/rhe.2021.0019.

Loes, Chad N., Brian P. An, and Ernest T. Pascarella. 2019. "Does Effective Classroom Instruction Enhance Bachelor's Degree Completion? Some Initial Evidence." *The Review of Higher Education* 42 (3): 903–31. https://doi.org/10.1353/rhe.2019.0024.

Loes, Chad N., and Ernest T. Pascarella. 2015. "The Benefits of Good Teaching Extend beyond Course Achievement." *Journal of the Scholarship of Teaching and Learning* 15 (2): 1. https://doi.org/10.14434/josotl.v15i2.13167.

Loes, Chad N., and Ernest T. Pascarella. 2017. "Collaborative Learning and Critical Thinking: Testing the Link." *The Journal of Higher Education* 88 (5): 726–53. https://doi.org/10.1080/00221546.2017.1291257.

Loes, Chad N., Kem Saichaie, Ryan D. Padgett, and Ernest T. Pascarella. 2012. "The Effects of Teacher Behaviors on Students' Inclination to Inquire and Lifelong Learning." *International Journal for the Scholarship of Teaching and Learning* 6 (2): 1–20. https://doi.org/10.20429/ijsotl.2012.060207.

Loes, Chad N., Mark H. Salisbury, and Ernest T. Pascarella. 2014. "Student Perceptions of Effective Instruction and the Development of Critical Thinking: A Replication and Extension." *Higher Education* 69: 823–38. https://doi.org/10.1007/s10734-014-9807-0.

Mayhew, Matthew, Gregory Wolniak, and Ernest Pascarella. 2008. "How Educational Practices Affect the Development of Life-Long Learning Orientations in Traditionally-Aged Undergraduate Students." *Research in Higher Education* 49 (4): 337–56. https://doi.org/10.1007/s11162-007-9081-4.

Meens, Evelyne E. M., Anouke W. E. A. Bakx, Theo A. Klimstra, and Jaap J. A. Denissen. 2018. "The Association of Identity and Motivation with Students' Academic Achievement in Higher Education." *Learning and Individual Differences* 64: 54–70. https://doi.org/10.1016/j.lindif.2018.04.006.

Nahon Crystal, Edna, Yael Segev, and Merav Hayak. 2024. "Integrative Learning of Literature and Science Promotes 21st-Century Skills." *Cogent Education* 11 (1): 2439625. https://doi.org/10.1080/2331186X.2024.2439625.

Nguyen, Manh Truc Huynh, Minh Quang Le, Thu Minh Vo, Loc Van Huynh, Phuong Viet Nguyen, and Thuy Hong Nguyen. 2023. "Factors Associated with Academic Motivation in Nursing Students: A Cross-Sectional Study." *Jurnal Kebidanan Dan Keperawatan Aisyiyah* 19 (1): 1–14. https://doi.org/10.31101/jkk.3027.

Pascarella, Ernest T. 1985. "College Environmental Influences on Learning and Cognitive Development: A Critical Review and Synthesis." In *Higher Education: Handbook of Theory and Research*, edited by John C. Smart. Agathon.

Pascarella, Ernest T. 2005. "Cognitive Impacts of the First Year of College." In *Improving the First Year of College*. Psychology Press.

Pascarella, Ernest T., and Patrick T. Terenzini. 2005. *How College Affects Students: A Third Decade of Research*. Vol. 2. Jossey-Bass.

Pascarella, Ernest T., Gregory C. Wolniak, and Christopher T. Pierson. 2003. "Explaining Student Growth in College When You Don't Think You Are." *Journal of College Student Development* 44 (1): 122–26. https://doi.org/10.1353/csd.2003.0007.

Pavlov, Oleg V., and Evangelos Katsamakas. 2020. "Will Colleges Survive the Storm of Declining Enrollments? A Computational Model." *Plos One* 15 (8): e0236872. https://doi.org/10.1371/journal.pone.0236872.

Perry, Raymond P., and John C. Smart. 2007. *The Scholarship of Teaching and Learning in Higher Education: An Evidence-Based Perspective*. Springer.

Pintrich, Paul R. 2000. “An Achievement Goal Theory Perspective on Issues in Motivation Terminology, Theory, and Research.” *Contemporary Educational Psychology* 25 (1): 92–104.

Pourfeiz, Jafar. 2016. “A Cross-Sectional Study of Relationship between Attitudes toward Foreign Language Learning and Academic Motivation.” *Procedia-Social and Behavioral Sciences* 232: 668–76. https://doi.org/10.1016/j.sbspro.2016.10.091.

Rogaten, Jekaterina, Bart Rienties, Rhona Sharpe, Simon Cross, Denise Whitelock, Simon Lygo-Baker, and Allison Littlejohn. 2019. “Reviewing Affective, Behavioural and Cognitive Learning Gains in Higher Education.” *Assessment & Evaluation in Higher Education* 44 (3): 321–37. https://doi.org/10.1080/02602938.2018.1504277.

Roksa, Josipa, and Sarah E. Whitley. 2017. “Fostering Academic Success of First-Year Students: Exploring the Roles of Motivation, Race, and Faculty.” *Journal of College Student Development* 58 (3): 333–48. https://doi.org/10.1353/csd.2017.0026.

Ryan, Richard M., and Edward L. Deci. 2000a. “Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions.” *Contemporary Educational Psychology* 25 (1): 54–67. https://doi.org/10.1006/ceps.1999.1020.

Ryan, Richard M., and Edward L. Deci. 2000b. “Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being.” *American Psychologist* 55 (1): 68–78. https://doi.org/10.1037/0003-066X.55.1.68.

Saeedi, Maryam, Raziyeh Ghafouri, Fereshteh J. Tehrani, and Zahra Abedini. 2021. “The Effects of Teaching Methods on Academic Motivation in Nursing Students: A Systematic Review.” *Journal of Education and Health Promotion* 10 (1): 271. https://doi.org/10.4103/jehp.jehp_1070_20.

Schunk, Dale H., and Maria K. DiBenedetto. 2020. “Motivation and Social Cognitive Theory.” *Contemporary Educational Psychology* 60: 101832. https://doi.org/10.1016/j.cedpsych.2019.101832.

Simpson, Eleanor H., and Peter D. Balsam. 2016. *The Behavioral Neuroscience of Motivation: An Overview of Concepts, Measures, and Translational Applications*. Springer.

Sogunro, Olusegun A. 2017. “Quality Instruction as a Motivating Factor in Higher Education.” *International Journal of Higher Education* 6 (4): 173–84. https://doi.org/10.5430/ijhe.v6n4p173.

Somers, Thomas, and Ana Llinares. 2018. “Students’ Motivation for Content and Language Integrated Learning and the Role of Programme Intensity.” *International Journal of Bilingual Education and Bilingualism* 24 (6): 839–54. https://doi.org/10.1080/13670050.2018.1517722.

Trolian, Teniell L., Elizabeth A. Jach, Jana M. Hanson, and Ernest T. Pascarella. 2016. “Influencing Academic Motivation: The Effects of Student-Faculty Interaction.” *Journal of College Student Development* 57 (7): 810–26. https://doi.org/10.1353/csd.2016.0080.

Vallerand, Robert J., and Robert Bissonnette. 1992. “Intrinsic, Extrinsic, and Amotivational Styles as Predictors of Behavior: A Prospective Study.” *Journal of Personality* 60 (3): 599–620. https://doi.org/10.1111/j.1467-6494.1992.tb00922.x.

Vansteenkiste, Maarten, Joke Simons, Willy Lens, Kennon M. Sheldon, and Edward L. Deci. 2004. “Motivating Learning, Performance, and Persistence: The Synergistic Effects of Intrinsic Goal Contents and Autonomy-Supportive Contexts.” *Journal of Personality and Social Psychology* 87 (2): 246. https://doi.org/10.1037/0022-3514.87.2.246.

Von Hippel, Paul T. 2020. “How Many Imputations Do You Need? A Two-Stage Calculation Using a Quadratic Rule.” *Sociological Methods & Research* 49 (3): 699–718. https://doi.org/10.1177/0049124117747303.

Wawan, Wawan, Heri Retnawati, and Wahyu Setyaningrum. 2023. "An Integrative Learning Model to Improve Problem-Solving and Creative Thinking Abilities, Collaboration, and Motivation." *Islamic Guidance and Counseling Journal* 6 (2): 1–21. https://doi.org/10.25217/0020236402400.

Weimer, M., and L. Lenze. 1997. "Instructional Interventions: Review of the Literature on Efforts to Improve Instruction." In *Effective Teaching in Higher Education: Research and Practice*, edited by R. Perry and John C. Smart, 154–68. New York: Agathon Press.

Weiner, Bernard. 2012. *An Attributional Theory of Motivation and Emotion*. Springer Science & Business Media.

Wigfield, Allan, and Jacquelynne S. Eccles. 2000. "Expectancy—Value Theory of Achievement Motivation." *Contemporary Educational Psychology* 25 (1): 68–81. https://doi.org/10.1006/ceps.1999.1015.

Wigfield, Allan, and Alison C. Koenka. 2020. "Where Do We Go from Here in Academic Motivation Theory and Research? Some Reflections and Recommendations for Future Work." *Contemporary Educational Psychology* 61: 101872. https://doi.org/10.1016/j.cedpsych.2020.101872.

Wu, Zebing. 2019. "Academic Motivation, Engagement, and Achievement among College Students." *College Student Journal* 53 (1): 99–112.

Xu, Chao, Stephanie Lem, and Patrick Onghena. 2021. "Examining Developmental Relationships between Utility Value, Interest, and Cognitive Competence for College Statistics Students with Differential Self-Perceived Mathematics Ability." *Learning and Individual Differences* 86: 101980. https://doi.org/10.1016/j.lindif.2021.101980.

Yoshida, Masahiro, Masaaki Tanaka, Kei Mizuno, Akira Ishii, Kumi Nozaki, Ayako Urakawa, Yuki Cho, Yosky Kataoka, and Yasuyoshi Watanabe. 2008. "Factors Influencing the Academic Motivation of Individual College Students." *International Journal of Neuroscience* 118 (10): 1400–11. https://doi.org/10.1080/00207450701242982.

APPENDIX

Variable Definitions

Variable	Definition
Outcome variable	
Fourth-year academic motivation	An eight-item scale that captures the extent to which respondents agree or disagree with the following statements: (a) I am willing to work hard in a course to learn the material even if it won't lead to a higher grade; (b) when I do well on a test, it is usually because I am well-prepared, not because the test is easy; (c) I frequently do more reading in a class than is required simply because it interests me; (d) I frequently talk to faculty outside of class about ideas presented during class; (e) getting the best grades I can is very important to me; (f) I enjoy the challenge of learning complicated new material; (g) my academic experiences (i.e., courses, labs, studying, discussions with faculty) will be the most important part of college; (h) my academic experiences (i.e., courses, labs, studying, discussions with faculty) will be the most enjoyable part of college (**α** = 0.76).
Predictor variables	
Prompt feedback	A three-item scale that captures the following: a) how often faculty informed the respondent of level of performance in a timely manner during current school year; (b) how often the respondent received prompt written or oral feedback from faculty on academic performance; (c) how often faculty checked to see if the respondent had learned the material well before going on to new material (**α** = 0.66).
Teacher clarity and organization	A 10-item scale assessing the frequency that: (a) faculty gave clear explanations; (b) faculty made good use of examples and illustrations to explain difficult points; (c) faculty effectively reviewed and summarized the material; (d) faculty interpreted abstract ideas and theories clearly; (e) faculty gave assignments that helped in learning the course material; (f) the presentation of material was well organized; (g) faculty were well prepared for class; (h) class time was used effectively; (i) course goals and requirements were clearly explained; (j) faculty had a good command of what they were teaching (**α** = 0.90).
Challenging classes/high expectations	A six-item scale assessing the frequency that: (a) faculty asked challenging questions in class; (b) faculty asked respondents to show how a particular course concept could be applied to an actual problem or situation; (c) faculty asked respondents to point out any fallacies in basic ideas, principles, or points of view presented in the course; (d) faculty asked respondents to argue for or against a particular point of view; (e) faculty challenged respondents' ideas in class; (f) students challenged each other's ideas in class (**α** = 0.83).
Higher-order exams and assignments	A six-item scale assessing the frequency that: (a) exams or assignments required the respondent to write essays; (b) exams or assignments required the respondent to use course content to address a problem not presented in the course; (c) exams or assignments required the respondent to compare or contrast topics or ideas from a course; (d) exams or assignments required the respondent to point out the strengths and weaknesses of a particular argument or

	point of view; (e) exams or assignments required the respondent to argue for or against a particular point of view and defend an argument (**α** = 0.79).
Integrative learning	A nine-item scale that asks participants to respond to the following: (a) the extent the respondent agrees that courses have helped them understand the historical, political, and social connections of past events; (b) the extent the respondent agrees that courses have helped them see the connections between intended career and how it affects society; (c) the extent the respondent agrees that out-of-class experiences have helped them connect what was learned in the classroom with life events; (d) the extent the respondent agrees that out-of-class experiences have helped them translate knowledge and understanding from the classroom into action; (e) during current school year, how often has the respondent worked on a paper or project that required integrating ideas or information from various sources; (f) during current school year, how often has the respondent put together ideas or concepts from different courses when completing assignments or during class discussions; (g) during current school year, how often has the respondent discussed ideas from readings or classes with others outside of class (students, family members, co-workers, etc.); (h) during current year, time the respondent spent synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships; (i) during current year, time the respondent spent making judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions (**α** = 0.77).
Collaborative learning	A four-item scale that assesses the how often respondents experienced the following: (a) taught each other in addition to faculty teaching; (b) participated in study groups in class; (c) participated in one or more study groups outside of class; (d) worked with other students on projects (**α** = 0.72).

Control variables

Male	Male student (reference group: female)
Black	Black student (reference group: White)
Other	Other race (reference group: White)
Asian/Pacific Islander	Asian/Pacific Islander student (reference group: White)
Hispanic	Hispanic student (reference group: White)
Federal grant	Students received a federal grant (reference group: no federal grant)
ACT score	A student's ACT or SAT equivalent score
Precollege academic motivation	(See outcome variable definition for list of parallel scale items)

STEM major	Majoring in a STEM discipline (reference group: all other majors)
College grades	Fourth-year grades were "A–" or above (reference group: those with grades of "B+" or lower)
Worked for pay	Worked for pay while in college (reference group: did not work)
Co-curricular activities	Participated in co-curricular activities (reference group: did not participate in co-curricular activities)
Lives on campus	Lives on-campus (reference group: off-campus residence)
Graduate degree aspirations	Intends to obtain a graduate degree (reference group: does not intend to obtain a graduate degree)