

## Comparisons Between Online and In-Person Offerings of AR 035 in Summer 2017

- Students were assigned to the online or in-person section(s) of ARC 035 (Pre-College Algebra) based on their distance from the UC Riverside campus. This produced groups that showed no significant differences in terms of variables that might predict performance (such as high school GPA and SAT math scores) and only some differences in demographics.
- There are no significant differences in terms of final exam scores for online and in-person sections. Differences between groups within the online group were mirrored in the in-person group. Results from linear regression also support the idea that students who took ARC 035 online and in person earned equivalent grades.
- Students in the online version evaluated the course in ways that were generally similar to those who took the class in person.

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This memo compares final grades in an online and traditional in-person offering of ARC 035 at UC Riverside in summer 2017. There is interest in developing an online version of ARC 035 for various reasons, including limited classroom space and making it easier for students to satisfy preparatory requirements before arriving on campus. Comparisons of the first online offering in spring 2017 to historical in-person offerings (from spring 2016) showed outcomes were similar.<sup>1</sup> In the planning stages for the summer 2017 offering of ARC 035 interest was expressed in administering the program in a manner amenable to strong evaluation design so that concerns about the comparability of online and in-person offerings could be more authoritatively adjudicated.

Randomly assigning individuals to groups typically yields a high-quality evaluation but is frequently difficult to implement. If statistically random assignment is not possible, another strong evaluation method is to assign individuals to groups based on a characteristic unrelated to what is being evaluated. Distance between a student's home and the UCR campus presents an interesting possibility because mathematical knowledge and ability should show no relationship to the distance of a student's home from the UCR campus. (While it is the case that many socioeconomic variables—such as school quality—are patterned in space, there is no reason to believe that this spatial patterning centers on the UCR campus.) This hypothesis was investigated using historical data. Students enrolling for fall 2016 in all math placement bands showed average distances of 35 to 39 miles from campus with an overall average of 36 miles across all placement bands. Within those, students who placed into ARC 035 (where placement scores were invariant), distance from campus showed no relationship to SAT math scores.<sup>2</sup>

When students registered for ARC 035 in the summer of 2017 they self-reported how far they lived from campus, and this information was then used to direct students who lived further from campus to register for online sections and students who lived closer to campus to register for the in-person section. Although some exceptions were made for students who lived nearby but had transportation difficulties, attempts were made to let students know only about the version of the course that was appropriate based on their distance from campus to guard against selection effects.

The process of assigning students to online and in-person sections appears to have produced two groups that vary only in terms of their distance from campus. The online group reported permanent zip codes (on their admissions application) that were on average about 100 miles from campus while the in-person group had permanent zip codes that were, on average, about 30 miles from campus. There are no significant differences in

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<sup>1</sup> See <http://ueeval.ucr.edu/ARC%20035%20Online%20Pilot%20Memo.Spring2017.pdf>.

<sup>2</sup> An OLS regression between distance and SAT Math scores produced a coefficient of -0.01, which failed to achieve significance at any conventional level ( $p = 0.276$ ).

high school GPA or SAT math scores, the most obvious correlates of math skills and abilities. There are also no significant differences in the percentage of students who are freshmen, women, or who identify as first generation. A majority of students in both groups identify as Hispanic, although the percentage is higher in the in-person condition than in the online condition. Biology is by far the most common major in both groups, followed by biochemistry; neuroscience; cell, molecular, and developmental biology; pre-business; and psychology (at 5–10 percent of each group, although ranked somewhat differently in the two groups).

Table 1: Demographics and academic characteristics of students who took ARC 035 in summer 2017

Demographics	Online		In Person	
	Average	N	Average	N
Distance from campus (miles)	97.88	134	28.70	77
High School GPA	3.76	134	3.79	77
SAT Writing/Language	27.97	113	27.58	71
SAT Math	26.81	112	26.45	71
SAT Reading	28.48	113	27.03	71
* indicates differences that are significant at $p < 0.05$				
Race/Ethnicity	Percent	N	Percent	N
African American	4.44	6	6.49	5
Asian	18.55	25	15.58	12
Indigenous	0.74	1	0.00	0
Latino	55.53	75	70.13	54
White	14.07	19	6.49	5
Two or more races	5.19	7	1.30	1
Freshmen	94.16	137	94.94	79
Female	67.41	135	68.83	77
First generation	62.96	135	61.04	77
Majors (with more than 5% of students)	Percent	N	Percent	N
Biology	37.04	50	37.26	29
Biochemistry	8.89	12	9.91	9
Neuroscience	7.41	10	7.08	5
Cell, Molecular & Developmental Bio.	8.89	12	6.60	2
Pre-business	7.41	10	6.13	3
Psychology	5.19	7	5.66	5
Microbiology	4.44	6	5.19	5
Environmental Sciences	5.19	7	3.77	1

Scores on the ARC 035 final exam are the focus here<sup>3</sup>: this was a comprehensive content exam that was administered in the same way (proctored on campus) for both groups.

There are no significant differences between average final exam scores in the online and in-person conditions.

<sup>3</sup> Substantively identical results were obtained when the outcome was overall score: no differences between online and in-person groups were observed; the only differences within each group that obtained significance were based on SAT scores; regression results showed no relationship between overall score and online or in-person group.

Table 2: Differences between final exam scores in ARC 035 in summer 2017, with select differences within groups (standard deviations in parentheses)

	Online		In person	
	Final Exam	N	Final Exam	N
Overall	81.66 (17.68)	137	83.57 (10.55)	79
<b>First-Generation Status</b>	<b>Final Exam</b>	<b>N</b>	<b>Final Exam</b>	<b>N</b>
First-Generation	81.59 (16.74)	85	82.79 (10.72)	47
Not First-Generation	85.05 (10.15)	49	84.79 (10.85)	30
<b>SAT Math Score</b>	<b>Final Exam</b>	<b>N</b>	<b>Final Exam</b>	<b>N</b>
Above Average SAT Math	88.45* (6.70)	21	88.57* (6.68)	14
Average or Below Average SAT Math	82.91* (11.21)	92	82.92* (11.10)	58

\* indicates differences that are significant at  $p < 0.05$

Some have worried that online education does not serve the needs of less prepared students. To test this idea, exam scores are disaggregated within both groups. There is a significant difference between students in the top half of SAT scores as compared to the bottom half of SAT scores within both the online and in person groups. There are no significant differences in final exam scores in terms of first-generation status within either group.

Table 3: Ordinary Least Squares Regression with Final Exam in ARC 035 as Dependent Variable (with standard errors in parentheses)

	Model 1	Model 2	Model 3
High School GPA	8.52 (2.72)*	8.49 (2.70)*	8.45 (2.67)*
SAT Math Score	0.06 (4.25)*	0.06 (4.25)*	0.06 (4.09)*
Online (= 1)		0.47 (0.31)	0.37 (0.24)
Female (=1)			0.68 (0.41)
First-Gen. (= 1)			-0.89 (0.54)
Constant	17.49 (1.09)	17.30 (1.08)	18.09 (1.11)
$R^2$	0.10	0.10	0.11
$N$	186	186	186

\* Indicates significance at the  $p < 0.05$  level

Another way to determine the relationship between the online and in-person groups is with linear regression. Linear regression produces estimates of the direction and extent to which variables change together and can be used with multiple variables at the same time. Specifically, in this case, it might be useful to understand how final exam scores change based on the format in which a student took ARC 035 while accounting for a student's high school GPAs and SAT scores. Model 1 looks only at the relationship between

high school GPA and SAT scores and finds that both have a significant impact on final exam scores. Substantively, the coefficients suggest that as high school GPA rises by one point, the final exam score should rise by about eight points, and that as SAT math scores rise by one point, the final exam score should rise by just over five-tenths of a point. Model 2 adds a variable for online versus in-person condition and finds that this variable has no significant impact on final exam scores. Model 3 adds some key demographic variables and finds their impact on final scores also to be insignificant.

Table 4: Student Evaluation of Course and HAWKS Learning System  
(2 = strongly agree, 1 = agree, 0 = neutral/not sure, -1 = disagree, -2 = strongly disagree)

	Online	In Person	Difference (online – in person)
I had a strong desire to take this course.	0.79	0.48	<b>0.31</b>
I attended class regularly.	1.81	1.28	<b>0.54</b>
I put considerable effort into this course.	1.55	1.48	<b>0.06</b>
I've been attending the majority of lab sessions.	1.70	1.31	<b>0.39</b>
I gained a good understanding of the course content.	1.40	1.34	<b>0.05</b>
I normally spent at least two hours preparing for each hour of class.	0.68	0.59	<b>0.09</b>
The syllabus clearly explained the structure of the course.	1.55	1.24	<b>0.31</b>
The examinations reflected the materials covered during the course.	1.49	1.34	<b>0.15</b>
The quizzes reflected the materials covered during the previous week.	1.47	1.41	<b>0.06</b>
The required homework contributed to my learning.	1.60	1.45	<b>0.16</b>
Supplementary materials (films, slides, videos, webpages, etc.) were informative.	1.25	0.97	<b>0.28</b>
I've been watching most of the recorded lectures.	1.25	-0.31	<b>1.56</b>
The recorded lectures have been helpful in learning the materials.	1.06	-0.14	<b>1.19</b>
I felt supported throughout the workshop.	1.28	1.17	<b>0.11</b>
I felt engaged in the workshop.	1.11	0.90	<b>0.22</b>
As an overall learning experience, the course was excellent.	1.30	1.28	<b>0.03</b>
I am confident that I will be prepared to take the final exam.	1.26	1.38	<b>-0.12</b>
I had no issues registering for Hawkes LS.	1.40	1.31	<b>0.09</b>
Hawkes LS was better than a traditional textbook.	1.42	1.07	<b>0.35</b>
Hawkes LS was better than other online or e-textbooks that I've used.	1.19	1.17	<b>0.02</b>
The practice problems in Hawkes LS were useful.	1.62	1.52	<b>0.11</b>
Hawkes LS fit in well with the homework, quizzes, and other assignments.	1.62	1.59	<b>0.04</b>
Hawkes fit in well with the lectures/lecture videos.	1.38	1.14	<b>0.24</b>

One final way to compare the online and in-person offerings is through students' evaluations of the courses. Students completed a survey that evaluated several items similar to the standard teaching evaluation and also asked a few questions about the learning management system of the course. On many items students gave very similar ratings, most importantly regarding how much they felt that they learned and the overall course rating. On some other items students who took ARC 035 online seemed to rate the course higher: online students claimed to have a stronger desire to take the course, attended class and lab sections more regularly, found the syllabi more informative, and seemed to have a better experience with the textbook. Online students reported slightly less confidence in being prepared for the final.