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The Implementation and Outcomes of Lesson Study in Community College Mathematics

Appendices A, B, C, and D

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Appendix A. Implementation Methods

A.1 Interviews, Observations, and Document Analysis

For this project, researchers conducted a total of 47 semi-structured interviews and focus groups with stakeholders at the three partner colleges, including administrators, math faculty who did not participate in the project, and all 22 math instructors who participated in the model development and pilot phases of the project. Faculty who served on the leadership teams, meaning they were integral to adapting the lesson study model for use in community colleges, were interviewed at the beginning of the project and again at the end. Interviews were transcribed and coded using Dedoose.

The research team observed and took field notes during 10 lesson study cycles. Six of these cycles took place during the model development phase, while the other four took place in the pilot study phase. For pilot study cycles, researchers took field notes and scored each team's cycle using an implementation fidelity rubric to assess the level of implementation across 18 indicators (see Appendix B). The rubric was developed with input from EdNW facilitators and from faculty who participated in the model development phase. Two researchers scored each of the four cycles independently, and the team saw high agreement across observers. In isolated incidents where scores differed, the average across observers was recorded.

Across all 10 observed cycles, the research team collected the lesson plans for the teach and reteach sessions as well as each faculty team's final report. For most but not all cycles, teams were working from original curricular materials, which were collected as examples of "baseline" instructional practices. These documents were analyzed qualitatively for the types of new instructional practices that teams adopted during the teach and reteach sessions.

A.2 Faculty Survey Development, Administration, and Analysis

To supplement the stakeholder interviews and further inform our second research question—Does lesson study influence instructors' beliefs, curricular materials, and teaching practices?—the research team developed two faculty surveys. The pre-pilot, or baseline, version of the survey was administered in fall 2018, and the follow-up survey was administered in fall 2019. All mathematics faculty at the three colleges were invited by CCRC via email to participate (see Table A.1 for survey response rates). Both surveys collected information about instructors' backgrounds (e.g., full-time or adjunct status, number of years teaching, courses taught, educational credentials), experiences working collaboratively with colleagues, and knowledge, beliefs, and self-efficacy in teaching mathematics, as well as about the professional development offerings at their colleges. The follow-up survey included an additional set of questions specifically for lesson study participants. Selected survey items were drawn and adapted from the Teaching and Learning International Survey (Organisation for Economic Co-operation and Development, 2018), the Teacher Self-Efficacy Scale (Tschannen-Moran & Hoy, 2001), and the TIMSS Teacher Questionnaire (Kastberg et al., 2013). Upon submission of a survey, respondents were entered into a lottery for a $50 gift card.

Appendix Table A.1

Faculty Survey Response Rates

	Fall 2018 Baseline	Fall 2019 Follow-Up
Total faculty population	241	236
Survey respondents	111	104
Survey response rate	46%	44%

In order to assess the influence of participating in lesson study on instructors' beliefs, teaching practices, and professional community, we restricted the faculty survey analytic sample to mathematics faculty who reported teaching at the developmental level within the past year. This approach yielded three samples for comparison: all 2018 developmental mathematics instructors (n = 90), 2019 lesson study participants (n = 22), and 2019 developmental mathematics instructors who did not participate in lesson study (n = 50).

Neither version of the survey collected unique identifiers for respondents, therefore we were unable to assess changes in outcomes on an individual instructor basis from the pre-pilot to post-pilot periods. Instead, we tested for differences in survey item responses between the three groups. As the majority of survey items used a Likert scale of either 1 to 4 or 1 to 5, we first identified the proportion of respondents in each of the three groups who provided an affirmative response to the item (e.g., "agree"/"strongly agree" or "moderate confidence"/"high confidence"). We then conducted pairwise t-tests to determine whether the proportions of affirmative responses were statistically different.

Appendix B. Lesson Study Implementation Rubric and Mean Pilot Scores

Appendix Table B.1

Cycle Stage 1: Study and Plan

	(1)	(2)	(3)	Mean Score
Plan a collaborative lesson	Not present	Team meets to collaboratively plan the research lesson	Team completes (or almost completes) the lesson plan collaboratively	2.5
Develop or revisit collaboration norms	Not present	Team develops or revisits norms	Team refers to or explicitly uses norms during the planning process	2.75
Develop or revisit the research theme	Not present	Team develops or revisits the research theme	Team explicitly refers to the research theme during the planning process	2.75
Identify and study the topic	Not present	Team identifies where the lesson falls on the syllabus	Team identifies a learning progression for the topic and the lesson's place in that progression	2.25
Identify learning outcomes for the lesson	Not present	Team establishes learning outcomes for the lesson	Team explicitly uses learning outcomes to guide instructional decisions during the planning process	2.5
Anticipate student responses and instructor support	Not present	Team generates one or more anticipated student responses	Team uses anticipated student responses to develop instructional support strategies	2.33
Apply evidence-based instructional approaches	Not present	Team refers to evidence-based instructional approaches	Team provides an evidence-based rationale for instructional decisions during the planning process	2.33
Establish points of evaluation	Not present	Team establishes one or more points of evaluation	Team connects points of evaluation to learning outcomes, anticipated student responses, and/or research theme	2

Appendix Table B.2

Cycle Stage 2: Teach, Observe, and Debrief

	(1)	(2)	(3)	Mean Score
Observe first teaching of the research lesson	Not present	Team members observe during the lesson period	Team members take detailed observational notes focused on students and their learning	3
Debrief first teaching of the research lesson	Not present	Team meets to debrief the lesson	Team follows the protocol, and all members share observational data during the debriefing	3

Appendix Table B.3

Cycle Stage 3: Revise and Reteach

	(1)	(2)	(3)	Mean Score
Revise the lesson	Not present	Team meets collaboratively to revise the research lesson	Team completes (or almost completes) the lesson revisions collaboratively	3
Ground revision decisions in goals for students	Not present	Team refers to student learning outcomes and/or research theme during revision	Team explicitly uses learning outcomes and/or the research theme to guide instructional decisions during the revision process	2.75
Apply evidence-based instructional approaches	Not present	Team refers to evidence-based instructional approaches	Team provides an evidence-based rationale for instructional decisions during the revision process	2.5
Observe second teaching of the research lesson	Not present	Team members observe during the lesson period	Team members take detailed observational notes focused on students and their learning	3
Debrief second teaching of the research lesson	Not present	Team meets to debrief the lesson	Team follows the protocol, and all members share observational data during the debriefing	3

Appendix Table B.4

Cycle Stage 4: Reflect and Report

	(1)	(2)	(3)	Mean Score
Reflect and report	Not present	Team meets to reflect on the cycle	Team generates a report documenting their learning during the cycle	3
Generate knowledge	Not present	Team identifies implications for instruction beyond the research lesson	Team articulates something new that they learned about instructional practice or student learning	2.75
Share knowledge	Not present	Team discusses sharing knowledge learned during the cycle with a broader audience	Team identifies a specific venue or format for sharing knowledge with faculty not on the lesson study team	2.25

Appendix C. Student Learning Assessment

C.1 Assessment Overview and Scoring

To explore the effects of lesson study on student learning, we developed an in-class assessment on percentages, a key concept in the quantitative literacy pathway (see Figure C.1).

Appendix Figure C.1

Student Learning Assessment Items

The table below shows the percentage of students by age at Shasta Community College in California for two different academic years. {Source: https://datamart.cccco.edu/students/Student Term Annual Count.aspx}

Age Group	2008 Student Count (%)	2009 Student Count (%)
19 or Less	28%	29%
20 to 24	23%	26%
25 to 29	12%	13%
30 to 34	8%	8%
35 to 39	6%	5%
40 to 49	11%	10%
50 +	12%	9%
Shasta Total	100%	100%

1. What observations can you make about changes in the student body from 2008 to 2009? *Use numbers to justify your claims*.
2. The total number of students at Shasta was 17,119 in 2008 and 15,406 in 2009. Which year (2008 or 2009) had more students aged 25 to 29? *Explain your reasoning.*

   Let's imagine that in the next year, in 2010, a recession resulted in a lot of layoffs at a local factory. The layoffs led to an increase in the number of students aged 40–49 going back to college. There were 1,540 students in 2009 and 3,578 students in 2010 in the 40–49 age group. The other age groups did not change much.
3. What would this increase in enrollment do to the percentage of 40–49-year-old students? *Explain your reasoning.*
4. How would this increase in enrollment change the percentages in the other categories? *Explain your reasoning.*

Researchers collaborated with faculty leaders to develop criteria for identifying correct responses on each of the four items. Those criteria are listed in the table below. Two members of the research team test scored a sample of assessments and then shared those assessments and scores with the faculty leaders for review. After test scoring, the research team scored the remaining assessments. A selection of assessments (about 10%) were cross-scored by two members of the team to ensure inter-rater reliability.

Appendix Table C.1

Student Learning Assessment Scoring Rubric

Student responses to **Question 1** were identified as correct if:	• the student correctly identified the enrollment trends of one or more specific age groups, *OR* • the student correctly identified one or more general enrollment trends.
Student responses to **Question 2** were identified as correct if:	• the student showed the correct number of students ages 25 to 29 at Shasta Community College for both 2008 and 2009 (both 2,054 and 2,055 were accepted for 2008, and both 2,002 and 2,003 were accepted for 2009), *OR* • the student correctly selected 2008 as having more students ages 25 to 29 than 2009 (even though the computations were not shown).
Student responses to **Question 3** were identified as correct if:	• the student correctly stated that the percentage of students ages 40 to 49 would increase as a result of the increase in enrollment of this age group.
Student responses to **Question 4** were identified as correct if:	• the student correctly stated that the percentages of other age categories would decrease as a result of the increase in enrollment of students ages 40 to 49.

C.2 Technical Notes on Analytic Method for Student Learning Assessment

Here we provide more technical details on the analysis of the student learning assessment administered to Math 098 students in fall 2018 (before the pilot phase) and fall 2019 (in the final weeks of the pilot phase). At one partner college, the assessment was also administered in sections of Math 058, a developmental course that serves as a prerequisite to Math 098 at some community colleges in Oregon. In total, over both years, 378 students completed the four-item assessment.

Appendix Table C.2

Student Learning Assessment Sample

	Fall 2018	Fall 2019	
	Pre-Pilot Sections	Lesson Study Sections (Post-Pilot)	Non-Lesson Study Sections (Post-Pilot)
Math 058	42	81	30
Math 098	139	39	47
N	181	120	77

Students who completed the learning assessment during the fall 2019 term were asked to provide informed consent, which allowed the research team to match students' learning assessment results with their administrative demographic records. The final, matched 2019 pilot sample included 197 students, 61% of whom were enrolled in a section taught by a lesson study faculty participant. As Math 058 is a lower-level course, we analyzed the learning assessment outcomes for Math 058 and Math 098 students separately.

We used two approaches to determine whether enrolling in a section taught by a lesson study participant influenced student performance on the learning assessment. First, we compared the performance of students in sections taught by participants (2019) with students in sections taught by nonparticipants (2019) and those in pre-pilot course sections (2018). To examine whether student performance differed across these three groups, we conducted a Pearson chi-square test for each of the five binary outcomes (i.e., a correct response on each of the four assessment items and answering all items correctly). Second, to control for underlying differences between students in sections taught by participants and those in sections taught by nonparticipants, we conducted binomial logistic regressions using the 2019 matched pilot sample that included students' demographic characteristics, including race/ethnicity, gender, age, Pell Grant status, and prior enrollment.

Math 098 learning assessment outcomes. In Table C.3, we show the aggregate percentage of students in Math 098 sections taught by lesson study participants, those in sections taught by nonparticipants, and those in pre-pilot sections who answered each learning assessment item correctly. We performed a chi-square test of independence for each outcome and found no significant differences in learning assessment performance between the three Math 098 groups.

Appendix Table C.3

Math 098 Learning Assessment Outcomes: Chi-Square Tests

	Lesson Study Sections (2019)	Non-Lesson Study Sections (2019)	Pre-Pilot Sections (2018)		
	% correct	% correct	% correct	Chi^2	*p*
Item 1	79.5	80.9	79.9	0.03	.985
Item 2	46.2	51.1	56.8	1.57	.455
Item 3	79.5	74.5	81.3	1.01	.605
Item 4	48.7	48.9	53.2	0.41	.814
All correct	17.9	23.4	12.2	3.54	.170
N	39	47	139		

***$p < .01$, **$p < .05$, *$p < .1$

Math 058 learning assessment outcomes. Table C.4 shows the proportion of correct responses and chi-square test results for students who completed the learning assessment while enrolled in Math 058.

Appendix Table C.4

Math 058 Learning Assessment Outcomes: Chi-Square Tests

	Lesson Study Sections (2019)	Non-Lesson Study Sections (2019)	Pre-Pilot Sections (2018)			
	% correct	% correct	% correct	Chi^2	*p*	
Item 1	66.7	73.3	85.7	5.12	.077	*
Item 2	53.1	30.0	35.7	6.27	.043	**
Item 3	76.5	43.3	71.4	11.43	.003	***
Item 4	49.4	53.3	38.1	2.00	.367	
All correct	22.2	20.0	4.8	6.22	.045	**
N	81	30	42			

***$p < .01$, **$p < .05$, *$p < .1$

Based on these chi-square tests, we were able to reject the null hypothesis for learning assessment items 2 and 3 as well as answering all items correctly. To estimate the influence of enrolling in a Math 058 section taught by a lesson study participant on learning assessment outcomes during the pilot term, we then omitted the 2018 comparison group and conducted multilevel regressions using only the two 2019 groups (students in sections taught by lesson study participants and nonparticipants). Table C.5 shows the results of mixed-effects logistic regression models for the five binary outcomes. All specifications in Table C.5 include student-level demographic fixed effects and random effects at the second, or instructor, level. We found a positive, statistically significant effect of enrolling in a Math 058 section taught by a lesson study participant for two assessment items. For items 2 and 3, we observe 1.09 (p = .035) and 1.38 (p = .010) changes in the log-odds of correctly answering these items, which correspond to estimated odds ratios of 2.97 and 3.97, respectively.

Appendix Table C.5.

Math 058 Learning Assessment Outcomes: Regressions

	(1) Q1 Correct	(2) Q2 Correct	(3) Q3 Correct	(4) Q4 Correct	(5) All Correct
Course taught by lesson study faculty (fall 2019)	-0.785 (0.572)	1.089** (0.517)	1.378*** (0.532)	-0.799 (0.560)	-0.463 (0.648)
Returning student	-0.210 (0.539)	0.106 (0.508)	0.651 (0.574)	-0.226 (0.554)	-0.566 (0.649)
Black	-0.568 (0.970)	0.122 (0.993)	-1.282 (1.041)	-1.199 (1.254)	1.113 (1.329)
Hispanic	-0.531 (0.684)	-0.842 (0.682)	1.058 (0.905)	-0.0918 (0.734)	0.0457 (0.842)
Asian	-1.724* (0.949)	-0.148 (0.883)	-2.373** (1.184)	-2.031* (1.078)	
Multiracial	-0.0218 (1.010)	-0.645 (0.996)	0.324 (1.214)	1.558 (1.093)	1.027 (1.406)
Female	-0.635 (0.480)	-0.878* (0.458)	-0.802 (0.527)	-1.770*** (0.507)	-1.480** (0.652)
Age (in years)	0.0515* (0.0290)	0.00900 (0.0236)	0.000378 (0.0258)	0.0523** (0.0253)	0.0747** (0.0309)
Pell Grant recipient	-0.623 (0.523)	0.0214 (0.474)	-0.432 (0.554)	-1.484*** (0.541)	-2.025*** (0.661)
Constant	1.036 (0.905)	-0.523 (0.777)	0.0782 (0.830)	1.239 (0.839)	-0.983 (0.932)
Observations	108	108	108	110	101
Number of groups	5	5	5	5	5
Instructor indicators	Yes	Yes	Yes	Yes	Yes

*** $p < .01$, ** $p < .05$, * $p < .1$

Note: Standard errors in parentheses.

Appendix D. Technical Notes on Analytic Method for Course Grades and Progression

In the proposal for this project, the original research design for assessing student course outcomes was an interrupted time series (ITS). The ITS design would have been used to detect the impact of lesson study on students by comparing course outcomes in Math 098 after the intervention was implemented to the outcomes that might have been expected based on pre-intervention trends (using course data from fall 2015 to summer 2019). The difference between the actual and projected outcomes would provide an estimate of the causal impact of the intervention (Bloom, 2003). However, this design proved unsuitable for this project since only about half of the Math 098 faculty members participated in lesson study in fall 2019, and the design would have pooled outcomes across sections taught by participants and nonparticipants in fall 2019. ITS is typically used to assess the effectiveness of whole-school reforms (Bloom, 2003). Additionally, ITS requires a significant amount of post-treatment data to model post-treatment trends, and the project team only had two terms of post-treatment data (from fall 2019 and winter 2020). The third term (spring 2021) was affected by the COVID-19 pandemic when colleges transitioned to virtual instruction before final exams. For these reasons, we adapted the research design and decided to use propensity score weighting to assess the association between lesson study and Math 098 course grades and progression during the fall 2019 pilot term.

Our sample included students taught by 15 faculty members in 18 sections of Math 098 in fall 2019. Eight of those faculty members participated in the lesson study pilot phase. Compared to students in sections taught by nonparticipants, students in sections taught by lesson study participants were slightly older on average and were more likely to be low-income (as measured by Pell Grant eligibility), female, and Hispanic (see Table D.1). Compared to students in sections taught by nonparticipants, students in sections taught by participants were also more likely to be returning students. Returning students who enrolled in sections taught by participants had previously attempted fewer developmental math credits and slightly more developmental reading/writing credits, on average, than returning students who enrolled in sections taught by nonparticipants.

Appendix Table D.1

Characteristics of Students in Math 098 (Fall 2019)

	Lesson Study Sections	Non-Lesson Study Sections
Number of Students	171	160
Student Demographic Characteristics		
Age	21.6	20.5
Pell Grant recipient	54%	44%
Veteran	4%	4%
Female	57%	54%
Male	42%	43%
Gender not reported	1%	3%
American Indian/Alaskan Native	1%	2%
Asian	1%	3%
Black	4%	4%
Hispanic	23%	17%
Multiracial	5%	8%
Native Hawaiian/Pacific Islander	1%	0%
White	62%	64%
Race unknown	2%	3%
Student Enrollment Data		
Returning student	29%	23%
Developmental reading/writing credits attempted	0.27	0.27
Prior Developmental Coursework (Returning Students)[a]		
GPA in developmental education courses	2.88	2.84
Developmental math credits attempted	4.82	6.65
Developmental reading/writing credits attempted	0.94	0.84

[a] These variables are not included in the regression analysis described below.

Note: Demographic differences between students in lesson study sections and non-lesson study sections were not statistically significant, except for age and Pell Grant recipient status. These differences were marginally significant at the 10% level.

We matched students in sections taught by lesson study participants with students in sections taught by nonparticipants using radius matching that calculated a propensity score (the probability of being in a section taught by a participant in fall 2019) for each student in the sample based on the individual characteristics listed below in Table D.2. After calculating the propensity scores with a caliper of 0.1 and assigning weights to each student, we examined the propensity score distribution and standardized mean differences to determine whether there was sufficient overlap of the distribution of the propensity scores between the two groups, as well as successful balancing of the covariates across groups. For most covariates, the standardized difference in means was reduced between the unmatched and matched sample. This was especially important for the indicator of socioeconomic status: In the unmatched sample, 55% of students in sections taught by participants were Pell Grant recipients, compared to 45% of students in sections taught by nonparticipants. In the matched sample, 54% of students in sections taught by participants were Pell Grant recipients, compared to 53% percent of students in sections taught by nonparticipants.

Appendix Table D.2

Characteristics of Matched and Unmatched Math 098 Students (Fall 2019)

Student-Level Variables	Sample	Students in Lesson Study Sections	Students in Non-Lesson Study Sections	Standardized Difference in Group Means
Black	Unmatched	3%	4%	0.04
	Matched	3%	3%	0.00
Hispanic	Unmatched	23%	18%	0.13
	Matched	22%	21%	0.01
Asian/Native Hawaiian	Unmatched	2%	3%	0.09
	Matched	2%	2%	0.02
American Indian/Alaskan Native	Unmatched	1%	2%	0.12
	Matched	0%	1%	0.11
Multiracial	Unmatched	6%	7%	0.06
	Matched	6%	7%	0.02
Race unknown	Unmatched	3%	2%	0.04
	Matched	3%	2%	0.03
Female	Unmatched	55%	54%	0.02
	Matched	54%	55%	0.03
Gender not reported	Unmatched	1%	2%	0.05
	Matched	1%	1%	0.04
Veteran	Unmatched	4%	4%	0.01
	Matched	4%	3%	0.03
Pell Grant recipient	Unmatched	55%	45%	0.21
	Matched	54%	53%	0.03
Age	Unmatched	21.69	20.54	0.20
	Matched	21.09	20.55	0.10
Returning student	Unmatched	31%	24%	0.16
	Matched	29%	25%	0.10

Note: For balance to be achieved, the absolute standardized differences in means should be less than 0.25 (Stuart, 2010). The pre-match standardized differences in group means were between 0.01 and 0.21; after the matching procedure, the standardized differences in group means were between 0.00 and 0.10. The formula for calculating the standardized difference in group means is:

$$|(\overline{X_t} - \overline{X_c})| \Big/ \sqrt{((\sigma_t^2 + \sigma_c^2)/2)}$$

The study also used a multilevel model to account for college and instructor characteristics that could explain differences in outcomes between students in sections taught by participants and those in sections taught by nonparticipants. Since 12 of the 15 instructors taught only one section of Math 098, it is also likely that students who had the same instructor were in the same section, meaning that they shared characteristics about their course section that might be related to their outcomes, such as the peers in their classroom and the time of day that the course was held (Theobald, 2018). The model was:

(1) $Y_{is} = a + \beta Lesson\ Study_{is} + \beta X_{is} + \gamma_s + e_{is}$

In this model:

$Y =$ the outcomes of interest including grade in Math 098, passing the Math 098 course with C or better, persistence to the end of the Math 098 course (that is, they did not withdraw or have an incomplete grade), and enrollment in college-level math in the subsequent term (winter 2020)

$Lesson\ Study =$ a dichotomous indicator that is equal to "1" if the student was enrolled in a Math 098 section taught by a faculty member participating in lesson study and "0" if the student was in a Math 098 section taught by a faculty member who was not participating in lesson study

X = a vector of student characteristics (all variables listed in Table D.2)

γ = an indicator of community college (college fixed effects)

$e_{is} =$ a random error term for student *i* in college *s*

The full regression results for each outcome (course grade, passing the course, course persistence, and progression to college-level math) are shown in Table D.3. Each column (1) in Table D.3 shows the coefficient estimates from a linear regression with no matching, college fixed effects, or instructor random effects. Each column (2) in Table D.3 shows the final coefficient estimates from a regression analysis that used college fixed effects and instructor random effects to account for instructor impacts on student outcomes, as well as propensity score weights so that students in sections taught by nonparticipants that were similar to the students in sections taught by participants were weighted more heavily in the regression analysis. Propensity score analysis ensures that the treatment and comparison groups are comparable on the observed covariates, and covariate adjustment (through regression analysis) may then be able to reduce any remaining differences on the observed covariates between the two samples and improve the precision of the impact estimation (Rubin & Thomas, 2000).

For course grade, we found a statistically significant negative impact of enrolling in a section taught by a lesson study participant in the model without matching (p = .02); the negative coefficient was no longer significant in the full model. For passing the Math 098 course, we also observed a negative effect (p < .01), which remained significant when propensity score weights and college and instructor effects were added (p = .01). For the other two course outcomes—persistence to the end of the course and progression to college-level math—no significant impact of enrolling in a section taught by a participant was found for either model specification.

Appendix Table D.3

Math 098 Course Outcomes: Regressions

	(1) Grade	(2) Grade	(1) Pass	(2) Pass	(1) Persist	(2) Persist	(1) Progress	(2) Progress
Course taught by lesson study faculty (fall 2019)	-0.35** (0.15)	-0.28 (0.24)	-0.13*** (0.05)	-0.11** (0.05)	-0.01 (0.02)	0.00 (0.02)	0.01 (0.05)	-0.02 (0.05)
Black	-0.45 (0.41)	-0.74 (0.46)	-0.13 (0.14)	-0.14 (0.13)	-0.06 (0.08)	-0.04 (0.07)	-0.12 (0.12)	-0.09 (0.14)
Hispanic	-0.02 (0.19)	-0.05 (0.26)	0.04 (0.06)	0.05 (0.06)	0.00 (0.02)	0.01 (0.02)	-0.01 (0.07)	0.02 (0.07)
Asian/Native Hawaiian	-0.48 (0.44)	-0.49* (0.30)	-0.11 (0.15)	-0.12 (0.11)	-0.08 (0.11)	-0.10 (0.10)	-0.21* (0.12)	-0.07 (0.20)
American Indian	-0.24 (0.70)	0.59** (0.23)	-0.20 (0.22)	-0.15 (0.22)	0.02 (0.01)	0.04 (0.03)	-0.33*** (0.04)	-0.30*** (0.06)
Multiracial	-0.05 (0.31)	-0.05 (0.32)	0.05 (0.10)	0.01 (0.10)	-0.02 (0.05)	-0.05 (0.06)	0.05 (0.11)	0.09 (0.12)
Female	0.51*** (0.16)	0.49*** (0.12)	0.09* (0.05)	0.08* (0.05)	-0.00 (0.02)	-0.00 (0.01)	-0.06 (0.05)	-0.06 (0.04)
Veteran	-0.29 (0.53)	-0.50 (0.33)	-0.09 (0.15)	-0.07 (0.12)	0.05* (0.03)	0.10** (0.04)	0.07 (0.15)	-0.01 (0.10)
Pell Grant recipient	0.23 (0.16)	0.30*** (0.11)	0.07 (0.05)	0.07 (0.05)	0.00 (0.02)	-0.01 (0.02)	0.02 (0.06)	0.04 (0.04)
Age at first term (years)	0.03* (0.01)	0.03*** (0.01)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00* (0.00)	-0.00 (0.01)	-0.00 (0.00)
Returning student	-0.10 (0.18)	-0.24 (0.17)	0.06 (0.06)	0.02 (0.06)	0.03 (0.02)	0.02 (0.02)	-0.05 (0.06)	0.01 (0.07)
Dev. reading/writing credits (fall 2019)	-0.17* (0.09)	-0.26*** (0.07)	-0.03 (0.03)	-0.04 (0.04)	0.01** (0.00)	0.03** (0.01)	-0.00 (0.03)	-0.04* (0.02)
Constant	1.85*** (0.32)	2.47*** (0.47)	0.75*** (0.09)	0.73*** (0.12)	1.02*** (0.05)	0.94*** (0.07)	0.43*** (0.11)	0.59*** (0.10)
Observations	310	303	331	326	331	326	331	326
R-squared	0.10		0.06		0.06		0.03	
College indicators	No	Yes	No	Yes	No	Yes	No	Yes
Instructor indicators	No	Yes	No	Yes	No	Yes	No	Yes
Matched group	No	Yes	No	Yes	No	Yes	No	Yes
Number of groups		15		15		15		15

*** $p < .01$, ** $p < .05$, * $p < .1$

Note: Asian and Native Hawaiian/Pacific Islander combined to account for small sample size in the Native Hawaiian/Pacific Islander group. Robust standard errors in parentheses.