Instructional Learning Assistant (ILA) Program Participation and Course Success

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This analysis was intended to answer the question - Were students who took courses with a learning assistant (ILA course) more likely to pass the course than those who did not (non-ILA course)? We considered performance in ILA courses taken between fall 2021 and fall 2022 against control courses taught without an ILA. We used propensity score matching (PSM) to create matched treatment (took ILA course) and control (did not take ILA course) groups and examined course pass rates across groups. Overall, the results suggest that students who took courses with a learning assistant were significantly more likely to pass (84%) compared to students who took a course without a learning assistant (82%). The ILA program appears to be one important tool in improving student course pass rates, and thus may also contribute to more distal outcomes such as higher retention and graduation rates.

Background

The ILA program started in fall 2021. ILA's are undergraduate students who previously took a course and work with students currently enrolled in the course. ILA's serve as a bridge between current students and faculty and are responsible for interacting with students and managing class discussions to help students understand course material. We considered ILA courses in fall 2021, spring 2022, and fall 2022 because final course grade data was available at the time of this analysis. ILA courses included: Math021 (Calculus I for Physical Sciences and Engineering), Math022 (Calculus II for Physical Sciences and Engineering), Bio001 (Contemporary Biology), Bio002 (Introduction to Molecular Biology), Phys008 (Introductory Physics I for Physical Sciences), Phys009 (Introductory Physics II for Physical Sciences), Phys018 (Introductory Physics I for Biological Sciences), Chem002 (General Chemistry I), Chem010 (General Chemistry II). Students tend to take courses early on in their academic careers.

This analysis had the following **research question**: Were students who took courses with a learning assistant (ILA course) more likely to pass[1] the course than those who did not (non-ILA course)? Our **analysis strategy** had two steps. First, we used propensity score matching (PSM) to identify demographically comparable matched treatment (ILA course) and control groups (non-ILA course; see Appendix A) to be more confident in drawing causal conclusions though a randomized control trial was not conducted. Second, using the propensity score matched treatment and control groups, we examined whether there were differences course pass rates. For completeness, we provide the results of the analysis for both the matched and total samples, but we focus on the results obtained using the matched sample.

Results Summary

The PSM approach was effective at creating matched treatment (ILA course) and control (non-ILA course) groups. From Table 1, overall, students who took courses with a learning assistant were significantly more likely to pass (84%) compared

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[1] Grades of C- or higher or a P grade were considered passing. Grades of D+ or lower as well as NP, W, and I grades were considered not passing.

to students who took a course without a learning assistant (82%). Though there was some variation by course that could be explored further in consultation with instructors and ILA's.

Table 1. Course Pass Rates by ILA Group and Course

Outcome	Matched Sample		Total (Matched & Unmatched Samples)	
	ILA (Treatment)	Non-ILA (Control)	ILA (Treatment)	Non-ILA (Control)
Received Passing Grade (Overall)	**84%**	**82%**	**85%**	**82%**
Received Pasing Grade (by Course)				
Course 1	**91%**	**81%**	**91%**	**82%**
Course 2	<u>82%</u>	<u>88%</u>	86%	86%
Course 3	82%	88%	82%	86%
Course 4	80%	76%	80%	76%
Course 5	75%	70%	**78%**	**70%**
Course 6	<u>71%</u>	<u>83%</u>	<u>72%</u>	<u>81%</u>
Course 7	**89%**	**84%**	**90%**	**84%**
Course 8	96%	95%	96%	96%
Course 9	**90%**	**78%**	**89%**	**75%**

Note: proportions were compared with a chi-squared test (as appropriate, column proportions were compared via the b-prop command and p-values were Bonferroni corrected for multiple comparisons). Bold text denotes statistically significant differences between the respective treatment and control group (p < .05). Underlined text denotes a statistically significant difference that is contrary to expectations - students in a learning assistant supported class (vs. not) were <u>less</u> likely to pass.

Though a 2% difference in overall pass rates may appear small, when considering overall course enrollments, this can be very impactful for students who are more likely to make progress toward their degrees. For example, Bio001 enrolled 508 students in fall 2022 who were included this analysis, and these results suggest that 10 (2%) of these students passed the course who may not have due to the support of a learning assistant. When considered for all students in this analysis who took a course with a learning assistant (n = 4289), these results suggest that 86 (2%) of these students passed the course who may not have due to the support of a learning assistant. Thus, the ILA program appears to be one important tool in improving student course pass rates, and thus may also contribute to more distal outcomes such as higher retention and graduation rates.

Appendix A: Detailed Methodology

Analysis Sample & Identification of Non-ILA Control Courses

When identifying non-ILA control courses for analysis, in general we tried to retain double the number of control courses as ILA courses to increase the possibility of matching students with similar characteristics across ILA and control courses. We prioritized control courses that had the same instructors as ILA courses (to reduce the likelihood of differences across instructors) and that were taught more recently (to reduce time-based impacts) when possible. For example, if instructors A and B taught ILA sections of Phys008 in spring 2022, as possible control courses we included those that were taught by instructors A and B even if they occurred during different semesters but tried to ensure that these comparative courses were taught as recently as possible relative to the ILA course. We only included control courses taught by different instructors when necessary to ensure a large enough sample of students for the matching procedure.

We excluded spring 2020, fall 2020, and spring 2021 as possible control course terms due to the emergency remote instruction period and other challenges during the Covid-19 pandemic. When additional control course terms were needed for analysis, we used courses that were taught in spring 2019 and/or fall 2019 because these occurred before the Covid-19 pandemic. Though Math005 is part of the ILA program, we excluded it from the analyses at this time.

Course Repetition

There were two course repetition related considerations: (1) repetition of a single course by a single student (e.g., a student that took Bio001 multiple times) and (1) repetition of students across courses (e.g., a student that took both Phys008 and Phys009). We addressed each as follows:

First, ideally the analysis would only include students' first experience with a course. However, given the terms included in the analysis dataset and the variables available, this was not always possible. In consultation with the Registrar's Office, when a student completes a course for the second time, their first attempt is coded as an "E" and their second attempt gets a different code. Thus, we only included only students who had not repeated a given course or who had a course repeat indicator code of "E". We also manually inspected the data and when additional course repeats were identified, we only included the first analysis term in which the student took the course. However, it is still possible that a student took a course in a term not included in the dataset such that this approach cannot account for all repetition of this type. Nine percent of entries were removed from the dataset due to this form of repetition.

Second, when we conducted the PSM procedure (described below) we included contrast coding for course to increase the likelihood that an ILA student would be matched to a non-ILA student in the same course. However, the procedure does allow that a student could be matched to themselves if their propensity scores were quite similar despite taking different courses (e.g., a student took Phys008 in fall 2021 without a learning assistant but took Phys009 in spring 2022 with a learning assistant). Methodologically, though the student took different courses, matching a student against themselves is

an effective method for accounting for individual differences that could be related to academic performance such that we did not remove any students for this issue.

Propensity Score Matching (PSM) Approach Description

PSM[2] has two steps. First, student characteristics are included as predictor variables in a logistic regression model to generate a predicted probability of group membership (i.e., ILA course treatment vs. non-ILA course control). Second, each student in the treatment group (ILA course) is matched to a comparable student in the control group (non-ILA course) based on the predicted probabilities. This helps to ensure that any differences between the treatment and control group are less likely to be attributable to selection effects – inherent differences between the groups unrelated to the treatment but which can contribute to differential outcomes. Background characteristics used for the PSM included pre-matriculation characteristics (first generation status[3], pre-matriculation GPA[4], entering level[5], underrepresented minority status[6], gender[7]) and term-based characteristics specific to the term in which the student took the course (School of first major[8], number of credits enrolled at census, course timing[9], and course[10]).

Figure 1 provides the group sizes for each analysis. The matching procedure produced 30 exact matches and 3132 fuzzy matches for a total of 3162 - thus the matched analysis included 3162 students in the matched treatment group and 3162 students in the matched control group.

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[2] We used the Propensity Score Matching dialog box in SPSS v. 29, which relies on R and Python modules. This dialog generates syntax for the STATS PSM extension command, which uses the FUZZY extension command to perform the matching. We used a match tolerance of .0005 and performed matching without replacement.

[3] In the UC system, first generation status is defined as neither parent having earned a 4-year degree. 1 = first generation, 0 = not.

[4] For students who matriculated as frosh (first-time, first-year students), pre-matriculation GPA was their high school GPA; for transfer students, it was their transfer GPA.

[5] 1 = matriculated as frosh (first-time, first year student) and 0 = matriculated as a transfer student

[6] The NSF definition of URM status was employed where URM includes the categories of Black, Hispanic, Native American, and Alaska Native. Non-URM (Asian, Pacific Islander, White) was used as the reference category. As such, two contrast codes were entered into the regression procedure: 1 = URM versus 0 = not; 1 = unknown (international, multi-racial, unknown) versus 0 = not.

[7] 1 = female and 0 = not (male/unknown).

[8] School of Natural Sciences (SNS) was used as the reference category. As such, three contrast codes were entered into the regression procedure: 1 = Undeclared versus 0 = not; 1 = School of Engineering versus 0 = not; and 1 = School of Social Sciences, Humanities, and Arts versus 0 = not.

[9] 1 = spring term and 0 = fall term

[10] We used contrast codes for each course with Bio001 as the reference category because it had the highest overall enrollment.
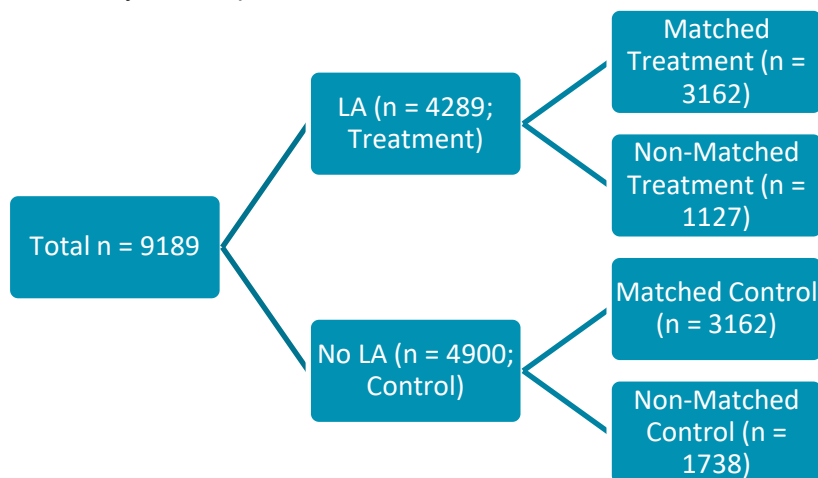
Figure 1. Procedure Analysis Group Results

Table 2 provides the descriptive information for each PSM covariate by analysis group to provide evidence of the effectiveness of the matching procedure. In examining the logistic regression model statistics, though the overall omnibus test was significant - χ^2 (19) = 679.20, p < .001 – the pseudo R-squared statistics were quite low – Cox & Snell R-square = .07, Nagelkerke R-square = .10. This indicates that there may be other variables that would do a better job at identifying ILA (vs. not) course participation. That being said, there were no statistically significant differences in student background characteristics between the matched treatment and control groups. In contrast, differences between the total treatment and total control groups were present for many background characteristics and were sometimes substantial (ranged from 1%-10% for categorical variables). Thus, it appears that the PSM was quite effective in creating matched treatment and control groups.

Table 2. PSM Covariate Comparison by Learning Assistant Analysis Group

Covariate	Matched Sample		Total (Matched & Unmatched Samples)	
	ILA (Treatment)	Non-ILA (Control)	ILA (Treatment)	Non-ILA (Control)
Pre-Matriculation GPA [Mean (SD)]	3.61 (.36)	3.61 (.33)	3.61 (.36)	3.61 (.33)
Race/Ethnicity				
% URM	55%	55%	**52%**	**56%**
% Non-URM	35%	35%	**39%**	**34%**
% Unknown	10%	10%	9%	10%
Entering Level (% Frosh)	99%	98%	99%	99%
First Generation Status (% First Generation)	64%	65%	**58%**	**68%**
Gender (% female)	43%	44%	**40%**	**44%**
School				
% SNS	46%	46%	44%	45%
% SOE	43%	43%	46%	45%
% SSHA	6%	6%	6%	5%
% Undeclared	4%	4%	4%	4%
Census Credit Hours [Mean (SD)]	15.38 (1.78)	15.35 (1.76)	**15.50 (1.75)**	**15.31 (1.76)**
Course Timing (% Spring)	35%	36%	**38%**	**29%**
Course				
Course 1	25%	27%	**20%**	**23%**
Course 2	7%	8%	**11%**	**6%**
Course 3	7%	7%	**6%**	**13%**
Course 4	7%	6%	**6%**	**10%**
Course 5	14%	14%	**22%**	**11%**
Course 6	13%	14%	**11%**	**16%**
Course 7	17%	17%	**17%**	**14%**
Course 8	6%	5%	**5%**	**7%**
Course 9	3%	3%	**3%**	**4%**

Note: Means were compared with a one-way ANOVA; proportions were compared with a chi-squared test (as appropriate, column proportions were compared via the b-prop command and p-values were Bonferroni corrected for multiple comparisons). Bold text denotes statistically significant differences between the respective treatment and control group ($p < .05$).